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CTF-IDB Geothermal Development Program

MEXICO
Geothermal Financing and Risk Transfer Facility
Proposal for Operation Development

INDEPENDENT TECHNICAL REVIEW

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ABBREVIATIONS

CO ₂	Carbon Dioxide
CFE	<i>Comisión Federal de Electricidad</i> (Federal Commission of Electricity)
CRE	<i>Comisión Reguladora de Energía</i> (Energy Regulatory Commission)
CTF	Clean Technology Fund
DPSP	Dedicated Private Sector Programs
GEA	Geothermal Energy Association
GHG	Greenhouse Gas
GoM	Government of Mexico
GWh / MWh / kWh	Gigawatt-hour / Megawatt-hour / kilowatt-hour
IDB	Inter-American Development Bank
IEA	International Energy Agency
IFC	International Finance Corporation
IGA	International Geothermal Association
INECC	Instituto Nacional de Ecología y Cambio Climático
IP	Investment Plan
M	Millions
MDB	Multilateral Development Banks
MtCO ₂ e / tCO ₂ e / tCO ₂ e	Metric Megaton / ton, of Carbon Dioxide Equivalent
MW / kW	Megawatt kilowatt
MWe	Megawatt electric
NAFIN	<i>Nacional Financiera S.N.C.</i>
NPV	Net Present Value
PPP	Public-Private Partnership
SENER	<i>Secretaría de Energía</i> (Ministry of Energy)
TFC	Trust Fund Committee
UN-ECLAC	United Nations - Economic Commission for Latin America and the Caribbean
USD	United States of America Dollars

1. INTRODUCTION

The Government of Mexico (GoM) is strongly committed through its Climate Change Law¹ to reduce 30% of greenhouse gas emissions (GHG) by 2020, and the present administration has clearly established that low carbon goals through increased renewable energy use, energy efficiency, and sustainable transport are among its priorities.

Under the provisions of the Clean Technology Fund (CTF), the GoM has agreed with three Multilateral Development Banks (MDBs), including the Inter-American Development Bank (IDB), an Investment Plan (IP) for USD 500 million of CTF resources, combined with additional funds from other sources, to support the achievement of low-carbon objectives. The CTF Trust Fund Committee (TFC) endorsed the Mexico IP on January 27, 2009.

As of early 2013, a combined amount of USD 465,6 M of CTF resources had been approved by the TFC for different projects and programs in Mexico. The remaining USD 34,4 M, originally allocated to energy efficiency and wind projects managed by the International Finance Corporation (IFC), were stalling since the IFC doesn't foresee short term investments in those sectors, and considered wind development in Mexico sufficiently mature to be financed on commercial terms without the need for CTF subsidy².

The unused CTF resources were then made available to other priority programs, and the GoM decided to reallocate the USD 34,4 M to a Geothermal Exploration Risk Mitigation Project, to be executed by the IDB. This project is conceived to encourage private investment in geothermal energy through financial and risk transfer mechanisms to reduce investment costs, mobilize private capital for projects and ensure a sustainable growth in the long term. The requested reallocation of CTF resources was analyzed and documented in a revised version of the Mexico IP, issued on April 2013, approved by the CTF-TFC on December 2013, and approved by the IDB on January 2014².

Following the new address and responsibilities set by the revised IP, the IDB is now preparing a proposal for implementation and development of the Geothermal Exploration Risk Mitigation Project. Within this framework the IDB - Climate Change and Sustainability Division asked the Consultant to perform an independent evaluation regarding CTF Investment Criteria and the robustness of the IDB's proposal for Mexico Geothermal Development Program to the CTF. In particular, the Consultant is asked to review the CTF-Geothermal Financing and Risk Transfer Facility based on compliance with the CTF Investment Criteria for public operations.

The Consultant is an independent geologist, with 28 years of experience in geothermal energy, including technical and financial evaluations in exploration and development projects in several Latin-American countries.

2. MEXICO'S ENERGY SECTOR AND GEOTHERMAL PERSPECTIVES

Mexico has a significant GHG footprint, and classifies as the second largest CO₂ emitter in Latin America. Most of the emission (~60%) comes from the energy sector³. The General

¹ Ley General de Cambio Climático. Nueva Ley DOF 06-06-2012. Published in the Official Gazette on June 6, 2012.

² Clean Technology Fund. Investment Plan for Mexico. Revision. April 2013

³ Climate Change and Development in Latin America and the Caribbean. Overview. UN-ECLAC, 2009

Law of Climate Change¹, enacted by the GoM in 2012, set a target to reduce 30% of GHG emissions by 2020, with respect to the business as usual scenario, as well as a specific goal of achieving at least 35% of power generation from clean energy sources by 2024. At present, approximately 80% of Mexico's electricity production still comes from fossil fuels⁴; urgent actions to transform the power generation matrix are therefore required to meet the low carbon goals.

Mexico has great and almost untapped clean energy sources, whose potential to abate GHG emissions is estimated by 2020 in 59,64 MtCO₂e, equivalent to 23% of the identified theoretical reduction potential⁵. Geothermal energy provides low carbon base-load capacity and represents one of the most effective alternatives for electricity generation among clean and renewable energy sources.

Geothermal development in Mexico dates back to 1959, and reached an installed capacity of 958 MWe (812 MWe effective running capacity⁶), representing the fourth largest generation of geothermal electricity by country worldwide⁷. Mexico is endowed of a great potential for further development; one of the most recent evaluations, conducted by the Geothermal Division of the Federal Commission for Electricity (CFE)⁸, classified and estimated the country's geothermal reserves as follows:

- Proved Reserves: 186 MWe, defined as the additional capacity likely to be installed in each known geothermal field.
- Probable Reserves: 2.077 MWe, subdivided in 1.643 MWe of high-enthalpy resources, 220 MWe of moderate-enthalpy resources, and 212 MWe of low-enthalpy resources.
- Potential Reserves: 7.422 MWe, subdivided in 5.691 MWe of high-enthalpy resources, 881 MWe of moderate-enthalpy resources, and 849 MWe of low-enthalpy resources.

Despite this promising situation, with a pioneering position and long experience in all phases of the geothermal process, a relatively significant geothermal production (ranging from 6.500 to 7.000 GWh/year⁹) and a very attractive potential for further development, the Mexican geothermo-electric industry represents only 2.35% of the country's total power generation⁴.

Mexico's state-owned utility CFE, runs the whole electricity industry, including the geothermal sector, being institutionally responsible for all electricity generated with geothermal steam; consequently, CFE has been developing and managing all geothermal fields in the country.

As commonly occur in geothermal, also in Mexico, lack of funding (capital and financing) associated with the uncertainty and high-risk exploration investments involved in the projects, has been a main cause of the comparatively limited development. Besides the financial problems, a weak regulatory framework, specifically with regard to the exploitation and use of fields and underground water for geothermal purposes, as well as the lack of specific legal instruments for the private exploitation of geothermal resources, increase the perception of

⁴ US Embassy - Mexico City. Electricity Fact Sheet. October 2013.

⁵ Bases para una Estrategia de Desarrollo Bajo en Emisiones en México. Instituto Nacional de Ecología y Cambio Climático (INECC), 2012.

⁶ Estadísticas del Sector Eléctrico. SENER website <http://egob2.energia.gob.mx/portal/electricidad.html>.

⁷ Geothermal Energy. International Market Update. GEA, May 2010.

⁸ Potencial Geotérmico de la República Mexicana. Ordaz Méndez C.A., Flores Armenta M., Ramírez Silva G. - Geotermia, Vol. 24, No.1, Enero-Junio de 2011.

⁹ Perspectiva del Sector Eléctrico 2012-2026. Gobierno Federal - SENER, México, 2012.

risk by investors and imposes additional barriers to investment in the sector¹⁰. Issues with energy tariffs, financial disadvantage against modern fossil-fuel generation, and other regulatory risks, such as rules on access to the transmission network and to the knowledge generated by CFE, are additional elements that have been discouraging private investments in the Mexican geothermal industry.

The situation is however changing. The GoM has recently started to reform the energy sector, and in December 2013 the Congress amended three constitutional articles to increase private participation in electricity generation, as well as to allow private participation in the hydrocarbons sector. The energy reform is expected to impact the sector in several ways, including allowing for greater efficiency in the planning and development of power generation projects, introducing competitiveness into the electricity market, providing non-discriminatory access and use of the transmission network, and increasing new investments, particularly in clean energy. As to geothermal specifically, the GoM worked with support from the IDB in preparing a law for a geothermal concessional regime, which is expected to attract private investments in the geothermal sector. The law is planned to be approved by April 2014.

3. PROJECT DOCUMENTS AND CONTACTS

For the purposes of this evaluation the IDB - Climate Change and Sustainability Division established the following key contacts:

- Mr. Claudio Alatorre - Senior Specialist of the Climate Change and Sustainability Division (INE/CCS), responsible for the supervision of the Consultant;
- Ms. Gisela Campillo - Climate Change Consultant (INE/CCS), supervision assistant;
- Mr. Sandro Bruni - Energy Seconded (INE/ENE) supervision assistant;

and provided the following project documents to the Consultant:

- Mexico. CTF - Geothermal Financing and Risk Transfer Facility (ME-L1148). CTF - Geothermal Financing and Risk Transfer Facility (ME-G1005). Fourth Individual Operation Under The Conditional Credit Line For Investment Projects (CCLIP) (ME-X1010). Proposal for Operation Development.
File: IDBDOCS-_38353547-v2-POD_Propuesta_para_el_Desarrollo_de_la_Operacion POST QRR clean.
- Mexico. CTF - Geothermal Financing and Risk Transfer Facility (ME-L1148). CTF - Geothermal Financing and Risk Transfer Facility (ME-G1005). Fourth Individual Operation Under The Conditional Credit Line For Investment Projects (CCLIP) (ME-X1010). Economic Analysis.
File: IDBDOCS-#38349576-v5-Optional_Link__Economic_Analysis [clean]
- Mexico. CTF - Geothermal Financing and Risk Transfer Facility (ME-L1148). CTF - Geothermal Financing and Risk Transfer Facility (ME-G1005). Fourth Individual Operation Under The Conditional Credit Line For Investment Projects (CCLIP) (ME-X1010). Monitoring and Evaluation Plan.
File: IDBDOCS-#38349567-v2-Link_2__Monitoring_and_Evaluation_Plan [clean]

¹⁰ SENER . Iniciativa para el Desarrollo de las Energías Renovables en México. Energía Geotérmica. Noviembre 2012. Document available at: http://www.energia.gob.mx/webSener/res/0/D121122%20Iniciativa%20Renovable%20SENER_Geotermia.pdf

- Annex II - ME-L1148; ME-G1005; ME-X1010. Result Matrix.
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- Annex III. Fit with CTF Investment Criteria
File: ANNEX 3_Fit with CTF Investment Criteria ME-L1148

Information and documentation about CTF investment criteria and the CTF Investment Plan for Mexico were also provided by the IDB, and additionally searched by the Consultant in the CTF website (<https://www.climateinvestmentfunds.org>). Data on the energy sector and status of the geothermal industry in Mexico were independently verified by the Consultant through investigations in websites of Mexican and international institutions and organisms (CFE, CRE, SENER, INECC, IEA, IGA, GEA).

4. PROJECT SUMMARY¹¹

The analysis reported in Chapter 2 identifies two main constraints affecting the development of geothermal power in Mexico, namely: a need to improve regulation, and lack of funding. The first one is being addressed by the GoM through the energy reform enacted in 2013, and preparing a new legislation for the geothermal industry, scheduled to be approved in April 2014. The CTF - Geothermal Financing and Risk Transfer Facility seeks to address the second constraint, providing an integrated financial solution for geothermal exploration and development.

The general objective of the CTF - Geothermal Financing and Risk Transfer Facility program, as specifically defined in IDB proposal documents, is envisaged to *increase power production from geothermal sources so as to contribute to the diversification of the energy matrix and reduce dependency on fossil fuels and GHG emissions in Mexico. To this end, the program intends to scale up investments in geothermal power generation projects by making available a range of financial mechanisms tailored to meet the specific needs for each project's stage of development. This will include risk mitigation mechanisms as well as various forms of financing for exploration, drilling, field development and construction phases of geothermal projects.*

The program is intended to support private, or privately-led PPPs, developers of geothermal projects, and will seek to build with CFE and SENER a PPP business model that may maximize return on the public sector accumulated assets (i.e. know how, studies, land permits) and scale up private sector opportunities.

Nacional Financiera S.N.C. (NAFIN), a national development bank controlled by the GoM, will be responsible for the supervision, technical and administrative coordination of the program and the necessary reporting duties to the IDB. NAFIN has extensive experience with IDB, which includes previous successful implementation of CTF resources.

The program comprises two components with specific financing mechanism to be determined on a project-by-project basis, assessing the risks involved and the best suited product:

¹¹ The information reported in this chapter is summarized from the CTF - Geothermal Financing and Risk Transfer Facility proposal documents provided by IDB - Climate Change and Sustainability Division (see references in Chapter 3).

- **Component I** - Risk mitigation for geothermal projects in the early stages of exploration and test drilling. NAFIN will use IDB resources and will channel CTF grant funds to share drilling costs with developers in case of unsuccessful drilling at the initial stage. Moreover, CTF resources together with existing funding from the Government of Mexico, will aim at overcoming geothermal reservoir risks and enabling projects to advance towards subsequent phases of development also through grants to partially cover private insurance and insured loans premiums and rates.
- **Component II** - Financing adapted to different phases of project exploration and development. NAFIN will use IDB resources along with CTF loan resources to provide direct financial support to private developers during intermediate and advanced stages (field development, production drilling, and construction) of geothermal projects, including through direct loans, contingent loans, subordinated loans, first loss guarantees, and insured loans. This component intends to scale up public and private efforts to develop a portfolio of bankable projects, familiarizing market actors (developers, banks, insurers) with this type of investments, leveraging additional financing from both the public and the private sector, and mobilizing capital to grow the industry in the long term.

Technical assistance from an independent third party will be hired to provide expertise and advice on the validation of eligibility of projects, as well as to conduct the required studies and verify success and failures on drillings.

The two components of the program plus costs for implementation and technical assistance will be executed with funds channeled to NAFIN from different sources, for a total amount of USD 120,1 M, as shown in the following table:

Costs of the program by source and component (USD million)

Cost component	IDB	CTF	Local	TOTAL
Component I. Risk mitigation for early drilling phase	---	18,5	111,5	30,0
Component II. Financing adapted to different phases of project exploration and development	54,3	32,8	---	87,1
Implementation costs and Technical Assistance activities (1.5 MUSD off each CTF IP and DPSP)	---	3,0	---	3,0
TOTAL	54,3	54,3	111,5	120,1

The program remains open to additional financing that could be provided by NAFIN, commercial banks and/or other donors and multilateral institutions.

The investment/disbursement of funds is planned to occur in a period of 6 years from the effective date of the loan agreement.

The Fund is targeted to trigger financing of some 300 MW of additional geothermal capacity in the long term, preliminary assumed to be developed in six geothermal plants of 50 MW average capacity, producing electricity by 2024.

NAFIN and IDB will call for expressions of interest and select a portfolio of eligible projects; then, the program will fund projects deemed eligible over the basis of a number of conditions. The eligibility conditions will include a maximum amount of resources from the program to be

used per project, a minimum amount of capital required from the developer, the preexistence of all necessary permits and compliance with environmental and social safeguards, and the financial and technical capacity necessary to develop a project of this nature. There will be no targets for the proportion of the resources that has to be disbursed under each financing alternative, which allows both NAFIN and developers to opt for the alternative best suited to their financing needs. The deployment of various financial instruments under a phased approach is intended to distribute the risk associated to the use of resources between developers, donors, the government and the private sector (financiers, insurance companies, etc.) and across multiple investments, so as to maximize the impact of the use of concessional resources.

The IDB project documents (see Chapters 3 and 6) provide extensive description, analysis and evaluation of the project structure, including: methodology, technical background, economic assessment, alignment and contributions to development goals and country strategies, environmental and social safeguard risks, development and fiduciary risks, implementation, information and monitoring procedures.

5. COMPLIANCE WITH CTF OBJECTIVES AND CRITERIA

The CTF is conceived to support high GHG abatement opportunities and to promote low carbon technologies, including power sector projects that result in substantial reduction of CO₂ emissions and increase the share of renewable energy in the total electricity supply. The CTF investment plans shall fit and integrate in national development plans or programs that include low carbon objectives.

The proposed Geothermal Financing and Risk Transfer Facility for Mexico has a great potential for contributing to abatement of CO₂ emissions promoting a very efficient clean energy source, which is widely untapped in the country. The project is thus well consistent with the overall objectives of the CTF. The activities of the program are also consistent with Mexico's development strategy for the energy sector, particularly its goals to reduce 30% of GHG emissions by 2020, and achieve at least 35% of power generation from clean energy sources by 2024.

The CTF investment criteria for public sector operation¹² aims at maximizing the impact of CTF resources, and provide the following criteria to assess the proposed programs and projects: Potential for GHG Emissions Savings; Cost-effectiveness; Demonstration Potential at Scale; Development Impact; Implementation Potential; Additional Costs and Risk Premium. The compliance of the proposed program with these criteria is analyzed and discussed hereafter.

Potential for GHG Emissions Savings

The proposed program promotes the development of geothermal power plants, which provide low carbon capacity using a clean and renewable energy source. Development of geothermal electricity in Mexico is indicated among the interventions with the greatest emissions

¹² The program is intended to support private, or privately-led PPPs, developers of geothermal projects, but the CTF financing will be managed through a national, government-controlled MDB (NAFIN), so it has to comply with CTF Investment Criteria for Public Operations.

abatement potential (393 MtCO₂e)¹³. Geothermal generation also has high load factors and contribute base-load capacity, with potential for substitution of fossil-fuels based generation.

The program is expected to foster and finance some 300 MW of additional geothermal capacity, producing electricity by 2024. The corresponding emission savings are estimated in the project document to be around 1,1 MtCO₂ per year, based on the average emissions factor for electricity in Mexico (0,5 kgCO₂/kWh) and a load factor for geothermal plants of 84%, which are quite conservative assumptions (See Chapter 6). With this, the CTF resources invested in the program (USD 54,3 M) would contribute to deliver emissions reductions of at least 33 MtCO₂ in 30 years of operation of the geothermal plants.

Conclusion - The program will significantly contribute to reduction of CO₂ emissions. The CO₂ abatement estimates are significant and quite conservative.

Cost-effectiveness

The program proposal complies with the CTF requirement of providing a calculation of the CTF investment per ton of CO₂-equivalent reduced, which results in USD 1,64/tCO₂e. The calculation is based on the reductions of CO₂ emissions reported above (1,10 MtCO₂ per year) over the course of a standard 30-year lifetime of the geothermal plants financed, and assuming USD 54,3 M of CTF investment. When considering the total resources adjudicated to the program (from the CTF, the IDB and the GoM - USD 120.1 M) the investment per ton of CO₂-equivalent reduced is USD 3.64.

The Marginal Abatement Cost for geothermal power in Mexico, is reported to be USD 12/tCO₂e¹³ and it is well below the top USD 200/tCO₂e indicated by the CTF criteria for CTF co-financing of public sector operations.

Calculations of costs and benefits of the program, reported in the project document, indicate that the net cash flows discounted at a rate of 12% produce a NPV of USD 194,53 M.

Conclusion - While this review has not verified all data, details and sources of information of the economic analysis, the main technical parameters and estimates appear to be reasonable and often conservative (see Chapter 6), therefore it is opinion of the reviewer that the overall analysis indicates that the project is cost-effective.

The project document does not provide an analysis of *the expected reduction in the cost of the technology due to technological progress and scale effect at a global level, and/or through organizational learning and scale effects at the country level*, as requested by the CTF investment criteria for public sector operations. It is opinion of the reviewer that this aspect difficultly applies to the activities of the proposed program, since geothermal development count on mature technologies, which are available in the country and in the region. With the increased support to geothermal industry in the region and worldwide it is expected that in the medium to long term the overall cost of geothermal developments will decrease, however the expected cost reductions cannot be quantified with the information available.

¹³ Low Carbon Development for Mexico. Johnson T.M. et al. The World Bank, 2010.

Demonstration Potential at Scale

The CTF investment criteria for public sector operation provides two main criteria to assess the compliance and eligibility of programs under the goal of supporting transformational investments at scale:

Scope for avoided annual GHG emissions - The combined proven and probable geothermal resources estimated for Mexico amount to 2.286 MWe (see Chapter 2). SENER¹⁰ estimates at 2,200 MW the potential capacity to be installed in the medium term (5-10 years), which would allow capturing 14% of the abatement potential in the energy sector CO₂ emissions in 2020, decreasing 8.4 MtCO₂ in that year.

Transformation potential - The program is designed to trigger investment in geothermal energy in Mexico, providing multiple financial instruments and options, and combining support from the GoM and incentives for private developers for the first time. This shall help project developers overcome financial barriers, create security for investors and generate knowledge for financial institutions. A track record for private intervention will be eventually established with a significant contribution to unlock the Mexico's great geothermal potential. If successful, the program will definitely have a transformation effect in the Mexican energy sector, increasing the participation of geothermal in the energy matrix. Additionally, being structured as a comprehensive intervention, it will provide a learning process and a model for additional projects in the Latin America and in other parts of the world.

The program also has a multiplier effect, as it is designed to optimize the use of available funding in terms of leverage and sustainability. The programmed investment of 120,1 M (from CTF, IDB and GoM) is expected to leverage USD 725 M from third party sources, and up to a total of US\$1,200 million financing (including capital resources), which is the estimated cost for development of 300 MW of new geothermal generation. These efforts should eventually demonstrate the viability and benefits of investing in geothermal, allowing for the development of a sustainable framework in the long term. Moreover, in the scenario where the insurance sector would evolve into building risk management instruments that make sense for geothermal technologies, the proposed program will contribute to improve data on historical loss patterns and technical information that could help facilitate the development of solutions for geothermal energy projects in the long term.

Conclusion - The proposed program demonstrates significant potential for scaling up, with transformation and multiplier effects on the geothermal industry in Mexico. The program will also generate a learning process, as well as technical and economic information that could contribute to development of solutions for geothermal energy projects in the long term, both in Mexico and Latin America, or other parts of the world.

Development Impact

Geothermal energy offers one of the most effective renewable, autochthonous, and low carbon alternatives for power generation. Additionally, it generally result in significant economic and social benefits, such as creation of high quality employment, demand of goods from the industry, and (in the specific case of Mexico) the potential to reduce the need to import gas. The environmental impact of geothermal installations is easily manageable through common, technologically mature, and generally simple, mitigation and recovery measures.

The program document reports an estimation of the macroeconomic and social impact corresponding to the development of additional 300 MW of geothermal generation:

- It would impact the GDP an equivalent to 0,1% of the 2011 GDP.
- Generate more than 5.400 jobs.
- It would increment the security of electricity supply by reducing a 2% of the imports of natural gas in 2020.
- It will help generating value-added industry.

Conclusions - The program will likely result in significant developmental impacts, consistent with CTF eligibility criteria; therefore, from an energy and environmental perspective, the expansion of geothermal generation in Mexico is widely justified.

Implementation Potential

The objective and structure of the program are fully consistent with Mexican energy policies and institutions, which are strongly committed with deployment of low carbon technologies and renewable energy sources. The CTF investment criteria for public sector operation provides the following elements to assess the compliance and eligibility of programs under the implementation potential point of view: Country and Sector Strategies; Institutional and Implementation Arrangements; Sustainability; and Mobilization of Resources.

Country and sector strategies - The Mexican Law of Climate Change (2012)¹ set a goal to reduce 30% of GHG emissions by 2020, and achieve at least 35% of power generation from clean energy sources by 2024. The GoM has recently reformed and adapted the legal framework to foster the expansion of clean technologies and the development of new infrastructure, strengthening the regulation to create security for investors. A new law for geothermal concessional regime is planned to be approved by April 2014.

Institutional and implementation arrangements - Sustainability - The program is strongly supported by the Ministry of Energy (SENER), which has taken geothermal development as a priority, as shown in the Geothermal Energy Forum organized in October 2013 in Mexico City, together with the IDB, the World Bank and other organizations.

The borrower and executing agency for the program, NAFIN, is a national credit institution with full backing of the Mexican government. NAFIN is a solvent institution with exemplary risk management practices and an excellent record of cooperation with the IDB. The program includes technical support from an independent third party that will be hired to provide expertise and advice on the validation of eligibility of projects, as well as to conduct the required studies and verify success and failures on drillings and other technical issues.

The Energy Regulatory Commission (CRE) plays a relevant role and has a 12 year experience in the development of regulations for Renewable Energy in Mexico. As a promoter of electricity generation by private developers, it has issued permits for renewable energy generation and will play a very relevant role in the expansion of geothermal energy in Mexico.

The Federal Electricity Commission (CFE) is the fourth producer of geothermal energy in the world and has 40 years of experience in exploring and developing geothermal fields in the country. The program seeks to build on the CFE expertise and data base by fostering PPP

business models, taking advantage of the impressive body of knowledge that the institution has gathered.

Mobilization of resources - The economic structure of the program is composed of funds from the CTF (USD 54,3 M), the IDB (USD 54,3 M), and the GoM (USD 11,5 M). The Program is then expected to leverage USD 725 M from third party sources including program and third party, public and private financing plus capital resources.

Conclusions - Based on the supportive energy policy and the favorable position of Mexican institutions that will be involved in the implementation and development for the program, the project meets the CTF eligibility criteria for its implementation potential. The financial structure of the program also meet the CTF objective of mobilizing resources at scale for the deployment, diffusion and transfer of low carbon technologies.

Additional Costs and Risk Premium

The program is aimed at developing a pipeline of geothermal projects in Mexico and tackle the financial barriers encountered by private developers to access to financing sources. A grant element will be made available to support the deployment of risk mitigation instruments, providing financing currently not available in the market. CTF funding will take risks that commercial lenders are not able to bear, catalyzing investment that would not happen otherwise.

Resources from the Utility-Scale Renewable Energy Program (DPSP) will be concentrated on riskier phases of exploration, following its objective to prioritize available concessional funds towards exploratory drilling and geothermal resource validation. Concessional loans backed by guarantees and insurance products funded with DPSP and Government resources, IDB/NAFIN/CTF, will be made available for all stages of development, reducing capital needs and value at risk for developers, also increasing the IRR of the projects.

The involvement of NAFIN (a public development bank), the private banking and insurance sectors should maximize leverage from public and private sources, accelerate and scale-up finance to a larger number of projects, enable the conditions for a sustainable development of the geothermal sector, and reduce the need for subsidies in the future.

Conclusion . These scopes and project structure are consistent with CTF requirements for financing.

6. OTHER OBSERVATIONS AND COMMENTS

The IDB proposal for the Mexico's Geothermal Financing and Risk Transfer Facility program is composed of a main document - Proposal for Operation Development - and a set of annexes and electronic links, which represent a thorough analysis of the problem and clear argumentation for the proposed solutions. The Consultant reviewed selected key components of the whole set of documents (see Chapter 3) and found them well structured and comprehensive of all the information required for the definition of the program in all of its aspects (background, problem and justification, intervention proposed, financing structure and risks, implementation and monitoring procedures).

The program effectively focus on a key element that is preventing geothermal development - lack of financing - and looks clearly and efficiently designed to trigger the investment in geothermal energy in Mexico, providing multiple financial instruments and options for private or PPP developers. The analysis reported in the previous chapter shows that the proposal is well consistent with the overall objectives and investment criteria of the CTF, and of Mexico's development strategy for the energy sector.

The reviewer provided some arguments for conceptual discussion and observations to enhance the project documents. These were discussed with the IDB team, particularly with Gisela Campillo, who provided further information and clarification with respect to each point of observation. The comments originally provided by the reviewer, the responses of the IDB team, and final comments from the reviewer are reported in Appendix 1. All observations resulted to be satisfactorily addressed, in the opinion of the reviewer.

One important aspect worth to be stressed is that calculations of project economics and potentials for CO₂ abatement are mostly based on well-founded, but somewhat conservative assumptions, and nevertheless they deliver positive and promising results. Some of the assumptions that, in the opinion of the reviewer, are based on conservative parameters are:

- CO₂ emission savings are calculated with reference to a reportedly average emission factor for electricity generation in Mexico (0,5 kgCO₂/kWh). This is somewhat conservative, since geothermal provides base load capacity and has high potential for substitution of fossil fuel generation, thus to avoid higher emissions than calculated.
- The geothermal plant capacity factor used in all calculations is 84%, which correspond to the average of the four operating Mexican geothermal fields in 2008 (Cerro Prieto, Las Tres Virgenes, los Azufres, Los Humeros)¹⁴. The geothermal generation technology and process is however able to deliver higher capacity factors, generally over 90%, and effectively the los Azufres and Los Humeros Geothermal facilities in 2008 performed with a capacity factor of 92%¹⁴. Values in the 90-95% range are commonly used in financial assessment of geothermal developments, assuming the application of modern technology and a sound management of the exploitation of the resource, which are conditions expected to occur in the projects to be financed by the proposed program.
- A 30-year lifetime of the geothermal plants is used for calculation of total CO₂ abatement. This value corresponds to a standard lifetime commonly used for economic and financial evaluation of geothermal projects, but geothermal resource is renewable and the real life of geothermal fields is in most of the cases not limited to 30 years. Examples from various countries (Italy, New Zealand, USA, among others) indicate that well-managed geothermal fields continue producing for much longer. In Mexico, the Cerro Prieto geothermal field had its first generation unit commissioned in 1973 and it is still working after 40 years.

On the other hand, it is important to keep in mind that the main potential risk that could prevent or delay the execution of the program is associated with the effective implementation of a favorable and functional legal framework for the operation of private entities in the geothermal sector. This is not just matter of the effective date the new Geothermal Law will come into force, but also of a potential successive term in which the application of the new geothermal regulations will be experienced by private players and institutions. The

¹⁴ Current Status of Geothermics in Mexico. Gutierrez-Negrin L.C.A. et al. Proceedings World Geothermal Congress 2010. Bali, Indonesia, 25-29 April 2010

experience in other countries, like Chile and Peru, show that the geothermal regulations can require successive modifications before getting to a well-adapted tool for the geothermal industry in a specific country-context. A strict monitoring of the development of these aspects, and a consequent provision of technical/legal support to SENER, in order to address any possible modification or legal gaps that might arise, will definitively be a key element for the overall success of the program.

7. CONCLUSIONS AND RECOMMENDATIONS

The IDB proposal for the Mexico's Geothermal Financing and Risk Transfer Facility was reviewed by the Consultant, and satisfactorily discussed with the IDB team. The overall content of the program looks well-structured and consistent with the objective of seeking a transformational intervention by triggering the investment in geothermal energy in Mexico and building a track record of geothermal projects, using CTF resources to afford the risks that commercial lenders are not able to bear.

The program meets the overall eligibility criteria for CTF financing of public operations, therefore its co-financing with CTF resources is justified.

APPENDIX 1 - OBSERVATIONS, AND ANSWERS FROM THE IDB TEAM

Reviewer Initial Comments	Team's response	Reviewer Final Comments
<p>I understand from the documents that the Fund is intended to support geothermal projects by private operators (or perhaps PPP type), and particularly intends to promote geothermal development by facilitating the entry of private operators. However, the ToR for my review specify the assessment has to be made with reference to the CTF criteria for public investment operations.</p>	<p>It is a particular internal distinction of IDB. The funds are channeled through NAFIN, a Mexican development bank, which has sovereign guarantee and therefore belongs to the public sector.</p>	<p>Clearly understood. A small introductory note in the project documents could help other reviewers.</p>
<p>Apparently, there are some minor errors when reporting data in the Program documents. Particularly I found the following imprecisions:</p> <ul style="list-style-type: none"> · In all documents the goal of GHG emissions abatement, as set in the Law of Climate Change, is indicated in 35%, while in the Law is 30%. · In all documents the potential abatement of CO2 emissions by 2020 through development of clean and renewable energies, as calculated by INECC (2012) is indicated in 86 MtCO2e, while in the INECC report is 59,64 MtCO2e. · In the Economic Analysis document, page 5, item b, Classification of Costs, the total investment is indicated to be USD 117,1 M instead of 120,1 M. The same imprecision is repeated in page 10 of the same document, in %Assumptions related to the cost of the program+, item xiv. <p>A general review and check of data consistency is suggested before issuance of a final version of the proposal.</p>	<p>Noted and changed.</p> <p>The data were taken from the following report by INE: http://www.inecc.gob.mx/descargas/dgipea/ine-ecc-ec-02-2012.pdf . However there seems to be a confusion, as p. 2 reports 59.64 and p. 39 reports 86. Apparently in the executive summary the potential estimated in 23% while on the other is 33%...is that human error? I really don't know anyway as it is mentioned in the same report I assume we can leave it as it is.</p> <p>Noted, However, the resources included as financing of projects do not include amount granted for technical cooperation activities. Hence the difference.</p>	<p>Observations accepted or reasonably answered by the IDB team</p>
<p>As to the consistency of the program with the CTF eligibility criteria %Cost-effectiveness+, the project document does not provide an analysis of %<i>.co-financed investment, proposals will also require an analysis of the expected reduction in the cost of the</i></p>	<p>Noted. The team, based on the interviews with the institutions and industry, did not consider this a parameter that can be quantified with the information available. Moreover, at a country level this is not estimated to vary widely, as the technology is well developed in</p>	

<p><i>technology due to technological progress and scale effect at a global level, and/or through organizational learning and scale effects at the country level.</i> This seems to be a CTF requirement. I understand this aspect difficultly applies to the activities of the proposed program, since geothermal development count on mature technologies which are widely available in the country and in the Region; however I suggest to include some comment to this respect in the program documents.</p>	<p>Mexico. However, it is expected that due to the growth of knowledge and the demonstration effect on both the insurance and financing industry, the total cost of geothermal financing will be reduced. With the increased support in the Region and worldwide due to the current initiatives under development is it expected that, in the medium to long term the overall cost will be reduced</p>	<p>The answer is reasonable and comprehensively addressed. The reviewer agrees with the IDB team</p>
<p>In the document <i>Fit with CTF Investment Criteria</i>, the parameter <i>Additional Cost and Risk Premium</i> is addressed considering the Program is aimed at developing a pipeline of geothermal projects in Mexico and tackle the financial barriers encountered by private developers to access to financing sources. A grant element will be made available to support the deployment of risk mitigation instruments, providing financing currently not available in the market and definitely needed to leverage funding in the sector, generating a track record and knowledge to reduce the perceived risk for investors.</p> <p>Can you briefly provide support for consistency of these considerations with the CTF criteria statement <i>CTF financing will provide a grant element tailored to cover the identifiable additional cost of an investment, or the risk premium required, in order to make the investment viable.</i></p>	<p>Due to the risk involved in geothermal power generation, there is currently no adequate financing for these projects in the market. CTF resources will be able to provide financing for these projects. CTF funding will take risks that commercial lenders are not able to bear, crowding in the private sector by catalyzing investment that would not have happened otherwise. Resources from the Utility-Scale Renewable Energy Program (DPSP) will be concentrated on riskier phases of exploration, following its objective to prioritize available concessional funds towards exploratory drilling and geothermal resource validation. On the other hand, backed by guarantees and insurance products funded with DPSP and Government resources, IDB/NAFIN/CTF IP concessional loans will be made available for all stages of development, reducing capital needs and value at risk for developers, also increasing the IRR of the projects. The IDB considers this is the most effective structure to mobilize financing for the development of geothermal projects, where specific incremental risks (i.e. resource risks) are high. The involvement of NAFIN (a public development bank) and the private banking and insurance sectors should maximize leverage from public and private sources, accelerate and scale-up finance to a larger number of projects, enable the conditions for a sustainable development of the geothermal sector and reduce the need for subsidies in the future.</p>	<p>The answer provide complementary description of the objectives and proposed use of CTF resources.</p> <p>The question is satisfactorily addressed.</p>

<p>Geothermal fields are often located in remote areas, so that logistics and connection of power plants to the transmission grid can sometime result to be a significant issues in terms of costs and project finance, especially for the kind of developments in the 50 MW range, targeted by the program. From the program documents it seems clear that the foresaw financing instruments applies to all components of a geothermal power plant, including connection to the main grid, but the potential risks associated with the logistics and transmission issues are not addressed in any part of the documentation. Long transmission lines can add different kind of risks to a project, mainly associated to time and costs (i.e. longer time to obtain permits and environmental clearance; additional cost component impacting project finance and viability). A similar problem, can also be faced with access facilities during early exploratory drilling. Construction of roads suited for safe mobilization of heavy drilling rigs, components and materials, can in certain morphological conditions require significant investment with strong impact on budgets for initial test holes.</p>	<p>Mexico has a very extensive network for electricity distribution, and therefore risks associated with these aspects were not considered relevant to the effective implementation of the program. The country has a well-developed scheme for connection and distribution of renewable resources (through open seasons) and therefore estimations on the capacity needed are agreed upon and accordingly planned.</p>	<p>The question is satisfactorily addressed.</p> <p>A specific check of logistics conditions in each project is, however, suggested to be conducted during evaluation and selection of the projects to be financed.</p>
<p>The program appear to be well structured and directed to provide effective results in the geothermal sector, however an external key element is strongly controlling its possibilities of success: the effective implementation of a legal framework and associated regulation for the operation of private entities. This is not just a risk associated with the effective date the new Geothermal Law will come into force, but also with a potential successive term in which the application of the new geothermal regulations will be experienced by private entities and institutions. The experience in other countries, like Chile and Peru, showed that the legal framework can require successive modifications before getting to a well-adapted tool for the geothermal industry in a specific country-context.</p>	<p>The Team is well aware of the relevance of the regulatory framework for the development of the technology. Therefore technical cooperation activities are envisioned to accompany SENER in the development of the regulation and address any possible modifications and gaps that might arise, as needed.</p>	<p>The question is satisfactorily addressed.</p> <p>A strict monitoring of the development of these aspects, and a consequent provision of technical/legal support to SENER, in order to address any possible modification or legal gaps that might arise, will definitively be a key element for the overall success of the program.</p>

<p>The promotion of PPPs within the program is a very important as well as sensitive element. CFE has an invaluable experience and knowledge of the geothermal resources in the country, therefore the criteria, mechanisms and procedures to be applied for the selection of private entities to enter in PPP require very strong and transparent rules.</p>	<p>Noted. The activities related to the promotion of PPP included in the technical cooperation should contribute to ensuring that these are performed through transparent and open procedures, and in close coordination and consultation with the relevant stakeholders, such as CFE, SENER, CRE and other Government entities and the industry.</p>	<p>The question is satisfactorily addressed.</p> <p>Coordination and technical/legal support to the national Institutions are key element for the success of the program.</p>
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