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Nicaragua: Policy Strategy for the Promotion of Renewable Energy: Geothermal Energy Component

January 2006

GLOBAL POWER SOLUTIONS LLC

Energy Sector Management Assistance Program
(ESMAP)

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Table of Contents

List of Tables

List of Figures

Preface

The objective of this study is to support Nicaragua's Comisión Nacional de Energía (CNE) in preparing and implementing new policy and strategy to encourage the private sector to participate in the development of electrical generation from geothermal energy. The study includes: (i) evaluation of the potential market for electricity generation via geothermal energy in Nicaragua, (ii) analysis of the existing barriers (legal, regulatory, financial, and so on) to geothermal energy development in Nicaragua and proposed options for the elimination of these barriers, and (iii) provide CNE with a policies and strategy framework that will serve as a basis for an implementation program to stimulate the development of geothermal electricity generation.

This case study is one of three (geothermal, hydropower, wind) that assessed prospects and barriers for the most important renewable resources in Nicaragua, and served as the basis for the formulation of the overarching strategies delineated in the main ESMAP report.

1

International Lessons

1.1 What can be learned from private geothermal development throughout the world? What have developing countries done to advance private investment in their geothermal resources? What lessons, both positive and negative, can Nicaragua learn from reviewing recent international development of geothermal energy?

1.2 This report provides an introduction to commonly utilized contracting structures that offer lessons learned from other countries. It also discusses the specific approaches taken by a number of the countries more active in privatized geothermal development and considers some views from the international financing community.

Types of Privatization

1.3 While there are many variations in ways to privatize geothermal development, the pattern in the geothermal industry focuses on a discrete number of alternatives. From the outset, the relationship between private industry and government (including government-owned resource companies and utilities) must be seen as a partnership, because if and when these relationships turn adversarial, geothermal development suffers. The most common structures include:

Build-Own-Operate (BOO)

1.4 Traditionally, energy or mining development is done through a straightforward own-and-operate arrangement, where a company will secure rights for the resource and sell product, in this case electric power, through a combination of spot market and bilateral long-term contracts. Most typically, this structure would continue on an indefinite timeframe, where concession or lease rights are held indefinitely by production. Occasionally, there is a reversion point in time, but generally at the expected economic term of the project – say 30 or 50 years.

Build-Own-Transfer (BOT)

1.5 Here the private company will build the facility, typically through an Engineering, Procurement and Construction (EPC) contract with a third party. It will own the project, typically through a single-purpose, wholly-owned subsidiary and financed with less than 50 percent equity and transferred on a date established under the project agreements. This type of arrangement would also include certain contractual guarantees of performance, including typically both output standards and conversion efficiency guarantees.

Build-Own-Operate-Transfer (BOOT)

1.6 A variation, actually more common than the BOT, is a concept that calls for the contractor not only to own but also to operate the facility during the term of the contract. Typically this adds additional long-term performance guarantees and associated risk of performance. Often the term BOT is used interchangeably for both BOT and BOOT structures, so relying on the short-form nomenclature can be misleading. BOT and BOOT contracts typically range in duration from 10 to 30 years, some with extension or renegotiation provisions.

Build-Lease-Transfer (BLT)

1.7 BLTs are some of the most common development/ownership structures found throughout Latin America. Within these structures a private investor often finances and constructs a power plant and then leases it to a nationalized generation company for a fixed number of years at fixed production payments. At the end of the lease term and after the developer has paid back the project debt and earned a predetermined profit, the plant is titled over to the generation institution that has generally leased the plant from inception.

Roles of the Private Contractor

1.8 For geothermal privatization projects the contractor may be responsible for the development of the geothermal resource, the power plant or both. In early development, the focus was on development of the geothermal resource by companies such as Unocal[1] in countries such as the Philippines and Indonesia. More recently, and particular as integrated companies such as Magma, CalEnergy (which later acquired Magma), Oxbow, Ormat and Caithness became more involved overseas, the structure included the power plant and sometimes, such as in the Philippines and Costa Rica, was solely for the power plant development. While again, almost every project has its particular considerations, a matrix of types of privatization and roles could be developed for most countries.

Country Review

1.9 The following are very brief outlines of select international experiences by several developing countries in the promotion of private investment in geothermal energy. This discussion shows methods and procedures by which these countries have managed to substantially improve the competitiveness of their geothermal resources to attract foreign investment.

[1] Unocal (the Union Oil Company of California), one of the first commercial developers of geothermal power along with Magma which began developing geothermal resources in The Geysers Area of Northern California in the late 1950s.

Philippines

1.10 In terms of the development of geothermal power, the Republic of the Philippines is an excellent place to begin. The Philippines has been one of the world's success stories in geothermal development in nearly every measure, including percent of total power needs supplied by geothermal energy, total installed geothermal capacity and how rapidly geothermal development can occur in a country with severe power needs. Today, the Philippines is the second largest producer of geothermal energy in the world, behind the United States.

1.11 Early exploration (in the 1960s) was conducted by the Philippine Commission on Volcanology, with financial assistance from the National Science and Development Board. In 1967, Republic Act No. 5092, also known as the Geothermal Law, was passed to provide the framework to promote and regulate the exploration, development and utilization of geothermal energy. In 1971, the Philippine government authorized the National Power Corporation of the Philippines (NAPOCOR or NPC), a government-owned utility corporation primarily responsible for power generation in the country, to enter into contract with Unocal's subsidiary, Philippine Geothermal, Inc. (PGI) for the commercial exploration and development of the steam field at Tiwi. PGI developed the steam resource and sold steam to NPC, which built, owned and operated the power plants at Tiwi and Mak Ban on the island of Luzon. The geothermal power plants at Tiwi and Mak Ban have a combined net capacity of 750 MW.

1.12 Meanwhile, since the early 1980s a division of the Philippine National Oil Company called the Energy Development Corporation (PNOC-EDC) had been exploring geothermal resources in the Philippines in parallel with Unocal. The so-called BOT Act (Philippine Republic Act 6957) authorized agencies and state-owned entities like PNOC-EDC to enter into contracts with private contractors for the financing, construction, operation, and maintenance of infrastructure projects. As a result, in the early 1990s PNOC-EDC entered into a number of BOOT contracts with private developers to construct and operate power plants for which PNOC-EDC would supply steam and from which PNOC-EDC would sell power to NPC. The contract between PNOC-EDC and the developers was termed an Energy Conversion Agreement (ECA), as it provided steam to the developer under a tolling arrangement[2] and accepted power from the developer in return for conversion fees.

1.13 A more detailed description of the history and future of Philippine geothermal development is included as Appendix A to this report.

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[2] A tolling arrangement provides steam to the plant without cost and accepts power generated from the plant. In other words, the developer did not need to purchase the steam, rather convert the steam to electricity.

Indonesia

1.14 Indonesia provides additional important lessons learned in the development of geothermal power. It has quite probably the most prolific geothermal resources in the world – estimates of its geothermal potential range as high as 20,000 MW. In the mid-1990s, Indonesia engaged in an aggressive and impressive development program through BOOT contracts for the development of combined steam field and power plant projects, taking the total geothermal power from about 300 MW to over 750 MW. Many lessons can be learned from Indonesia's development experience – not all of them positive, however.

1.15 In 1974, through Presidential Decree No. 16/1974, the Indonesian government appointed Pertamina (the government-owned oil company) to conduct exploration and operation of the geothermal fields. This decree allowed Pertamina to operate the Kamojang field and to explore other geothermal resources in Indonesia. The government of Indonesia later issued Presidential Decree No. 20/1981 allowing Pertamina to enter joint ventures with local and international partners.

1.16 The presidential decree led to endorsement of a Joint Operations Contract (JOC) between Pertamina and Unocal Geothermal of Indonesia Ltd., and an Energy Sales Contract ("ESC") with the State Electric Company ("PLN") for the Gunung Salak contract area, West Java, in 1982. Amoseas Indonesia signed a JOC with Pertamina and an ESC with PLN for the Darajat contract area in 1984.

1.17 Presidential Decree No. 45/1991 allowed the Pertamina partnerships to build and operate geothermal power plants. Another presidential decree, No. 49/1991, was promulgated to provide economic incentives to support implementation of the preceding decree, No. 45/1991. Both regulations sought to accelerate development of geothermal projects under Pertamina management.

1.18 In late 1997, coincident with the so-called Asian Monetary Crisis, Indonesia took steps to scale back its aggressive geothermal development program through the issuance of Presidential Decree No. 5/1998. This decree has resulted in significant delays or effective cancellations to geothermal projects in the advanced exploration and development stages at Sarulla, Darajat, Kamojang, Dieng, Patuha, Karaha, and Sibayak.

1.19 Unfortunately, the contracts did not contain provisions for the delay or canceling of the projects and/or contracts, so substantial litigation in the form of international arbitrations ensued – many not yet fully resolved. Generally, the arbitrations have found in favor of the developers and found that the Government of Indonesia and its government-owned companies of PLN and Pertamina were in default of the agreements and the Indonesian government support letters. Hundreds of millions of dollars have been paid out as a result of political risk insurance policies. These actions have created shock waves through the international financial and insurance communities and affected worldwide geothermal development immeasurably. More discussion of the financial outfall is provided in paragraph 1.59-1.68 of this report.

1.20 Despite the awards in international arbitration, inordinate steps have been taken to use the Indonesian courts to overturn these awards – including the much publicized US$261 million award to Karaha Bodas Company. The award, granted in December 2000, has been overturned in Indonesian courts thereby further undermining foreign investor confidence.

1.21 Currently, as a result of the Karaha Bodas debacle, there have been no new investments in geothermal in Indonesia. It seems to have also spilled over and affected the appetites of developers and the financial community for new geothermal development in other countries. Nicaragua will likely face the fallout and may wish to consider diplomatic pressure on Indonesia to entertain a sensible and expedient resolution.

1.22 Unocal and Amoseas are the only foreign owners in geothermal that remain active in Indonesia, and both companies have vested interests in oil and gas fields there – the only reason they remain. Unocal purportedly gave back its concession at Sarulla in North Sumatra (one well at an unbelievable 75 MW) because no one could finance a power line. No new contracts involving foreign investment have been signed since 1994 and, with Karaha Bodas not being paid, the sentiment remains that "no contract will be honored if not guaranteed by an outside body such as World Bank," one developer told GPS.

1.23 While the current president appears very positive about geothermal energy development, the government cannot seem to find a solution as to how to build and finance additional development – and likely will not, in GPS's opinion, until and unless the Karaha Bodas situation finds a resolution and international lenders and political risk insurers are sufficiently confident that another Karaha Bodas will not happen. This may take a long time, as confidence can be destroyed much quicker than it can be rebuilt.

1.24 Indonesia is currently experiencing widespread brownouts and is running out of natural gas in Java causing the additional use of oil for generation. With such abundant supplies of geothermal energy in Indonesia, hopefully the past will soon give way to more business-like development approaches. Elections are scheduled for 2004. While policies and procedures with respect to international investment and especially energy development should not change administration-to-administration in countries seeking foreign investment, all too often it does; and Indonesia has been particular susceptible to this phenomena.

Iceland

1.25 Iceland is rather unique in many respects. It has population of only about 300,000, which is quite successful and productive. It also has abundant geothermal and hydroelectric resources, with much undeveloped potential remaining. Its power rates are approximately US$22/MWh, which is less than half of the average rates in the U.S. and Europe. It also has enough respect and high enough credit ratings in world business and financial communities to be able to negotiate contracts with large companies, such as Alcoa, and to seek capital in the international bond markets.

1.26 An assessment of the total potential for electricity production from the high-temperature geothermal fields in the country indicates a possible value of 15 terawatt-hours (TWh) per year over a 100 year period. The electricity production capacity from geothermal fields is now only 1.2 TWh per year, or eight percent of useable potential. Virtually all Iceland's electricity is produced from hydroelectric and geothermal power. Iceland's future industrial development depends on utilizing its abundant hydroelectric and geothermal power. Future plans include constructing a large aluminum smelter and exporting hydroelectric energy via submarine cable to Western Europe.

1.27 Privatization activity, initiated in 1991, is currently focused on banking and telecommunications. Previously Iceland announced that foreign investors would, for the first time, be permitted to participate in the partial privatization of Iceland Telecom. The economy has prospered as a result of the government's privatization program. Industries privatized during the past 10 years range from financial institutions to pharmaceutical companies, although the government has not included the National Power Company in its privatization plan. Such privatization will pave the way for expanded foreign investment, and Iceland plans to change other policies, such as tax rates, to attract more foreign investment as well. Iceland generally welcomes foreign investment, and foreign investors receive domestic treatment, although the government still maintains some restrictions in such key areas as fishing and primary fish processing, aviation, and energy.

1.28 Foreign investment in power-intensive industries over the past five years is probably the single most important contribution to the economy in that period. The government's agenda emphasizes the increased use of energy resources for economic development. In the near term, power-intensive industries are the most realistic option for large-scale utilization of the domestic energy resources. Currently, the government, The National Power Company, and Alcoa Aluminum are pursuing the joint development of a power and aluminum smelting facility. The National Power Company issued a solicitation for US$1.0 billion in bond financing for general uses.

Kenya

1.29 Kenya is the first country in East Africa to commercially develop its geothermal resources, with other countries now beginning their own programs. The government-owned utility, Kenya Electricity Generating Company, Ltd. (KenGen) first began development in the 1980s, with its first 15 MW unit coming online in 1981 and the third unit, making up the 45 MW Olkaria I Project, operational in March 1985. Later it developed the 64 MW Olkaria II project, which is due online in the summer of 2003.

1.30 In July 1996, the Government of Kenya (GOK) issued an international tender seeking private development for the Olkaria III concession area, and the Electric Power Act of 1997 allowed the entry of Independent Power Producers (IPPs) into the market. The GOK received bids from only two developers for the BOOT contract: CalEnergy and Ormat. CalEnergy sought a larger concession – one that was larger than 100 MW – so

Ormat was deemed the only bidder compliant with the bid terms. In November of 1998, and award was made to Ormat, which entered into a 20 year Power Purchase Agreement (PPA) with Kenya Power and Lighting Company (KPLC) – Kenya's sole electricity distributor. The early development Phase I units (totaling 13.5 MW) came on line initially in July 2000 through 100 percent equity financing. Ormat is still seeking debt to complete the 28-100 MW project. In Phase II, Ormat expects to use conventional steam turbine technology for the balance of the plant's capacity by installing one or two steam turbine generator(s) totaling 54 MW.

1.31 In GPS's estimation, the prospect of future private geothermal development in East Africa largely hinges on the ultimate success of Olkaria III and whether Ormat is able to work through rumored contract difficulties in order to secure long-term debt financing. Without a first successful private geothermal project, other developers will be less interested. In due course, geothermal projects must be financed with a reasonable debt-to-equity ratio in order to assure project economic viability.

Mexico

1.32 Mexican law allows for private investment only in geothermal power plants, not in subsurface resources, which are considered the *patrimonio* of Mexico. Presently, the only two Mexican geothermal projects with private development are the Cerro Prieto IV power plant (100 MW) and the 10 MW Tres Virgenes project. Both of these plants are Build-Lease-Transfer projects whereby Alstom built and owns the plants but is leasing them for a fixed period of time to the Comisión Federal de Electricidad (CFE). At the termination of the lease the ownership of the plants will revert to CFE.

1.33 The incentives for private investment in the Mexican geothermal industry are that there is no resource risk and a developer has a guaranteed power sales market. Pricing is discounted by CFE but returns are guaranteed. The types of firms interested in such projects tend to be equipment manufacturers, not geothermal developers who seek higher risk in order to command higher returns.

1.34 Mexican law also does not allow CFE to participate as an equity partner in private geothermal investments outside the nation. CFE is allowed to take part in ventures outside Mexico, but only as consultants or project engineers. Therefore, there can be no investment or equity ownership by the Mexicans in developing geothermal projects in Nicaragua.

Guatemala

1.35 The most significant geothermal development in Guatemala is the Zunil project. The steam field was explored, drilled and put into production by the Guatemalan government's Instituto Nacional de Electrificación (INDE). Plant financing has been contributed by the Scudder Latin American Power Fund and ownership of the project is managed by DB Capital Partners (the private equity group of Deutsche Bank). Plant operations are run under an O&M contract with Ormat, the plant developer.

1.36 The Zunil I project went online four years ago with a 24 MW plant constructed by Ormat. INDE supplies steam to the plant where it is converted to electrical power, which in turn is sold under a 20 year ECA. Since INDE is completely responsible for the geothermal field and guaranteed levels of steam delivery, the composite power price sold back to INDE from the geothermal plant is around $60/MWh. However, the steam field is producing at volumes capable of sustaining only about 20 MW of electrical production, therefore, designated clauses in the ECA guarantee at least a minimum 90 percent plant capacity payment. DB Capital has recently chosen not to exercise its option to develop the Zunil II concession due to lack of confidence in an expanded geothermal reservoir.

1.37 Overall, Deutsche Bank is very pleased with its investment in geothermal energy in Guatemala and is comfortable with its relationships with INDE and the government. It has a very good day-to-day working relationship with INDE and receives energy payments on time. A strong incentive for private investment in Guatemalan geothermal energy is that the Zunil project is tax exempt for all equipment and materials importation and does not have asset based taxation (such as Nicaragua's pending *Ley de Equidad Tributaria*).

1.38 Other than resource risk factors at Zunil, the biggest problem encountered by DB Capital in Guatemala is the government's propensity to continually want to renegotiate clauses in agreements and incessantly pursue loopholes. The government does not understand the perceived political and financial risks of continually seeking modifications to its commitments. One of many examples is that INDE wanted to assign the original PPA over to Unión Fenosa. DB Capital refused due to the lack of credit worthiness and payment history of Unión Fenosa and has insisted on implementing its original contracts with INDE, complete with government sovereign guarantees. Another potential impediment to private geothermal development in Guatemala is the new Commercial and Agricultural Business Tax, which will require additional tax payments of 2.5 percent of net profits annually.

1.39 DB Capital has indicated that it would definitely be interested in financing and developing private geothermal projects in Nicaragua. One of the most attractive incentives in Nicaragua is the abundance of its geothermal resources. The Deutsche Bank financial group's primary concerns for Nicaraguan geothermal development include (i) the country's tax structure and the question of whether it will be conducive to private investment, (ii) the credit-worthiness of the power purchaser, and (iii) the government of Nicaragua's willingness to stand behind its power industry and "backstop" private PPAs.

El Salvador

1.40 El Salvador is in a very unique situation within Central America regarding private investment in geothermal energy. This country succeeded because of its distinctive association between private industry and government ownership.

1.41 The Ahuachapán and Berlín geothermal fields and plants were originally developed through the investment of El Salvador's national electrical utility, Comisión

Ejecutiva Hidroeléctrica del Río Lempa (CEL). Ahuachapán has been producing 95 MW of electrical power continually for years, and the Berlín plant is generating 66 MW with load factors consistently over 90 percent. Ongoing exploration, drilling and construction will increase these projects by at least 35 MW.

1.42 In 2002, the government of El Salvador began the privatization of its wholly-owned Geotérmica Salvadoreña, SA de CV (Gesal), which is the country's only commercial geothermal developer. Enel SpA ("Enel", the Italian national electric company) purchased a 10 percent interest in Gesal, and this ownership interest will increase over the coming years as Enel invests all of the necessary new additional capital into exploration, drilling, development and plant construction at Ahuachapán and Berlin. Ultimately, Enel can "earn-in" greater than a 51percent equity position in Gesal.

1.43 In addition to Gesal's present geothermal ventures in El Salvador, there is indeed a "level playing field" for new investors and geothermal developers in this country. New concessions are available to private entities, there is a geothermal law supporting private development, power markets are expanding rapidly with strong pricing, and dispatch loads are at virtually 100 percent for every generator in the country. Of equal importance, the government of El Salvador has the second-highest credit rating of all countries in Latin America.

1.44 Though Gesal presently holds PPAs at both Ahuachapán and Berlín, these are not strictly arms-length contracts. Gesal is presently owned 90 percent by CEL, which is also the power purchaser under the PPA. Further, ownership in Gesal is by Enel, which itself is majority owned by the Italian government. All excess capacity generated by Gesal (over and above the contractual obligations of the PPA) is being dispatched 100 percent into the El Salvador national power grid via merchant sales. Gesal has also set up a power marketing group that dispatches and sells electricity to direct users.

1.45 Private investment in El Salvador's geothermal industry is working. Obviously, prior to Enel's acquiring its ownership position in Gesal and committing to invest millions into El Salvador's geothermal industry, it had to satisfy itself, its Board of Directors and the government of Italy that there would be sufficient growth in El Salvador's electric markets, the geothermal laws were favorable, and the country's taxation structure on renewable energy was not prohibitive. An additional example of the potential of private geothermal investment in El Salvador is that further capitalization of Gesal development is not being project financed; rather, it is balance sheet equity from Enel.

1.46 Members of Enel's management have stated that they would be very interested in investment and development of geothermal energy in Nicaragua. They feel that Nicaragua has the most extensive geothermal resources anywhere in the Americas. They are also comfortable with Nicaragua's political stability and anti-corruption campaign. Though the Salvadorans are not familiar with Nicaragua's geothermal and tax laws, they would insist upon standard financing requirements such as sovereign guarantees, PPAs, credit worthy power purchaser, and so on. There is concern over Nicaragua moving toward merchant power markets and whether the power demands in Nicaragua are growing sufficiently to support longer term geothermal PPAs.

Costa Rica

1.47 Geothermal sources provide 8 percent of Costa Rica's electrical capacity and 16 percent of its electrical energy, with the bulk of its capacity and energy provided by hydroelectric plants. Electrical demand is expected to grow at approximately 10 percent per year, and its National Energy Plan calls for building 29 new power plants (mainly hydroelectric) by 2020. Costa Rica will need approximately $3 billion of investment in the sector by 2011 to achieve this.

1.48 Instituto de Costarricense de Electricidad (ICE) is the primary government-owned utility and provides virtually all the power in the country. ICE also controls transmission and is responsible for planning and infrastructure development with the Ministry of Energy and Environment. A separate agency oversees the power sector and sets electricity tariffs. There is some private sector participation in generation. The laws continue to evolve to reduce the monopoly power and increase competition.

1.49 While ICE is considered a competent enterprise, it maintains a dominant position in the sector that may inhibit competition and private sector investment. ICE has a major influence in the screening process for new projects and, even under a deregulated industry, its position as major participant in generation and distribution gives it significant power over the industry. The structure of ICE and other agencies has been in transition with recently proposed law. The outcome of those measures could influence investment by the private sector.

1.50 Costa Rica began progress toward privatization of its energy assets in the 1990s. The Power Generation Act of 1990 initially opened the sector to private participation. It was amended in 1995 to allow private investment into the energy sector for the first time. Since then, a number of private generators have secured contracts to provide power to ICE.

1.51 ICE requested bids for Miravalles III in late 1996 and contracted with an international consortium in the spring of 1997. The Banco Interaméricano de Desarrollo (InterAmerican Development Bank, IDB) coordinated a $49.5 million loan, underwritten in part by other foreign banks, to help finance this $70 million project. The consortium built the 27.5 MW plant in approximately 18 months, beginning operation in early 2000. Under the BOT arrangement, it will operate the plant for 15 years, sell the electricity output to ICE during this time, and then transfer the plant to ICE. This is the first project of this kind in Costa Rica and the first geothermal BOT in Latin America to be completed.

1.52 ICE contracted for the 18 MW Miravalles V plant in April 2002, which is scheduled to begin operation in 2004. The contract is with Ormat of Israel, which will use its binary technology, using isopentane as the working fluid. The project is being financed by IDB.

1.53 The Sistema de Interconexion Electrica de Paises de America Central (SIEPAC) transmission line is expected to create a competitive regional market, which could change the economics of the industry and affect the relative viability of some projects. The project also aims to encourage investment to build more efficient power plants and improve system reliability, thereby reducing electricity costs. In February 2002, IDB signed a US$40-mil loan with Costa Rica, the first of a series of loans for the development of SIEPAC.

Chile

1.54 During the period 2001-2003, there has been extensive geothermal exploration throughout Chile, which has been financed by the government and carried out by Empresa Nacional de Petróleos (ENAP), the Chilean national oil company. ENAP made excellent progress in geothermal resource exploration and evaluation and targeted several very promising concessions. In October, 2002, ENAP solicited international tenders for major drilling contracts to begin the drilling of deep geothermal exploration wells. Shortly thereafter the Chilean legislature implemented a government-wide austerity program and cut all funds for geothermal development, even though these funds had already been approved and budgeted by the congress.

1.55 The overall electrical power markets in Chile are on the verge of significant problems resulting from aging equipment and a strong economy putting increased demands on power generation and expansion. The Chilean National Energy Commission is very supportive of geothermal development though it does not have the funding to continue ENAP's geothermal programs.

1.56 A private geothermal developer would find Chile an excellent opportunity. Chile has 10 percent of the world's on-shore volcanoes and extensive exploration programs have identified numerous excellent geothermal concessions. The country has one of the most stable and pro-business governments in the western hemisphere, the highest international credit rating of any country in Latin America, and Chile's economy continues to grow and expand. Most of ENAP's geothermal management comprises ex-pats from some of the largest geothermal developers in the world (ex-Unocal and others). Many of these experts are very eager to pursue geothermal development in Chile if they can find private investment capital or international financing.

1.57 ENAP and the government of Chile hold all the best geothermal concessions. Therefore, private developers are going to have to strike deals with the government. Most of the geothermal spotlight in Chile has been on resource exploration and there has not been a strong focus on PPAs and the status of electrical power markets. Pricing may be suppressed due to low-cost imported natural gas from both Argentina and Bolivia.

1.58 At this time it does not appear as if the geothermal management of ENAP would have any interest in pursuing opportunities in Nicaragua. This is primarily due to its frantic efforts to get Chile's geothermal programs funded and operable once again.

However, some of ENAP's management has extensive geothermal experience worldwide, including Nicaragua. ENAP feels that the geothermal resource potential of Nicaragua is not nearly as great as projected by the Nicaraguan government. Nicaragua has some average geothermal prospects but none that necessarily exceed those in Chile. Further, as expressed in a direct quote from ENAP management, "I would need some significant guarantees before I would invest in Nicaragua [geothermal] including a rock-solid PPA. The politics are intractable, the infrastructure is poor, and the campesinos can shut you down in a heartbeat."

Perceptions of International Financing

1.59 International financing of a geothermal project includes not only equity and debt, but also critically important political risk insurers. Without political risk insurance, little or no equity or debt investment will be secured.

1.60 The following are attitudes of several international financial institutions and banks regarding their experiences in Latin American geothermal projects and their perceptions of potentially financing geothermal development in Nicaragua.

DB Capital Partners, Inc.

1.61 Overall, the Deutsche Bank financial group is very pleased with its investments in geothermal energy and Central America. If the government of Nicaragua approached DB Capital with a new geothermal development venture, which had a PPA similar to that currently in place at Zunil, Guatemala, it would seriously consider the opportunities. One of the strongest overall incentives for financing geothermal projects is the credit worthiness of the power purchaser. Deutsche Bank would often prefer to deal with the sovereign government of many countries rather than see a PPA signed with one of the largest international utility companies in Europe and Latin America. The Deutsche Bank financial group is very positive on geothermal energy overall and is quite confident in their knowledge and expertise regarding resource risks, political risk, and in financial risks throughout Central America.

Japanese Lenders

1.62 West Japan Engineering Consultants (WJEC) represents three Japanese financial institutions, including the Japan Bank of International Cooperation (JBIC). WJEC feels that the Japanese commercial banks are very weary of investing in private projects in Nicaragua because the country is currently a heavily indebted nation. The principal concerns of involvement in Nicaragua are (i) resource risk – while this requires a fairly straightforward evaluation, Japanese lenders have been reluctant to take action in the past without the involvement of an experienced geothermal developer and the participation of U.S. or European banks acting as lead lenders; (ii) political risk – the Japanese are concerned with the political and economic stability of Nicaragua and its anti-corruption campaign; and (iii) market risk – they question whether there is a sufficiently high priced power market which will support private geothermal energy development. The Japanese acknowledge that when SIEPAC[3] goes online this will considerably mitigate market risk. WJEC does not believe the Japanese commercial banks will be overly interested in financing private geothermal ventures in Nicaragua. However, the commercial banks would probably be willing to take small pieces of syndicated financing transactions and the larger Japanese trading companies will partially finance ventures in which they are involved as equipment vendors or turnkey contractors.

Banco Interaméricano de Desarrollo

1.63 The InterAmerican Development Bank is essentially the Latin American equivalent of the World Bank. The IDB has both public and private sector divisions and the private sector group tends to focus on infrastructure projects. In addition to focusing on a project's credit worthiness, energy markets and government support/guarantees the IDB tends to heavily weigh considerations, which they internally call "financial additionality". This is for infrastructure projects where private investors are hesitant to invest in a venture generally due to political risk, country risk and economic factors. For projects that, for the good of the people, need a large Latin American financial institution to step forward and give credibility and financial worthiness to a project, this is where the IDB will step in. The IDB is enthusiastic about geothermal energy and also Nicaragua. It is comfortable with extended term financing, wholeheartedly supports renewable and clean energy projects, and has a history of power projects in Nicaragua. Most recently the IDB was the lead lender for the project financing of Coastal Power's Tipitapa diesel plant. At this time the IDB seems unconvinced of the near-term demand for the expansion of Nicaragua's generating capacity.

Banco Centroaméricano de Integración Ecónomica

1.64 Banco Centroaméricano de Integración Ecónomica (BCIE) is similar to IDB, but specifically for Central America. Though the Central American member countries own the bank it finances both private commercial ventures as well as public projects. BCIE looks favorably toward renewable energy projects (wind, geothermal and both large and small hydro) and even had a brief history in geothermal financing when it participated in El Salvador several years ago when Ahuachapán and Berlín were both owned and developed by CEL. Basically, it pursues financing opportunities in a manner similar to international commercial banks. Its primary concerns when looking at a potential geothermal project in Nicaragua are (i) the credit worthiness of the borrower, (ii) the demands of the electric sector markets, and (iii) government guarantees and support.

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[3] Six countries in Central America are building a 1830 km (1137 mile) electricity transmission inter-connection. This US$320 million transmission project will interconnect Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica and Panama.

The Overseas Private Investment Corporation

1.65 The Overseas Private Investment Corporation (OPIC) offers political risk insurance as well as financing assistance to U.S. companies doing business overseas. It is one of the leading providers of political risk insurance together with private insurers such as Lloyd's of London. It typically looks to countries with BB- or better credit ratings (investment grade) but would consider business in countries such as Nicaragua. Political risk insurance is typically expensive – on the order of 2 percent for investment grade countries and likely higher for higher risk.

1.66 While OPIC has not provided insurance for Nicaragua, it has provided $30,000,000 in financing for Roberto Zamora Mortgage (Latin American Financial Services Corp. (LAFISE)) and, in our discussions, seemed keen to consider geothermal opportunities in Nicaragua.

1.67 OPIC-supported private investment funds provide long-term growth capital, management expertise, and new technologies. Furthermore, they support the adoption of international standards of reporting, transparency and adherence to environmental and worker rights standards, all to promote private sector growth, which is fundamental to the development of emerging market economies. OPIC has provided financial support in every region of the world.

1.68 In summary, the availability of political risk insurance will be critical for most international geothermal developers to consider geothermal project development in Nicaragua.

2

Background and Status of Geothermal Electricity Generation

2.1 With the wealth of available geothermal resources and the need for power, there must be impediments to development that have kept Nicaragua from exploiting its vast natural resource. What are these impediments and how can they most effectively be removed?

Introduction

2.2 This chapter covers the identification of barriers hindering private investment in geothermal energy in Nicaragua and the proposing of alternative approaches to promote development. In order to obtain first-hand information on the progress and obstacles, we traveled to Managua, Nicaragua the week of 25-31 May 2003, as detailed below.

2.3 As we investigated the barriers and obstacles to geothermal development, two types or categories of obstacles presented themselves:

a. Hindrances particular to geothermal developers – for example, a company is required to obtain a concession and invest in exploration and development of the resource with no assurance that a long-term PPA will be obtainable, and

b. Disincentives that hamper renewables – this includes not only geothermal, but wind and hydroelectric as well, as these technologies endeavor to compete with fossil-fueled generation for power sales. An example might be the higher taxation due to higher capital requirements versus fossil fuel costs that, at present, are not subject to taxation.

Scope

2.4 Based on the need for power in Nicaragua and the region, together with the identified geothermal resources in country, and viewed through the filter of the current legal framework, we assess barriers and obstacles to private development with an eye to proposing alternatives to promote and enhance the use of renewable power alternatives, primarily focused on geothermal.

Meetings in Nicaragua

2.5 Robert Tucker and Jay Dick traveled to Managua, Nicaragua the week of 25-31 March 2003 and, with the valuable assistance of CNE, conducted extensive meetings with Nicaraguan Governmental Agencies, Unión Fenosa (the only large-scale purchaser of power in Nicaragua) and private developers in order to better understand the perspectives of all participants in geothermal development in Nicaragua. Appendix B provides a list of those individuals and organizations we met with in Nicaragua. Prior to leaving Nicaragua, GPS presented CNE with a brief overview of its initial findings.

2.6 Prior to traveling to Nicaragua, Robert Tucker met with Charles Feinstein and Clemencia Torres of the World Bank and a representative of the Overseas Private Investment Corporation (OPIC) in Washington, DC. After returning from Nicaragua, interaction continued with CNE, developers, prospective lenders, and others having interest in Nicaragua's geothermal development activities.

Generation Capacity of Nicaragua

2.7 Nicaragua's National Center for Load Dispatch (Centro Nacional de Despacho de Carga, or CNDC) estimates that the nation's current peak electrical demand is 435-440 MW, with baseline demand being around 220-280 MW. A detailed review of the country's principal power plants and generation capacity shows that Nicaragua's effective generation capacity is probably just over 450 MW, of which CNE estimates that only 80 percent is operational at any given time.

Privatization of Nicaragua's Generating Assets

2.8 Within the past several years ENEL has made a concerted effort to privatize the largest generating plants in the country. The two northern most power plants owned by ENEL, Planta Chinandega (15 MW) and Planta Nicaragua (100 MW), were assigned as assets to a new generating company called Generadora Eléctrica Occidental, SA (GEOSA). The two largest generating plants in the City of Managua, Planta Las Brisas (66 MW) and Planta Managua (57 MW), were made assets of the new company Generadora Eléctrica Central, SA (GECSA). When a public tender was solicited to the international electrical power development community only the assets of GEOSA were bid upon and El Paso Energy (through its associated subsidiary, Coastal Power) became the new private owner of both Planta Nicaragua in Puerto Sandino and Planta Chinandega. At this time there has still not been any expressed interest in privately acquiring Plantas Las Brisas and Managua, although ENEL has assured GPS of its intention to again publicly solicit the privatization of the assets of GECSA.

2.9 As the international geothermal community is well aware, the Momotombo geothermal field and plant were semi-privatized by the government of Nicaragua in 1999. Through an international solicitation process ENEL requested public bids for the acquisition of a 20 year concession for the expansion and operation of both the Momotombo geothermal field and power plant. The only company to successfully tender an offer was the private geothermal development company, Ormat, from Israel. The multinational company, Marathon Oil Company, while expressing interest, did not submit a bid in time to be considered. The result of the privatization of the operations of the Momotombo field and plant is that when Ormat took over operations in 1999 this generating plant was able to produce only around 14 MW due to extremely reduced geothermal steam availability. Over the past several years Ormat has improved geothermal steam production as well as optimize plant efficiencies such that at this time the Momotombo plant is steadily generating around 30 MW of electrical power.

2.10 Several years ago ENEL sought to privatize through the international tender process Nicaragua's two large hydroelectric plants. Plantas CentroAmérica and Santa Bárbara were folded into the asset base of a new company called Generadora Hidroeléctrica, SA (HIDROGESA) and then put out for public bid. After numerous delays, the new ownership of these plants was awarded to El Paso Energy/Coastal Power Company. However, subsequent to El Paso/Coastal's being chosen as the successful bidder, and prior to the award of the final acquisition contracts, political and legal challenges ensued and were argued all the way to the Nicaraguan Supreme Court. It has now been determined by the Supreme Court that a new international tender will be required[4] and these further delays and bureaucratic changes will just further dampen the international power community's enthusiasm for private investment in Nicaraguan power projects.

Today's Generation Assets

2.11 The country's installed generation capacity today is over 600 MW but much of this generation is from old, high maintenance thermal plants; geothermal resources that are not performing up to plant design; and seasonal hydroelectric plants and cogeneration sugar refineries. The effective generating capacity of Nicaragua's power plants is somewhere between 450 and 490 MW, depending upon the season of the year (affecting hydroelectric capacity) and the maintenance schedules of various plants.

2.12 The Nicaraguan government is apprehensive about how the country expands its economic base and attracts foreign investment in high employment manufacturing facilities when its electrical generation network is aging, deteriorating, and becoming less dependable. The concern is that there are no new power plants under construction; the older plants need significant overhauls and in many cases repowering[5]; and there are no new international tenders currently underway for the purchase of additional power.

2.13 The nation's two lar`gest generating plants (Plantas Nicaragua and Managua) are rapidly deteriorating and continually being overhauled and rehabilitated. The two large hydroelectric plants (100 MW) are 35 years old and are operational, but their privatization status will once again be put out for international tender. When the assets of

[4] Part of the Supreme Court litigation involved the assigning of water rights, however, the government would still like to privatize these plants. After all these legal battles it is now a question as to whether or not El Paso/Coastal is still interested in pursuing these assets.

[5] *Repowering* is when an existing power plant site is utilized to construct a new or significantly enhanced power plant.

GECSA were publicly offered for privatization no bidders submitted tender offers on Planta Managua (53 MW, oil fired steam and diesel units) and Planta Las Brisas (51 MW, diesel fueled gas turbine). Planta Managua has antiquated equipment (it went online in 1958), and both face projected high capital improvements and maintenance costs as the plants are rapidly approaching the end of their economic life. Planta Las Brisas is not as old but requires high-cost diesel fuel.

2.14 Specific information regarding the present status of Nicaragua's generating plants is represented in the following table.

Table 2.1: Generation Assets of Nicaragua

plant name	owner/operator	unit #	date on-line	type of equipment	manufacturer	fuel	installed capacity (MW)	available capacity (MW)
Chinandega	El Paso/Coastal	1	1967	gas turbine	Brown Bovari	diesel	15	13.5
Nicaragua	El Paso/Coastal	1	1976	steam tubine	Brown Bovari	hfo	50	47.5
		2	1976	steam tubine	Brown Bovari	hfo	50	47.5
Las Brisas	GECSA/ENEL	1	1992	gas turbine	Pratt Whitney	diesel	26	20
		2	1998	gas turbine	Stewart & Stevenson	diesel	40	31
Managua	GECSA/ENEL	3	1958	thermal/steam	Asgen	hfo	45	26
		4	1994	int'l comb	Wärtsilä	hfo	6	5
		5	1998	int'l comb	Wärtsilä	hfo	6	5
CentroAmérica	Hidrogesa/Coastal	1	1965	hydro		n/a	25	24
		2	1965	hydro		n/a	25	24
Santa Bárbara	Hidrogesa/Coastal	1	1971	hydro		n/a	25	23
		2	1971	hydro		n/a	25	23
Momotombo	Ormat	1	1983	geothermal	Franco Tosi (Ansaldo)	n/a	35	30
		2	1989	geothermal	Franco Tosi (Ansaldo)	n/a	35	0
Corinto	Enron		1999	int'l comb	MAN	hfo	70	68
Puerto Sandino	Censa/Amfels	1-9	1997	int'l comb	Caterpillar	hfo	40	35
		10-13	1999+	int'l comb	MAK	hfo	30	29
Tipitapa	El Paso/Coastal		1999	int'l comb	Wärtsilä	hfo	56.5	52
Ing. San Antonio	Nica Sugar Estates			cogen		biomass	10	6
Ingenio Timal						biomass	10	7

2.15 In addition to all the previously outlined comments and concerns, further points to note regarding the information represented in Table 2.1 follow:

Planta Chinandega

2.16 This is a 35 year old gas turbine plant that utilizes diesel fuel. El Paso/Coastal acquired it in the asset acquisition of GEOSA; its present operating status is unclear. The plant was retired in the early 1990s due to the capital demands for extensive rehabilitation. However, the plant underwent a life extension program – it was extensively overhauled and put back into production with a new plant life of an additional ten years. The plant is believed to be presently operational but likely to be decommissioned in the near future. At this time the long term operational status of Planta Chinandega is uncertain.

Planta Las Brisas

2.17 Unit #1 is a 26 MW Pratt Whitney gas turbine installed in 1992 that utilizes diesel fuel. In 1998, a Stewart & Stevenson gas turbine was installed as Unit #2; it is capable of generating an additional 40 MW from diesel fuel. Table I-I.1 of the *Plan Maestro Geotérmico* (Nicaragua's "Geothermal Master Plan") shows that Planta Las Brisas has an effective capacity of only 35 MW, but there is an explanation for the apparent loss of 30 MW of generating capacity. However, CNE's informational brochure of October 2002 forecasts that the effective generating capacity of Planta Las Brisas is 51 MW, which is a considerable improvement over the previous projections of the Master Plan, but there is still an unexplained capacity loss of 15 MW.

Planta Managua

2.18 The 45 MW steam turbine of Unit #3 is over 30 years old, which probably explains why the assets of GECSA were not bid upon in international tenders. This might also explain why this turbine's effective generating capacity is only 26 MW.

Planta Santa Bárbara

2.19 Hurricane Mitch (October 1998) destroyed the largest dam in Nicaragua, thereby rending Planta Santa Bárbara not operational. While the dam was being rebuilt and its containment reservoir was being refilled, Planta Santa Bárbara underwent extensive overhauling of its two 30-year-old turbines and generators.

Enron-Corinto

2.20 The diesel engines installed on the Corinto barge are manufactured by MAN, and not Wärtsilä as reported in the Master Plan. The Enron group holds a 50 MW PPA for generation from this plant with the additional 20 MW of plant capacity being sold into the spot market.

Censa-Puerto Sandino

2.21 The Censa/Amfels plant at Puerto Sandino originally went into operation with nine Caterpillar diesel units of 4.4 MW apiece. A second phase, which consists of four 7.5 MW MAK diesel units, has been added in recent years.

Ingenio San Antonio and Ingenio Timal

2.22 These two cogen/biomass generating plants are owned by the largest sugar companies in Nicaragua. These two units are operational only during the harvest season and then only serve peak load demand.

Power Purchase Agreements versus Merchant Systems

2.23 The government of Nicaragua, via its revised and updated electricity law *Ley de la Industria Eléctrica No. 272* (1998) is steering the national power grid away from long-term, fixed-cost PPAs and toward a merchant power system. This may, in theory, have its advantages for lowering electricity costs; however, there are a number of factors that, in practice, end up discouraging the development of geothermal energy and most renewable energy sources.

2.24 With a focus on short-term contracts or spot market pricing, plants with the lowest installed cost are favored. In the case of Nicaragua, this will be diesel units. Long-term power purchase agreements form the backbone of geothermal and renewable power development – due to their relatively large capital cost requirements and the need to assure capital recovery for the investment.

2.25 In order to assure a healthy renewable portion of Nicaragua's power portfolio, GPS believes a focus on alternatives that enhance the long-term power purchase processes within a competitive power market environment are imperative. Nicaragua's aggressive and successful deregulation process will need to be strengthened in the area of medium-to-long-term contracting, particularly in the area of renewables, to buttress the benefits of the existing competitive merchant power market.

2.26 GPS also is somewhat concerned with the monopsony[6] environment in Nicaragua, at least until the substantial power market ushered in by the new Central American Transmission Intertie – SIEPAC, occurs. This market will range from Panama all the way to Guatemala and will greatly reduce the impacts of Nicaragua's current monopsony situation.

2.27 Unión Fenosa stated to GPS that at present, roughly 80 percent of the nation's generation capacity is under PPA contracts with the company and the balance is dispatched into CNDC's merchant power grid. Many of these PPAs incorporate structures whereby with each subsequent year the take-or-pay capacities for sale under long-term fixed pricing under the PPA are decreased and more generation is sold at short-run market pricing to be dispatched daily via a competitive rate bid structure. For example, the long-term take-or-pay commitments of the PPA between Planta Nicaragua and Unión Fenosa began in 2000 at only 28 percent of the total plant capacity[7]. The balance of electrical generation is being sold into the national grid at spot market rates. This 28 percent contracted level drops to 22 percent in the year 2002, 20 percent in 2003, 17 percent in 2006, 11 percent in 2007, and in the last year of the PPA Unión Fenosa is only contractually obligated to take 8 percent of Planta Nicaragua's generating capacity.

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6 A monopsony is a market wherein the products of several sellers are sought by only one buyer.

7 This number comes from PPA data sheets provided to us by CNE. These PPA data sheets show that the take-or-pay commitments of Unión Fenosa's PPAs with the recently privatized generating plants begin at 28 percent-50 percent of plant capacities, and then decrease with time. These statistics do not correlate with Unión Fenosa's statement regarding 80 percent of the nation's generating assets are under PPAs.

Fulfilling Future Electric Needs

2.28 The electrical energy market that Nicaraguan geothermal power could fill includes both the indigenous needs of Nicaragua as well as the needs of the region as a whole. As SIEPAC comes online in approximately 2008 this will significantly change the entire power marketing structure of this region and create for Nicaragua the opportunity of exporting power.

Nicaragua's Generation Expansion Plans

2.29 Nicaragua's expansion plans provided by CNE generally call for an average growth rate between 4.4 and 6.6 percent, depending upon assumptions. This means by the year 2013, base load for the country could be 675 MW with a peak system demand as high as 850 MW. Given the current installed capacity of just over 600 MW or an available capacity at approximately 450 to 490 MW, geothermal power could account for 250 to 400 MW of growth over the coming decade. This would not include the estimated 400 MW of shortfall projected in the Central American region, by the time SIEPAC becomes operational.

2.30 CNE and Unión Fenosa are both projecting that there will need to be an additional 40 MW of generation capacity to come online by 2006. The government appears supportive of having a large component of this new generation come from geothermal energy. Unión Fenosa, likewise, appears amenable to geothermal generation fulfilling this additional 40 MW if a feasible plan can be developed such that the first 20 MW comes online by November 2004.

2.31 The San Jacinto geothermal project could possibly be the best opportunity to meet the government's interest in a geothermal component for the next 40 MW of new generation. The San Jacinto Power Company, S.A. is claiming that it will have 10 MW online by December 2003, a total of 22 MW by June 2004, and ultimately 66 MW by 2006. San Jacinto Power currently has three shut-in geothermal wells on site; these have been extensively flow-tested and proven to have a combined production capacity of greater than 20 MW for a period of at least 30 years.

2.32 The ways in which government support could be an integral part of a plan for geothermal energy to fulfill this immediate demand for 40 MW of additional generating capacity might include temporary, short-term back pressure geothermal turbines. A private developer could sign a multi-year PPA with Unión Fenosa with the Phase I intention that the first 20 MW to be placed online by the end of 2004 be only temporary units. The developer would immediately commence the permitting and concession process to drill a minimum of geothermal wells such that sufficient steam reserves would be available to power four 5 MW back pressure turbines which may be available from CFE in Mexico or from ICE in Costa Rica. With a fully permitted and explored field, it would be clearly possible under ideal conditions to have 20 MW of temporary geothermal power online within 18 months.

2.33 San Jacinto, the most likely candidate for such power and one already possessing a PPA, has for half-dozen years been unable to begin construction for lack of financing. In GPS's view, until and unless this project moves forward, it is unlikely that other developers will seek other concessions in Nicaragua. As a result, GPS encourages CNE and INE to consider how to best support the initial stages of this project development.

2.34 The second phase of this development scheme would be a permanent 40 MW geothermal plant to go into production by the end of 2006, at which time Phase I units would be deactivated and the initial 20 MW of power generation would be replaced by the permanent plant. This development calendar will be very demanding, yet achievable, for an experienced geothermal developer.

2.35 In addition to the government's granting fast-track permitting and licensing rights to a geothermal project of this nature, the most important participation of the government could be to utilize multilateral grants and funding to acquire the Phase I geothermal turbine units. See also paragraph 2.130-2.134, "Renewable Project Financing" below.

Central American Region

2.36 CNE has projected that Central America will need an additional 400 MW of generation by the year 2010. With SIEPAC online in approximately 2008, Nicaragua stands to take advantage of the projected regional shortfall. If new geothermal projects were begun immediately it would likely be 2007 or 2008 before these ventures would begin commercial production. In other words, it is not too early to be contemplating the benefits to Nicaragua of developing additional power in anticipation of exporting to the Central American region.

2.37 Perhaps additional investigation into both the validity of the estimated regional shortfall and methods of marketing Nicaraguan geothermal power should be done. The benefits to both the Nicaraguan economy and its balance of trade could be significant.

Geothermal Master Plan

2.38 Nicaragua is easily one of the most studied, explored and modeled countries in the world when it comes to reviewing its geothermal resource asset base. With numerous active volcanoes, dozens and dozens of volcanic eruptions in recorded history, hundreds of hot springs and fumaroles, and continual small scale seismic activity, just the layman's appraisal of the country's geothermal potential is extensive.

2.39 In August 1999 the world-renowned geothermal consulting group, GeothermEx, was engaged by the Comisión Nacional de Energía (with funding from international multilateral institutions) to undertake the most extensive geothermal resource study and evaluation ever undertaken of Nicaragua. Over the ensuing two years they prepared the Geothermal Master Plan in which they first compiled, reviewed and analyzed all the known geological and exploration data and materials that exist on Nicaragua. After analyzing this data,GeothermEx conducted new geophysical, geochemical and geological studies to highlight the potential geothermal resources of various parts of the country. Then it undertook studies of previous and ongoing drilling and reservoir testing programs in certain areas and compiles all of the composite data into the most modern proprietary computer modeling programs; the end result was an extensive and detailed analysis of the potential geothermal resources of Nicaragua.

2.40 Based on these models and studies, the Geothermal Master Plan projects the potential magnitude of geothermal energy resources and reserves throughout the principal geothermal areas of Nicaragua. The reserve projections are broken out into various categories based upon their potential for accuracy. For this report we will use the reserve projection terms of proven, probable and possible reserves, as these are the most widely accepted terminologies utilized throughout the world by both the commercial petroleum and geothermal industries. Proven reserves are those geothermal resources that have already been encountered in commercial quantities by the drilling of deep exploration and production wells, and have been extensively tested via extended time reservoir production testing. Probable reserves are calculated based upon a large amount of geological, geophysical and geochemical data and surveys, combined with some possible test wells. Generally there is enough geological and exploration data in areas of probable reserves that the locations of at least the first deep exploration wells have already been targeted. Possible reserves are the least reliable form of projections but are based upon sound geological principals when combined with some degree of geophysical and geochemical testing and often nearby active volcanic activity. Though possible reserves are computed using modern computer modeling, the data put into the models is much more subjective.

2.41 The overall evaluation in the Geothermal Master Plan projects that Nicaragua has nearly 5,500 MW of geothermal reserves. Presently, there is only 30 MW of electrical generation from geothermal resources in Nicaragua – or about one-half of one percent. Obviously, 5,500 MW of geothermal energy may never be commercially developed. What amount of power, however, can reasonably be developed over the years ahead? With these considerations in mind, GPS reviewed the geothermal resource data and projections of the ten prospect areas throughout Nicaragua. For each area, the company has taken an additional look at what kind of geological and exploration data the reserve projections are computed from; what is the existing infrastructure of access, roads, topography and existing transmission lines in the area; what are limitations of land use, environmental sensitivity, local population; and combined this information with the discussions herein of Nicaragua's increasing energy demand levels and proposed generation expansion. Each geothermal resource area is then given a revised projection of what is the potential for commercial geothermal development in that area within the next ten years.

2.42 Table 2.2 represents the geothermal energy reserve projections as outlined in Nicaragua's Geothermal Master Plan, combined with GPS's ten year forecasts of geothermal commercialization.

Table 2.2: Geothermal Resource Projections for Nicaragua (megawatts)

	Plan Maestro Geotérmico			Commercial
Area	**proven reserves**	**probable reserves**	**possible reserves**	**Development in 10 years**
Volcán Cosigüina			425	0
Volcán Casita - San Cristóbal		224	676	50
Volcán Telica – El Ñajo		127	180	50
San Jacinto – Tizate	161		207	150
El Hoyo-Monte Galán		148	491	50
Momotombo	142		190	50
Managua-Chiltepe		113	337	0
Tipitapa		18		0
Masaya-Granada-Nandaime		172	1285	50
Isla de Ometepe			584	5
	303	802	4375	405
		5480		

Revised Geothermal Resource Projections

2.43 The following are brief descriptions of the ten geothermal resource areas projected by GeothermEx in the Geothermal Master Plan, together with GPS's 10-year commercial forecasts.

Volcán Cosigüina

2.44 This area is located three hours to the northwest of Managua and is a large peninsula jutting into the Pacific Ocean and the Gulfo de Fonseca. Access to this general area is excellent via major highways and well-kept gravel roads. The peninsula itself has been created over thousands of years by the volcanic activity of Volcán Cosigüina. This volcano had one of the largest and most violent eruptions in the entire western hemisphere in 1835. There is only very minimal geological and exploration data on this region, most of which was undertaken in the 1970s.

2.45 The Geothermal Master Plan projects that the Volcán Cosigüina area could have as great as 425 MW of reserves. Access into the site, however, is exceedingly difficult and we project that there will not be any commercial geothermal development in this area over the next ten years primarily because of this remoteness. There is only extremely limited exploration data available; presently much of the land use is within the boundaries of a nature reserve; and there is movement to change the nature reserve into a national park. There are no electrical transmission lines in the area due to the fact that the area is so sparsely populated. If not for one very large volcano this would probably not be of much geothermal interest.

Volcán Casita-San Cristóbal

2.46 Volcán San Cristóbal is the northernmost volcano in the Marrabios chain and is also the highest active volcano in Nicaragua (5725 feet). This resource area is located approximately three hours northwest of Managua on major highways (past the city of Chinandega) and then around the back side of the volcanoes on improved gravel roads. A 230 kV transmission line provides excellent transmission access to within five kilometers of the principal geothermal resource area. Triton Energy, SA (a subsidiary of the Canadian company, Black Hawk Mining, owns and operates the nearby El Limón mine) was awarded a geothermal exploration concession for this area in August 1999 and still holds the concession. The volcanoes within this resource area are active today, there is extensive alteration throughout the area, there are two hot springs, but there have only been limited geological, geophysical and geochemical investigations undertaken at this locale.

2.47 The Master Plan forecasts 224 MW of probable geothermal reserves in this area. Though GPS is encouraged by the fact the area is on the flanks of one of Nicaragua's most significant volcanoes and there is a major transmission line through the area, it does not yet see enough solid geological evidence for a probable geothermal field of this size. The company forecasts that in ten years there could possibly be 50 MW of commercial geothermal development at the Volcán Casita-San Cristóbal geothermal area.

Volcán Telica-El Ñajo

2.48 This area is located approximately two hours northwest of Managua on excellent highways and improved secondary roads. It is immediately adjacent to the northwest side of the San Jacinto-Tizate geothermal area. Located ten kilometers to the west of the principal geothermal resource target is a 230 kV transmission line.

2.49 The major geothermal developer, Unocal, was awarded the first geothermal exploration concession at El Ñajo in August 1997. After two years of exploration activities and major geothermal setbacks in Asia, Unocal relinquished the concession back to the government of Nicaragua. Shortly thereafter, in December 1999, this concession was awarded to SAI Geothermal. After only one year SAI requested an extension of the concession into boundaries included within the San Jacinto concession area. When INE denied this extension, SAI voluntarily returned the concession to the government.

2.50 The active volcanoes on this concession have not had significant eruptions in the past centuries, but they do have very active fumarolic activity in their craters. There are also several hot springs throughout the area. Extensive geological, geophysical and geochemical surveys have been undertaken by Unocal, InterGeoterm and others.

2.51 GeothermEx has projected there are 127 MW of probable geothermal reserves at Telica-El Ñajo, plus an additional 307 MW of possible reserves. It is just not highly probable that there will be this magnitude of geothermal commercialization in this area ten years from now. There are potential land use restrictions due to the proposed boundaries of a municipal ecological park. This report is projecting maybe 50 MW of geothermal potential from Telica-El Ñajo in ten years' time.

San Jacinto-Tizate

2.52 This geothermal field is located two hours northwest of Managua and only 30 minutes outside the large city of León. Access is excellent on major highways. There is a 230 kV transmission line only 12-15 km away and a 138 kV line within 10 km; in addition, the site has a complete housing and field/plant development complex. A geothermal exploration concession was originally issued to a Russian-Nicaraguan consortium in May 1993. It conducted extensive geological, geophysical and geochemical exploration activities and ultimately drilled seven deep geothermal exploration wells (to depths of 2335 meters with temperatures of 290°C). Long-term reservoir testing on three of these wells proves the existence of a commercial geothermal reservoir exceeding 25 MW. The San Jacinto-Tizate geothermal concession is presently held by a consortium of Nicaraguan and Canadian investors (the same group that owns Triton Energy) and the Daimler Benz group from Germany.

2.53 From the extensive exploration, drilling, and reservoir testing done to date, the Master Plan projects 161 MW of proven geothermal reserves. There may be an additional 61 MW of possible reserves located immediately adjacent to this concession near Volcán Rota. GPS predicts that it is highly feasible that within ten years there could be 100-150 MW of commercial geothermal production from the San Jacinto-Tizate geothermal area.

2.54 The company does not foresee within ten years a total of 50 MW of geothermal commercialization at San Cristóbal, plus an additional 50 MW at El Ñajo, plus another 150 MW at San Jacinto. Maybe 100-150 MW could be commercialized from these three areas combined within ten years.

El Hoyo-Monte Galán

2.55 This concession area, located to the northwest of the Momotombo geothermal field, and about one hour northwest of Managua, is accessible by major highway and well maintained secondary roads. However, remote areas of the El Hoyo-Monte Galán concession area itself are accessible only by 4-wheel drive vehicles. The area is only eight kilometers from the 138 kV transmission line that connects Momotombo to the Nicaraguan national power grid.

2.56 The western limit of this concession borders the El Hoyo and Cerro Negro volcanoes. Cerro Negro is the most active volcano in Nicaraguan recorded history and had a very active eruption in 1999 with lava fountains of up to 500'. There are numerous fumaroles and hot springs throughout the concession area and a geothermal gradient hole drilled in the 1970's encountered 125°C temperatures at depths of only 80 meters.

2.57 TransPacific Geothermal leased the El Hoyo-Monte Galán concession area in December 1995. Extensive geological, geophysical and geochemical studies have been conducted throughout the area. In 1998 a joint venture was entered into with Calpine Corporation, however, a PPA was never obtained and financing has never been acquired. INE withdrew the concession from TransPacific in December 2002 because of lack of development.

2.58 The Master Plan's reserve projections for El Hoyo-Monte Galán are for 148 MW of probable geothermal reserves plus an additional 491 MW of possible reserves. Due to its very good infrastructure, large amount of exploration work, active volcanoes and its proximity to Momotombo, GPS sees excellent potential for 50 MW of geothermal commercialization within ten years. However, an existing nature reserve encompasses much of the concession area and may be given national park status in the future.

Momotombo

2.59 The Momotombo geothermal field is located approximately one hour northwest of Managua and can be accessed by one of Nicaragua's principal highways and a highly improved secondary road. The field and plant have been in commercial geothermal production for the past twenty years, so there is no doubt that proven reserves exist. More than 44 exploration wells have been drilled to depths of 2500 meters and encountered temperatures in excess of 330°C. The plant has an installed capacity of 70 MW, but that production level has never been reached for more than a few hours. In the 1990s, production had declined to only 14 MW.

2.60 In 1999, Ormat International was awarded a twenty year concession to maintain and operate both the field and plant. They have increased plant production to a stable rate of 30 MW. The field sits on the southern flank of the active volcano, Volcán Momotombo, there are numerous hot springs and fumaroles throughout the area, and this is combined with twenty years of drilling, production history and long-term reservoir testing. Utilizing this data and information, the Geothermal Master Plan projects 142 MW of proven geothermal reserves plus and additional 190 MW of possible reserves.

2.61 Momotombo never has been able to produce up to its designed capacity of 70 MW for more than a few hours. When Ormat bid on the operation concession, it committed to returning the plant's production to its full 70 MW. The Momotombo geothermal field and plant is totally land locked by the boundaries of an existing nature reserve and proposed national park, leading GPS to believe there will probably not be any field expansion outside of its current geographical area. Due to limited resource viability combined with land use restrictions, it is likely that the Momotombo plant will not be able to generate more than 50 MW in ten years.

Managua-Chiltepe

2.62 This potential geothermal resource area is located on the Chiltepe Peninsula, which is only 10 km outside the city of Managua. It is easily accessible by principal paved highways because it is a very popular tourist and recreational area used extensively by the inhabitants of Managua. The main target area for geothermal development is still 2 to 3 km off the main roads in very steep terrain and is accessible only by 4x4 vehicles. The nearest transmission lines are a 230 kV line located 7 km from the peninsula.

2.63 The peninsula comprises of two dormant volcanoes that lie at the intersection of two major structural lineaments, and there are numerous hot springs and fumaroles. Some geophysical work has been done in the area, as has extensive geochemical modeling by GeothermEx. Based upon these geological conditions and computer modeling of available data, the Master Plan projects probable geothermal reserves at Chiltepe of 113 MW, with an additional 337 MW of possible geothermal reserves.

2.64 There is uncertainty in the classification of these reserves as "probable," particularly in a ten-year planning horizon, as there has been neither temperature gradient nor exploration drilling in the area and the dormant volcanoes are the main source of geothermal indicators. Further, commercialization of geothermal resources at this locale within the next ten years is unlikely due to the questionable presence of resources combined with the fact that the entire exploration target area is situated within an existing nature reserve and a proposed national/municipal park, and is partly within the boundaries of an active military base.

Tipitapa

2.65 This geothermal prospect is located in the middle of the town of Tipitapa, a city of 48,000 inhabitants located only 15 minutes northeast of the international airport in Managua, on the PanAmerican Highway. There are two 138 kV transmission lines that run directly through the town. Hot springs are situated in the center of town, but other than this, there are few surface indicators of geothermal activity. There are no hills in the town, much less dormant volcanoes. Some electrical geophysical surveys have been conducted. The entire geothermal potential of this area is based upon geochemical modeling, which indicates the possibility of 140-180°C geothermal fluids at depth.

2.66 The Master Plan projects 18 MW of probable geothermal reserves directly under the center of the town of Tipitapa. Again, GPS would not classify these reserves as probable as they are based solely upon geochemical modeling and not supported by surface geology. Because the company believes there are only minimal, if any, commercial geothermal reserves at Tipitapa, combined with very restrictive land uses (this is in the center of a good sized city), this report projects that there will not be any commercial geothermal development at Tipitapa in ten years.

Masaya-Granada-Nandaime

2.67 This prospect area by far encompasses the greatest area of land in the Master Plan. It is located in an area that begins 20 minutes to the southeast of Managua and extends to nearly 45 minutes southeast of the city. The western border of the area is the Volcán Masaya, which is the most famous active volcano in Nicaragua. One can drive up to the edge of the crater, look down into the active volcano, and actually see molten lava in a vent known as *La Boca del Infierno* ("the mouth of Hell"). Centered in the area is the large caldera (7 km in diameter) of Laguna Apoyo, which is presently a dormant volcano. To the extreme southeast is the active Volcán Mombacho. Access throughout the entire resource area is excellent on paved major highways and highly improved secondary roads. Running through the center of the entire area is a 230 kV transmission line plus a 138 kV line. There are also two 69 kV lines through the northern and western parts of the area.

2.68 Extensive geophysical and geochemical surveys and modeling have been undertaken throughout the entirety of the three target areas in this prospect. The western target is to the north of Volcán Masaya and lies in its entirety within the boundaries of an existing national park. The Laguna Apoyo anomalous area is situated between restricted land use areas and appears to be fine for future development. The Volcán Mombacho potential exploitation area is mostly outside the boundaries of an existing nature reserve, but portions of the potential extended reservoir may fall within future reserve boundaries.

2.69 The presence of large active volcanoes in this area strongly suggests the presence of geothermal energy potential. This, combined with hundreds of hot springs and fumarolic activity, and two large subsurface anomalies (geophysical near Laguna Apoyo and geochemical south of Volcán Mombacho) are also strong indicators of geothermal potential. GeothermEx has projected 172 MW of probable reserves in this resource area plus an additional 1285 MW of possible reserves. We would tend to agree with the probable reserve projections of this area but do not find it likely there will ever be sufficient geothermal development in Nicaragua to prove the existence of this volume of geothermal reserves in this area. Therefore, for purposes of this report GPS has assigned only 50 MW (possibly two separate 25 MW plants) of geothermal commercialization to this prospect area for the ten year planning horizon.

Isla de Ometepe

2.70 Isla Ometepe is easily one of the most pristine and mysterious parts of Nicaragua. It is an island located approximately two hours by car, plus an additional one hour by old and precarious ferries, to the southeast of Managua. Access to much of the island is by well improved gravel roads. The western half of the island consists of the huge and active Volcán Concepción which has erupted more than 26 times between 1883 and 1999. The volcano is flanked by the only two small towns on the island, Moyogalpa (the small port) and Altagracia. There are not likely more than 5-6,000 inhabitants on the entire island.

2.71 The area of greatest geothermal potential on the island is located directly south of Volcán Concepción. If commercial grade geothermal resources are encountered at this location, then 9-10 km of transmission lines would need to be run northwest to Moyogalpa, and a second 10 km line to the northeast to Altagracia. The existing nature reserve is limited to the upper slopes of Volcán Concepción, but if a proposed extension to this reserve is ever voted into law, it will encompass 100 percent of the targeted geothermal resource area.

2.72 The Master Plan projects 297 MW of possible geothermal reserves surrounding Volcán Concepción plus another 287 MW of possible reserves surrounding Volcán Madera (a large volcano comprising the eastern half of the island which has been dormant throughout recorded history). These numbers seem too optimistic in the near term, especially considering that Volcán Madera has not shown any geothermal activity in recorded history. The island presently has a small thermal plant of 1.86 MW; due to its remoteness and small population, at the most there could possibly be geothermal production from one exploratory well and a 5 MW back pressure turbine.

Summary of Revised Resource Projections

2.73 It is highly unlikely that Nicaragua will ever reach its forecast geothermal potential of nearly 5,500 MW of generation. In reality, even GPS's revised projection herein of 405 MW of total geothermal generation in Nicaragua by the year 2013 seems overly optimistic. The company believes there is a very realistic chance that the San Jacinto-Tizate geothermal field and plant could be producing at the 100 MW level within ten years, but it is doubtful that Momotombo will ever produce in excess of a total of 50 MW. It is highly unlikely that all three resource areas of Volcán Casita-San Cristóbal, Volcán Telica-El Ñajo, and El Hoyo-Monte Galán will each have a 50 MW plant on site, but it may be feasible that the combined production from these three areas could reach 50-75 MW in ten years. The Masaya-Granada-Nandaime geothermal area is so large, and has so many huge and active volcanoes, hundreds of hot springs and fumaroles, plus several exploration anomalies, it is certain to eventually have commercial grade geothermal energy production. Within ten years it could easily have a 50 MW plant near Santa Catarina, or possibly two 25 MW plants in the area. GPS would foresee the very real possibility that Nicaragua may have 250 MW of geothermal energy online by the year 2013. The company believes, however, this may be achievable only if the government enacts the alternatives and incentives to private geothermal development that we discuss in paragraph 2.114-2.143 herein.

2.74 A significant obstacle facing geothermal development in Nicaragua involves land use. Geothermal development will be severely impeded if the Nicaraguan government enacts the decrees which expand many of the existing nature reserves and establish the proposed national parks and the municipal parks. A review of the discussions in the previous section, combined with looking at the nature reserve and national park boundaries shown in the numerous figures in the Master Plan, reveals that the prime geothermal development targets in many of these areas lie within existing or projected lands which may have restricted development usage. The geothermal resource areas of Volcán Cosigüina, Managua-Chiltepe and Isla de Ometepe are all 100 percent surrounded by either existing nature reserves or areas that are proposed for future national parks. Several areas have proposed national parks whose new boundaries will be defined by all lands above 300 meters in elevation. This is due to very arbitrary legislation to declar all lands in certain areas above 300 meters national parks. This decree alone will severely restrict the potential exploration and development areas of Volcán Casita-San Cristóbal, Volcán Telica-El Ñajo, and El Hoyo-Monte Galán. The Momotombo geothermal field is already 100 percent "land locked" by an existing nature reserve, and to undertake any field expansion whatsoever would have to explore and drill on protected lands. Though the Masaya-Granada-Nandaime geothermal resource area is enormous, only those potential geothermal targets near Santa Catarina would not be affected by these proposed new national parks.

2.75 Vast amounts of land would be affected by these sweeping decrees, and this would significantly impede, if not stop all together, geothermal energy development in Nicaragua. Most of these areas would not be considered pristine lands that are environmentally sensitive, like those found in the rain forests. These are mostly lands that are very arid, with minimal habitation, and virtually never used for agriculture, recreation or tourism. The people of Nicaragua would realize vastly greater value and benefits through geothermal exploration and exploitation than from setting these lands aside and prohibiting natural resource development. The government must seriously consider these sweeping proposals for protected land status and perhaps look to joint use lands as one means of dealing with the manifold uses sought, as has been done in connection with geothermal development in Kenya.

2.76 Kenya's principal geothermal resource, the Olkaria Field, which contains three separate geothermal power projects, is in the Hell's Gate National Park in Kenya. While the park was not established until the first of the three projects was commissioned, the projects have been successfully developed in conjunction with the needs of the park and could be a model for Nicaragua for joint use lands.

Available Market for Geothermal

2.77 While the magnitude of Nicaragua's geothermal resources, similar to countries such as Indonesia, the Philippines and Iceland, is significant (where the geothermal resources could supply much if not all the foreseeable needs of the country) issues such as diversity of power generation and peaking needs must also be considered.

2.78 The three renewable technologies being evaluated for Nicaragua have significantly different characteristics vis-à-vis system integration and dispatch. They are:

- Firm or Intermittent Hydroelectric – which depends to a great degree on issues of minimum river flow and seasonal (annual) variability and exhibits an asset of "energy storage" – difficult to find electrically. Makes for a good partner or match with Wind.

- Wind – which generally exhibits a great degree of daily or diurnal variability. Difficult to dispatch, as the MW load is dependent on wind speed and to some degree direction, as differs from geothermal.
- Geothermal – exhibits some degree of risk in the resource identification and development phase, but generally provides very stable and predictable output during the operational phase. Availabilities and/or capacity factors can be in the upper-90 percent range (say 95 percent) with forced outage rates perhaps less than one percent. Nearly all the maintenance can generally be predicted months in advance and coordinated with, say, the rainy or the windy season to best take advantage of the above technologies.

2.79 With roughly 50 percent of Nicaragua's current peak demand being baseload, the balance should be made up of some form of intermittent or peaking capacity, as geothermal cannot compete economically as dispatched, peaking power. While all three technologies (since they do not require the purchase of fuel) provide power with low incremental or marginal costs, geothermal presents itself as an ideal baseloaded power plant – with wind and hydroelectric providing excellent intermittent and storage capabilities due to their energy availability.

Geothermal Potential Exceeds Need

2.80 From GPS's review of the Geothermal Master Plan, it would appear that the geothermal potential in Nicaragua significantly exceeds the need for power in the foreseeable future. This not only should place geothermal power high on Nicaragua's national interests, but also provide an avenue for enhanced export sales through SIEPAC and the apparent shortage in power supply in the Central American region.

2.81 The use of indigenous resources, particularly in the long run, also enhances Nicaragua's balance of trade and hence the strength of its currency. It also makes electric power prices more stable, with less volatility stemming from changes in world oil prices. Additionally, as Costa Rica has been a substantial exporter of hydroelectric power, Nicaragua can, in the future, be a substantial exporter of geothermal power.

Existing Concession/Licensing Process

2.82 Geothermal development in Nicaragua is governed by two principal legislative acts and their associated regulations. Specifically for geothermal development and production is the *Ley de Exploración y Explotación de Recursos Geotérmicos*, which was enacted into law in November, 2002. This geothermal law basically replaces the former natural resource law, *Ley General sobre Explotación de las Riquezas Naturales*, but only when it is specifically associated with the exploration and exploitation of geothermal resources. Through the geothermal law and its regulations, a developer can receive a concession to explore for and produce geothermal resources; however, this does not grant a license to generate electricity. The procedures to acquire a license to generate electricity fall within the *Ley de la Industria Eléctrica No. 272* (1998).

2.83 The intent is not to outline in detail all the ramifications of the geothermal law, nor to express in exact detail the procedures for obtaining geothermal exploration and exploitation concessions. These procedures are addressed in considerable detail in the Master Plan prepared several years ago by GeothermEx. Further, though it is a bit bureaucratic and redundant for a private investor to be required to obtain both a geothermal concession and a generation license, these are not major obstacles or red flags impeding the overall promotion of private investment in Nicaragua's geothermal industry.

Geothermal Concession

2.84 The geothermal resources of Nicaragua are considered the national *patrimonio*. In other words, they are the property of the state and the people of Nicaragua. Therefore, in order to conduct geothermal exploration and development, first a geothermal exploration concession must be obtained from the government regulatory ministry, the Instituto Nicaragüense de Energía (INE).

2.85 The procedures for obtaining a geothermal concession are outlined in explicit detail in Annex H of Nicaragua's Geothermal Master Plan, and there is an excellent graphic representation of procedures and timing shown in Figure I-H.1 of that report. Simply outlined, a developer must submit an application for a geothermal concession to INE. This application includes the basic information necessary for the government to understand who is the developer, what is his experience in geothermal development, what he wants to do, and where. This is a very straightforward process involving the detailed submittal of information, plans and background materials from the developer and the subsequent analysis by INE. If everything is fairly straightforward, well documented, and the application for concession area is not within an environmentally sensitive area, then the entire process should take less than three months. A geothermal exploration concession is generally valid for three years with available extensions depending upon the mutual agreement of INE and the developer.

2.86 An environmental study or plan is not required for the issuance of a geothermal concession. However, for all work to be done on the concession or for any drilling activities, the Ministerio del Ambiente y los Recursos Naturales (the Ministry of Environment and Natural Resources, or MARENA) must first approve all environmental impact applications and studies. Annex G and Figure I-G.3 of the Geothermal Master Plan outline in detail the procedures for these environmental permitting requirements.

2.87 The holder of a geothermal exploration concession has the "right inherent and preferential" to obtain a geothermal exploitation concession inside the same geographical area, once the occurrence of commercial amounts of geothermal energy have been proven. An exploitation concession gives the developer the rights to produce commercial volumes of geothermal resources, but not the right to generate electricity.

Generation License

2.88 Once a geothermal exploitation concession has been issued by INE, a developer can begin the procedures for obtaining the electricity generation license (concession). A generation license authorizes its holder to build, own and operate an electrical power plant and to generate electricity generally for a term of up to 30 years.

2.89 The application process for a generation license is pretty straightforward and standard. Again, this process is outlined in detail in Annex H of Nicaragua's Geothermal Master Plan, and there is an excellent graphic representation of procedures and timing shown in Figure I-H.2.

2.90 The license application will discuss in explicit detail the ownership of the power plant, the group/company's related experience, type of plant and its overall design and specifications, source of energy, the transmission/interconnection system, and an environmental impact study approved by MARENA. After several weeks of evaluation, clarification and discussions between the developer and INE the government may then choose to approve the license and a Granting Right fee is paid to the state for an amount equivalent to 0.1 percent of the assets of the project.[8] A developer, upon paying the Granting Right fee, must post a guarantee bond for 1 percent of the asset base of the project. Generally, this bond is in effect until one year after the scheduled completion of plant construction.

2.91 Within ten days after payment of the Granting Right fee and posting of the guarantee bond, INE will issue the generation license, which will be executed by the developer. The entire process for acquiring a generation license should take no more than two to three months from the time the initial application is submitted to INE.

Power Purchase Agreements

2.92 Unión Fenosa is the only entity in Nicaragua that can purchase and distribute large quantities of electrical power. It is the holder of the two principal electrical distribution concessions (DISNORTE and DISSUR) that supply the power needs for the vast majority of the country. Under the regulations of *Ley de la Industria Eléctrica*, Unión Fenosa is prohibited from owning and operating its own large-scale generating plants.

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8 As discussed in other sections of this report, this is one of those fees or taxes that is exorbitant and onerous for geothermal energy. For example, a 55 MW diesel plant would only have capitalized assets of around US$55,000,000 because fuel costs are not included. To obtain a generating license for this diesel plant would require a Granting Right fee of around US$55,000, and posting a guarantee bond of US$550,000. A geothermal project of equivalent size would require a Granting Right fee of US$135,000 and a guarantee bond for over US$1.3 million. This is primarily because the cost of geothermal fuel is essentially capitalized into the project's asset base in the form of wells. Both plants put the same amount of electricity into the Nicaraguan national grid, and one project requires the reliance on high cost foreign fuel. There is something inherently wrong with this scenario.

2.93 With these prohibitions and restrictions designed into Nicaragua's electric power laws, for all practical purposes Unión Fenosa is presently the only feasible purchaser of electrical power generation from geothermal plants. Upon the commissioning of SIEPAC, electrical generation can be exported throughout the entirety of Central America, but at this time it must be sold to either Unión Fenosa or select buyers in adjacent countries. Presently there are only five independent power users in all of Nicaragua that utilize greater than 2 MW of electrical demand. These include both of the large cement plants, the El Limón mine, the large Managua brewery, and the City of Managua. Noticing that the City of Managua is a large power buyer raises the questions, "Can power be sold directly to the federal government of Nicaragua in much the same way as to a large factory or industry?" And if so, would the Nicaraguan government be willing to commit to a significant portion of renewable power?

2.94 Unión Fenosa can purchase power only directly from a generator without a long-term contract and for no more than one year. The intent of this part of the law is that the distributor can meet short-term demand needs to address outages created by maintenance down-times and overhauls to its contractual generators, or significant problems resulting from natural disasters. For power needs exceeding one year, Unión Fenosa must sign long term contracts that have been solicited through international tenders resulting in competitive bidding.

2.95 Once a successful bidder has been recognized, it must negotiate a PPA with Unión Fenosa and the tariff structure must be approved by the regulating agency, INE. For a geothermal venture the developer must then be awarded an exploration concession, an exploitation concession, and ultimately a generation license.

Barriers and Obstacles to Private Investment in Geothermal Development in Nicaragua

2.96 After reviewing the basis of Nicaragua's generation expansion plans and evaluation of the Nicaragua Geothermal Master Plan, together with an appraisal of the current legal framework, we present the following analysis of the barriers and/or obstacles of a technical, economic, and regulatory nature, hindering investment in geothermal energy in Nicaragua.

Technical Constraints

2.97 Geothermal power is not a new technology and today, worldwide, it generates more power than wind and solar combined. Development began in the early 1900s, and by the 1980s thousands of MW of geothermal power generation dotted the globe. Recent advances in geophysics, well drilling and power turbine technologies have all made their way into the geothermal community, so that today few technical constraints are observed. The technology can be considered mature and power plants can be timely built in increments from 1 MW to 220 MW using a variety of equipment designs most appropriate for any given resource.

2.98 There are at least a half-dozen turbine manufacturers with geothermal experience, from Japan, Italy, France, Israel and the United States providing state-of-the-art equipment and appropriate warranties of up to five years on the primary equipment. Suppliers and engineering construction companies routinely form joint ventures to provide highly competitive bidding for projects of any substantive size (25 MW or above).

2.99 Finally, there is highly skilled technical talent from not only the long-standing geothermal countries such as the United States, New Zealand, Iceland and Italy, but also increasingly from other countries with more recent experience such as the Philippines, Mexico and Kenya. While none of these yet invest in developing countries, they are increasingly providing a pool of skilled technical talent, keeping the cost of expatriate labor competitive. Hopefully, we will soon see private development companies established in these countries.

Economic Constraints

2.100 A number of economic constraints face the development of renewables in Nicaragua – particularly geothermal. Most of these are common to wind, hydroelectric and geothermal – although a few are particular to geothermal development.

In-Country and Political Risk

2.101 Political risk can cost as much as 4 percent of a project's overall assets on an annual basis. For just a 50 MW geothermal plant this can represent as much as $5 million per year. This is an extremely large financial impact merely for the protection of investing in and doing business in a particular country. Since most developers will need to insure both the project debt and equity for political risks, this represents a 15-25 percent premium onto the weighted average cost of capital for a project – raising the fixed costs of renewable assets substantially.

2.102 In a country such as Nicaragua, this availability and affordability of political risk insurance is one of the most critical economic parameters facing prospective geothermal developers. Neither developers nor their financers will entertain a project without insurance (particular after those who did in Indonesia met with disastrous consequences). Nicaragua is not the only developing country with geothermal assets facing this difficulty, and paragraph 2.114-2.143 includes a suggested alternative to reducing the cost of such insurance.

Competing on a "Level Playing Field"

2.103 The geothermal industry generally believes it can compete with other energy sources in the production of electric power, provided it is allowed to contend on a level playing field. This means that all else being equal, geothermal power should be as inexpensive as viable competitors. So, with respect to the current Nicaraguan power market, what constitutes a level playing field or all else being equal?

2.104 Compare state-of-the-art projects developed using geothermal energy with diesel fuel oil generation. Since geothermal power requires 2 – 2.5 times the invested capital ($2000 – $2500 per installed kW vs. about $1000 for diesel[9]), the geothermal project will pay 2 – 2.5 times the amount of: (i) income tax, (ii) *Ley de Equidad Tributaria* (1 percent asset tax or equity tax), and (iii) property tax (on "fixed assets").[10] We loosely refer to the equity tax and other taxes as the Renewable Energy Disincentive Act – since they unduly discriminate against renewable energy projects, particularly geothermal.

2.105 These, however, only begin to describe the disproportionate treatment. For example, a developer of a diesel plant (such as Tipitapa) will locate the plant very near an existing transmission line. A geothermal, wind or hydroelectric plant will need to be located at the resource – often many kilometers from an existing transmission line. The developer will be saddled with the cost of acquiring the rights-of-way (often by purchasing the land) and building the transmission line, only to have the line's value made available to others without due compensation, potentially even to its competitors.

2.106 Likewise, geothermal, wind or hydroelectric facilities require more land use than diesel plants and often the building of many kilometers of access roads, which are available for use by others. These many miles of roads contribute to stimulating the local economy and development – providing substantially more total value than the minimal infrastructure upgrades corresponding to a diesel plant.

Unequal Taxation of Renewable Energy

2.107 Though it generally is unintentional, many country's tax codes are very restrictive towards renewable energy sources. A classic case in point is Nicaragua's new tax equity law. This is a 1 percent investment tax on all project assets. Though this taxation law is not intended to adversely affect renewable energy development, in reality it does. For example, a diesel generation plant may have an asset base of around $1,000 per kW of capacity whereas a geothermal project's asset base will be around $2,500 per kW. Taxation within the tax equity law would be approximately $500,000 on a 50 MW diesel plant but over $1.25 million for a similar sized geothermal plant. In essence, this taxation law favors the importation of foreign fuels rather than development of secure domestic resources. Further, new taxation laws such as these also send a dangerous signal to international developers that if a country needs money it will change the rules and begin implementing new taxation.

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[9] Assuming comparable after tax rates of return on equity together with similar project debt-to-equity ratios.

[10] Apparently diesel operators are arguing that much of the "equipment" in a diesel plant is not "fixed" since it can be easily removed. We assume the same treatment between diesel and geothermal, however, it is possible that more of the "equipment" in a diesel facility could be argued to be "movable" and thus not "fixed" – and thus the tax treatment even more unfair to the geothermal operator.

2.108 Nicaragua's geothermal laws also pay a 1.17 percent tax on "gross" revenue to the local municipalities and alcaldias. Paying a tax on gross revenue rather than "net" revenue is extremely onerous to the developer. Additionally, the local municipalities receive local benefits of all infrastructure improvements, roads, electrical, water, etc. This is yet another form of tax which discriminates against renewable energy projects.

2.109 Unión Fenosa continually states in the press that it has no money. How does a private developer finance a geothermal project in Nicaragua when the only customer in the nation repeatedly claims to be financially short of money?

2.110 Geothermal power pricing needs to improve. Ormat's price at the plant's meter at Momotombo is only 4.5¢ to 4.8¢/kWh. This project, at the point Ormat entered into the contract, contained no substantive resource or development risk – having taken over a constructed and operating field and plant. San Jacinto's PPA price, which includes drilling, developing and operating a geothermal field (though it has acquired online wells capable of over 25 MW of production) as well as plant construction is only 5.95¢/kWh. For new geothermal development to become attractive in Nicaragua pricing at the plant must begin to approach 7¢/kWh.

Regulatory Constraints

2.111 The logistical process in Nicaragua for obtaining permits, licenses, and both geothermal concessions and an electric generation license may seem a bit bureaucratic and cumbersome. A company is required to obtain a concession and invest in exploration and development of the resource with no assurance that a long-term PPA will be obtainable. Over the past several years more geothermal concessions have been returned to the government than have new concessions been issued. This is neither a good indication of a successful process nor a good inducement to international developers. The San Jacinto Power Company signed its PPA in 1999 but did not receive its generation license and geothermal concession until 2002. Though GPS does not know why this was the case, the process should not take so long and it is viewed negatively by other geothermal developers contemplating the Nicaraguan market. If this bureaucratic process is indeed a pattern then this is a definite obstacle for private development.

2.112 GPS heard numerous times that the regulations associated with the new electricity law are burdensome, confusing, and highly restrictive. The majority of groups and individuals the company met with in Nicaragua claim that these *normativas* are prohibitive.

2.113 Though INE has been a successful regulator of Nicaragua's energy industry for years; it now needs, in GPS's opinion, to take on the role of being a champion and facilitator of private development of renewable energy. Can INE see itself with the job of being a catalyst for encouraging geothermal development? GPS's view is that, without a governmental entity specifically chartered to encourage geothermal development and streamline the requisite processes, geothermal power faces an uphill battle. In fact, the company suggests that from the president on down, an attitude of promoting the use of renewables rather than regulating them, would do more to foster growth than any specific legislation or program.

Alternatives and Incentives to Private Geothermal Development in Nicaragua

2.114 It is critical that the next geothermal development venture in Nicaragua be a success. The single greatest attractor for more geothermal developers to come to Nicaragua is the success of the current development activities. If developers perceive struggles or difficulties with the existing developments, they are dissuaded from entering the market. On the other hand, when, as was the case during eras in Indonesia and the Philippines, they see successful negotiations of PPAs and projects coming online, they perceive a business opportunity for their own entry into the market. The government (INE and CNE) must do everything within its power to assure success, particularly with regard to projects already in development.

2.115 The international perception is that Nicaragua sits upon a “volcano” of geothermal potential but because of excessive bureaucracy, taxation and political in-fighting has yet to get it developed. The international community sees that many of the larger geothermal developers, including CalEnergy, Unocal, Caithness, Calpine, and Marathon Oil have pursued Nicaraguan opportunities and have now left the country.

2.116 Granted, many of these companies left because of economic situations and failures in other parts of the world that were absolutely no reflection on Nicaragua, but the developers who remain are not finding success, providing confirmation that leaving was a good business decision. As proof, currently more developers are returning concessions to INE than are taking out new ones. To overcome this, the next geothermal venture in the country must be an expeditious success, be it San Jacinto, Momotombo, or a new geothermal concession. The world geothermal developers need to see Nicaragua as open for business when it comes to geothermal opportunities.

Technical Alternatives

2.117 Regarding the government’s participating in up-front resource development, there are private developers that feel likewise. Ormat suggested that the government subsidize further exploration and drilling at Momotombo. Is this merely self-interest or could these ideas be expanded to promote other geothermal concessions? If, for example, the government began investing in geological and geophysical programs, heat flow surveys, and ultimately deep exploration drilling as a way to evaluate and promote specific geothermal resource areas, how might this be paid for? One possibility is have the private investors pay a royalty after the first 10-15 years of operation, when the project debt is either paid off or substantially paid down. A second thought would be to repay the government’s front-end risk investment through a reduced power purchase price in the PPA.

Financial Alternatives/Incentives

2.118 Viable power markets, reasonable pricing, and government support will combine to pique the interest of foreign investors. Special incentives such as exemption from taxation for renewable energy, reduced or cancelled government royalties on geothermal production, and streamlined bureaucratic processes are ways to attract foreign investment.

2.119 GPS believes the most critical elements of financial incentives will be the offering of long-term power contracts together with innovative pricing structures which allow for higher returns in early years to pay off or pay down the large amounts of debt required for geothermal projects, combined with lower pricing in out years. This should provide reasonable "levelized" pricing for power from geothermal projects and was the style of pricing utilized in Indonesia for its geothermal projects.

Political Risk

2.120 In higher risk countries like Nicaragua, or elsewhere in Central America, private developers may be charged as much as 4 percent annually for political risk insurance. This can represent an annual budget item for a project of up to US$5 million. Since it is both critical to the developers' needs and very expensive, it would behoove CNE to work with insurers to find ways of reducing the cost of such insurance.

2.121 When meeting with OPIC we discussed the possibility of encouraging a number of developing countries with geothermal assets to form a pool or groups for political risk insurance. The concept would for a small group of countries to commit to supporting the political risk of geothermal development and to co-insure. They would be charged their full, say 4 percent premium payments; but each year that no claim was made under the policies, each government would receive a refund of say 1-2 percent. If there were a claim by one of the projects (in one of the countries, as an example), there would be no refund to any of the governments.

2.122 For the insurer, there is always safety in numbers, and this would allow the other governments to encourage any non-performer to cover its own political risks for the benefits of all. It would, in the absence of any defaults, bring a significant benefit to each of the participating countries – providing millions of additional dollars for critically important government programs.

Equality in Taxation

2.123 Changes in a country's tax codes and taxation laws and policies is definitely one of the largest incentives for private investment in geothermal development. In Nicaragua, numerous tax issues have been mentioned as impediments to geothermal energy, specifically:

- Tax Equity Law
- Municipal Royalties
- Import Duties

- Absence of Accelerated Depreciation
- Depletion Allowances

2.124 The tax equity law has already passed the Asemblea (Nicaraguan parliament) and now is the law of Nicaragua. However, the *normativas* thereto are now being argued in committee.

2.125 It is our recommendation that key individuals from the private and public sectors as quickly as possible begin to schedule presentations in front of COSEP, President Bolaños' economic cabinet, and the normative committee of the Asemblea. A concerted effort needs to be made to exempt renewable energy projects from the Tax Equity Law.

2.126 In an effort to establish a level playing field between renewables and fossil fueled generation, a number of approaches could be taken. First, for example, Nicaragua could substantially tax fossil fuels for power generation. This would, in turn raise power prices and have adverse political consequences. Instead, the government could consider how to lessen the tax burden somehow for renewables, as more fully discussed herein.

2.127 Private developers have provided the suggestion that all equipment and materials imported over the entire life of a geothermal project be duty-free. Today's geothermal law provides only for a three-year moratorium. This makes sense for geothermal energy because field development and drilling is an ongoing process throughout the life of a project and power plants are often not constructed in the initial three years of a geothermal venture. Suggestions have been made for a depletion allowance similar to mining and petroleum resources. Also, suggestions have been made to exempt geothermal projects from all income taxes for the first seven years of a venture. Are these suggestions truly stimuli for geothermal development or merely self-interest of the promoters?

PPAs and Sovereign Government Guarantees

2.128 Throughout the developing world, geothermal power projects are financed on the basis of long-term Power Purchase Agreements with Sovereign Government Guarantees. Nicaragua will be no exception. If it wishes to invite foreign investment, these two key elements will need to be put in place.

2.129 From GPS's information, financing projects with corporate guarantees from Unión Fenosa will be insufficient to provide lenders with the creditworthiness they seek for such projects. As a result, the government of Nicaragua will need provide its support for geothermal projects in order to attract developers and financing.

Renewable Project Financing

2.130 An increasing number of funding sources are available for renewable energy projects in general and geothermal projects in particular. The International Finance Corporation has a facility to purchase greenhouse gas (GHG) emission reductions for the benefit of the government of the Netherlands using the "Clean Development Mechanism" of the Kyoto Protocol. The Netherlands will use these emission reductions to help meet its commitments under the Kyoto Protocol.

2.131 The Netherlands has allocated €44 million (about US$46 million) for this facility over the next three years. The facility will provide additional revenue to eligible projects, including geothermal power projects, which generate emission reductions in developing countries, such as Nicaragua.

2.132 If a project is approved, the facility will make payments to the project over a period of 7 to 10 years upon annual certification of actual GHG emission reductions. In return for these payments, the Netherlands will receive certified emission reductions (CERs) that can be used to meet its obligations under the Kyoto Protocol. The facility may consider limited advance payments for reductions but only under unusual circumstances.

2.133 This facility would allow a private developer to generate power at a lower cost for the first 7 to 10 years of the project – thereby making the geothermal project more competitive with fossil-fueled generation. Additional information on the funding facility is available at the IFC's website, at www.ifc.org/enviro/EFG/CarbonFinance/carbonfinance.htm

2.134 GPS believes that additional funding through the IFC and other sources will be forthcoming. A prototype carbon fund has been established, with additional information available at www.prototypecarbonfund.org. In addition, a number of investment funds have been established to invest in "clean energy" and other environmental projects. The CNE, working with developers, should endeavor to maximize the use of available, low-cost financing sources.

Organizational Alternatives – "Streamlining the process"

2.135 Bureaucratic processes develop naturally within organizations. Periodically, a concerted effort needs to be made to streamline processes and make them sensitive to the needs of the end user. This is particularly true of regulatory law and those who administer it.

Streamline the Process

2.136 For both governmental and private organizations, the processes at work need to be continually reviewed with an eye to streamlining the time and effort required to develop geothermal projects. Three particular areas come immediately to mind:

i. Streamlining processes associated with obtaining critical project agreements, including: PPAs, geothermal resource concession, and generation concession,

ii. Adjusting attitudes of critical agencies from the regulator outlook to a facilitator way of thinking, and

iii. Streamlining the electric *normativas*, which are unduly lengthy and complex. The government needs to setup a committee, through CNE, to review the *normativas* of the electric law. What can be done to simplify, reorganize, and modernize these regulations so as they are not an impediment to energy development in the country?

2.137 Implementing the country's environmental regulations and working with MARENA seems to be a very strong "plus" and virtue of geothermal development in Nicaragua. In all GPS's background meetings and discussions, the company did not once hear any negative comments regarding the attitude, policies or actions of MARENA. Ormat obtained approval for all its requests for additional drilling. San Jacinto called the overall experience with MARENA very positive and said it was only a 3-4 month process to get complete approval of its environmental plan and program. MARENA partially attributes this to its "get it done" attitude and adds that the nation's environmental regulations are basically the same today as when they were implemented as law around 1994-95. MARENA believes it has become more efficient at administering and regulating the environmental process.

Pre-Qualify Geothermal Concession Applicants

2.138 A number of geothermal concessions have been forsaken or continue to face difficulty in development in part owing to the inexperience of the developer. GPS believes that insufficient pre-qualifying of applicants may have contributed to some of the difficulties encountered. Rigorous yet rapid pre-qualifying of applicant companies might improve the probability and propinquity of success.

2.139 Once applicants are pre-qualified, the Nicaraguan government agencies responsible for overseeing concessions, PPAs and permitting should do whatever then can (within the reasonable limitations of their functions) to assist the developers. As it is now, many of the concessions have been obtained and returned, without a single successful commercial development since the Sandinista era.

2.140 Additional ways of leveling the playing field:

- credits for infrastructure improvements that benefit the public
- promotion of the ancillary public benefits of renewable energy projects through speeches, educational materials and media outlets.

2.141 GPS encourages CNE to consider promotional marketing of developers in order to: (i) turn around recent attitudes concerning development opportunities in Nicaragua, (ii) be proactive instead of wanting developers to wait to hear about the opportunities, and (iii) develop competition amongst prospective developers, in the hope of attracting the best firms and the best possible power pricing. As an example, the petroleum directorate of INE targeted and toured a number of petroleum industry centers in North America, introducing their request for bids for Nicaraguan oil. As a result of this marketing effort, in some cities there were audiences representing 15 or more companies at meetings, developing a significant interest in Nicaraguan oil concessions.

Establish a Mandate

2.142 As alluded to earlier, GPS believes there needs to be substantive mandate from the highest levels of government trumpeting the benefits of renewables and establishing their development as a top priority. The benefits of renewable energy development are numerous and need to be presented in speeches by top officials; furthermore, priorities need to be established to reduce Nicaragua's dependence on foreign oil and its price fluctuations. It needs to be established that renewables in general and geothermal in particular are important to the future of the country.

2.143 With the sense that this is important to the people of Nicaragua and to the Government, there then needs to be a concerted push towards specific and measurable goals.

3

Proposed Structures for Private Geothermal Development in Nicaragua

Introduction

3.1 The most critical factor relating to attracting investment in Nicaraguan geothermal power is what we might term leveling the playing field. With imported fuel oil not being taxed and the large amount of capital investment required in renewable power subject to heavy income taxes, property taxes and the new equity tax law; the competitive development environment is skewed in favor of fossil-fuel generation. The outcome of competitive bidding will already be pre-determined not by the efficiency of the market place and reasonable competition amongst the generation sources, but rather by the advantages caused by an unlevel playing field that favors non-renewable energy sources.

3.2 In general, the problem can be approached in one of two ways – by (i) leveling the playing field by either taxing imported fossil fuels or by granting fair and appropriate tax relief or tax credits to renewable forms of power generation, or (ii) establishing a separate market for renewable power; in essence creating a separate playing field. Competitive development of renewable energy sources can thus be undertaken by: (i) initiating taxation of all imported fossil fuels used for the generation of electricity, (ii) waiving most of the unintended tax burden placed on renewable energy assets by the equity tax, income and property taxes and other taxation, which in turn will create economic parity with fossil-fueled generation, and/or (iii) establishing an independent renewable energy market.

3.3 The current trend elsewhere is the latter – the establishment of a separate renewable market through either set-asides or by implementing a Renewable Portfolio Standard (RPS), which is the generally preferred approach in other countries. GPS believes there are decided benefits to this approach.

3.4 First, new taxes on imported fuels will translate directly into higher electricity prices, which cause unfavorable economic and political consequences. On the other hand, granting fair and appropriate tax relief or tax credits to renewables is often seen as providing a crutch or subsidies to uneconomic technologies – also with both economic and political consequences, though perhaps lesser in magnitude. The approach of initiating an RPS for Nicaragua may provide an approach where some or much of the economic costs may be borne by others.

3.5 With the advent of the Kyoto Protocol and the commitment on the part of an increasing number of countries to lower their emissions of greenhouse gases there will likely be a market for the reduction in emissions that Nicaraguan renewable power would represent. Said another way (and discussed more fully below), Nicaragua could have other countries pay the cost margin associated with renewable power through the reduction in emissions, which this power represents. This is not a far-fetched concept – with early genesis already implemented in both the United States and Europe. Those international developers who will be interested in developing projects in Nicaragua in the future likely already understand and work with this concept on a regular basis.

3.6 The short-term, immediate results of these proposed measures will not only stimulate energy competition but a side effect will be the reduction of the country's dependence on foreign oil – which at this time is potentially critical should oil prices or the Middle East political situation change drastically. Nicaragua can begin focusing on the private development of its own, domestic energy resources and reduce, in the long term, its expenditures of millions of dollars in hard currency flowing out of the country.

3.7 This section addresses the issue of the level playing field separately from GPS's proposed structure for encouraging private geothermal development through the use of a Renewable Portfolio Standard. In the company's view, however, if one of these two approaches is not implemented, the potential for private geothermal energy investment and development in Nicaragua will be minimal.

Approach

3.8 A detailed Internet and literature search of possible sources of standardized contracts from the "global catalogue of institutional agreements" turned up little of relevant value. This is primarily due to the geothermal industry's being a fairly specialized field and in general Denmark, Germany, Spain, and the UK have little or no potential geothermal energy development. The United States generally does not utilize standard contracts as Europe does (although California's Standard Offer Contracts and the U.S. Bureau of Land Management's leases[11] would be the exceptions to this comment). A further review of information and contracts/agreements available from the Organization for Economic Cooperation and Development was not applicable to private geothermal energy development. Therefore, GPS believes that a review of standardized contracts and agreements really is of only minimal value to the stimulation of private geothermal development in Nicaragua.

[11] Both the Standard Offer form contracts utilized in the early 1980s in California and the U.S. Bureau of Land Management's leases have applicability to the current situation in Nicaragua, but cannot be used directly – rather instead form valuable reference documents for the task of establishing methodology and agreements for Nicaragua.

3.9 GPS does have access to quite a number of geothermal contracts from many of the countries encouraging geothermal development. These were reviewed in some detail and utilized in developing the contracting structures discussed later in this report.

3.10 Since there is no current exact analogy to Nicaragua's needs in the face of a changing marketplace resulting from the Kyoto Protocol, this report will focus on enhanced structures and financings that can be readily implemented successfully. There may be criticism that these proposals are not the lowest cost options, in theory. But structures that do not lead to success are by definition not the least expensive cost option. In GPS's view, given the new world marketplace for GHG emission offsets, the RPS approach will likely provide Nicaragua the lowest cost option in the long run.

3.11 Finally, any suggested approach must be well-supported in order to be successfully implemented. Without a full commitment and determination the best methodology will fail. Conversely, many countries have succeeded in utilizing approaches considered less than optimal, due to a strong resolve. With this realization, both CNE's and the World Bank's feedback is critically important. Are GPS's proposals feasible in the current political climate? Is wholehearted support possible? Are there other workable approaches more likely to receive the full backing needed?

3.12 Before beginning, one observation from should be re-emphasized – that Nicaragua particularly needs to find success in its next endeavors in privatizing its geothermal development. As was pointed out, a number of concessions have been returned to the government owing to a variety of factors, but the principal cause is likely the lack of available long-term PPAs.

Leveling the Playing Field

3.13 Since renewable power in general and geothermal in particular require substantially more capital per installed MW than do fossil-fueled power plants, taxation based on capital cost affects developers of geothermal power much more than those developing, say, diesel units. The types of taxes include income taxes, property taxes and the equity tax (see paragraph 2.103-2.106 for discussion and calculations).

3.14 As mentioned above, the problem can be approached in one of two ways – by (i) leveling the playing field by either taxing imported fossil fuels or by granting fair and appropriate tax relief or tax credits to renewable forms of power generation, or (ii) establishing a separate market for renewable power; in essence a separate playing field. GPS's view is that the former option of leveling the field through changes to taxation causes both economic and political consequences that are generally undesirable.

3.15 Initiating new taxes on imported fuels will translate immediately into higher electricity prices, which cause both a slowing in economic development and political unrest – both highly undesired in Nicaragua at present. The alternative of granting fair and appropriate tax relief or tax credits to renewables may have less undesirable consequences, but unfairly suggests that renewable technologies need economic assistance. While either of these approaches should solve the problem, GPS believes a third and better approach should be considered – that of initiating an RPS for Nicaragua. This would not only allow the renewable technologies to compete in a fair market, but may allow much of the cost difference (and benefit of GHG emission reductions) to be borne by others.

3.16 Historically, there has been little doubt that renewable power (sometimes called green power) has environmental benefits and should be preferred over the combustion of fossil fuels. Until recently, this benefit has been seen in qualitative measure, but not necessarily in quantitative measure. Said another way, while the benefits are obvious, putting a price tag on the benefits has been difficult.

3.17 The combined approach of establishing a Renewable Portfolio Standard (in the United States or Kyoto Protocol provisions elsewhere) with allowing trading in the environmental offsets including oxides of nitrogen (NO_X) and sulfur (SO_X) emission offsets and Renewable Energy Certificates (RECs, affectionately known as Green Tags) has allowed a free market approach to quantifying or pricing these benefits. GPS believes the approach, while appearing somewhat forward-thinking, will in fact provide a timely and cost-effective approach to funding renewables development in Nicaragua.

More About Renewable Portfolio Standards

3.18 Renewable Portfolio Standards have been established to bring more renewables to the market by establishing a separate market instead of trying to balance the market through either taxing fossil fuels or providing tax incentives to renewables. RPS requires that a national or state government mandates the generation of a specific percentage of the energy being produced in the region by renewable generating sources.

3.19 The implementation of RPS programs is ongoing and evolving in the United States and abroad. To date, 13 states in the U.S. (including most of the larger states, such as California, Pennsylvania, New Jersey, and Texas) have established RPS programs, and another six are in some stage of establishing an RPS. Each state's legislation is slightly different, so to date there has been no clear-cut standardization. For instance, states have different criteria for defining renewable sources, different target levels for the contribution of renewable generating sources, and differ as to whether the power must be generated within the state or not, and even over what time period the standard must be met – some being as stringent as hourly and some as flexible as averaged over a three year period.

3.20 It is important that Nicaragua determine a structure and targets that are consistent with its renewable resources, energy strategy, other laws, etc.

3.21 The following steps describe how an RPS might be implemented[12]:

[12] Chapter 4 describes our proposed, detailed implementation plan.

1. The legislators and agencies responsible for energy and power would develop a strategy and goals for integrating renewable sources into the generation base.
2. The strategy and goals would be incorporated into a law that would require that the agencies ensure that the amount of energy from renewables meets the goals.
3. Each year the agencies would forecast how much energy will be needed in the country and how much could come from renewable sources that will exist in future years.
4. The percentage of energy supplied by renewable sources would then be calculated for each year in the future and compared with the RPS goals in each year.
5. To the extent that the contribution by renewable sources is not expected to meet the RPS goals, the agencies will solicit bids for new renewable generation.

3.22 The program would need to have reasonably strong requirements for meeting the goals, with some form of penalties for not meeting them, as is customary in any RPS program. GPS also thinks that Uniõn Fenosa is the best to market the RECs and some form of bonus/penalty should assure that is accomplished well.

3.23 As there are often questions concerning Renewable Portfolio Standards, how they function and what the resulting benefits are; a copy of the answers to Frequently Asked Questions regarding RPSs, as provided by the The Union of Concerned Scientists[13], is attached as Appendix D to this report. While these questions and answers are specific to a proposed national RPS in the United States, they are quite relevant to GPS's proposed program for Nicaragua.

Renewable Energy Market Value

3.24 By way of illustrating how RECs could benefit Nicaragua's renewable development, perhaps reviewing the current state of play in the United States will provide a useful background on the subject.

Renewable Energy Credits and U.S. Development

3.25 As previously mentioned, in the United States 13 states have some form of Renewable Portfolio Standard with another six states are in the process of formulating a standard. Additionally, the U.S. Congress continues to debate the benefits of a national RPS; the version of the Energy Bill passed by the U.S. Senate contains a 10 percent national RPS to be achieved by 2020. While the national RPS may not survive in the

13 Obtained from The Union of Concerned Scientists website, at: http://www.ucsusa.org/clean_energy/renewable_energy/page.cfm?pageID=46

final Energy Bill, the general consensus is that sometime within the next decade some sort of national RPS will be enacted.

3.26 An RPS establishes the minimum amount of renewable energy required for each state for milestone years. For example, goals of 10 percent renewable power by the year 2005, 15 percent by 2010 and so on, might be legislated. The utilities are generally obligated to build, purchase or otherwise secure the level of electricity generally measured in produced and sold MWhs. The "purchase or otherwise secure" provisions have led to what is called Renewable Energy Certificates or Green Tags. In essence, this allows the developer or seller of renewable power to market the renewable part of the electricity separate from the electricity itself.

3.27 Thus a utility can purchase renewable power or RECs to indicate it is procuring the satisfactory level of renewable power. RECs currently trade in the U.S. for price ranging from $10 to 30/MWh. In the event the utility is unable to procure the required power they pay a penalty, generally about $50/MWh. The establishment of tradable Green Tags has given the U.S. renewables industry a needed boost which should result in the doubling of renewable generation within the next decade.

3.28 There is consideration being given to the procurement of renewable power from Canada and it is not inconceivable that RECs from Central America could, at some point, be tradable in the United States.

Kyoto Protocol

3.29 The United Nations Framework Convention on Climate Change (UNFCCC) drafted a mandate for the nations of the world to come together to significantly reduce GHG emissions and pollutants throughout the world. By March of 1994 the text of this Convention had been executed by 166 individual countries.

3.30 A third conference was held by the UNFCCC in Kyoto, Japan in 1997, where the parties thereto adapted what is known today as the Kyoto Protocol. At Kyoto the text was further clarified with the intent that as of 1990 the 34 largest industrial countries (referred to in the Kyoto Protocol as the Annex I countries) accounted for 55 percent of the world's total carbon dioxide emissions (CO_2). Most of these countries agreed to reduce the overall CO_2 emissions of the Annex I countries to a level 5 percent below the 1990 baseline. Within two years 84 countries had signed the Kyoto Protocol, and today 111 nations have ratified it. Of the Annex I countries, enough of these countries have now ratified the Kyoto Protocol to represent a total of 44.2 percent of the world's 1990 CO_2 emissions.

3.31 The heart and substance of the Kyoto Protocol is found in excerpts from its Article 3, which states, "The Parties included in Annex I (which are defined as the major industrial countries of the world) … shall, individually or jointly, ensure that their … carbon dioxide equivalent emissions of the greenhouse gases … do not exceed their assigned amounts … with a view to reducing their overall emissions of such gases by at least 5 per cent below 1990 levels in the commitment period 2008 to 2012."

3.32 As detailed and outlined in this chapter 3, the various nations of the Kyoto Protocol are allowed to assign, purchase or sell renewable energy certificates (referred to in the Kyoto Protocol as emission reduction units) in order to meet their individually targeted and agreed CO_2 emissions standards by the year 2012. This principle, as established and agreed to in Kyoto, is one basis for buying, selling and trading green tags, as outlined in this report.

3.33 The first paragraph of Article 6 of the Kyoto Protocol very clearly states, "For the purpose of meeting its commitments under Article 3, any Party … may transfer to, or acquire from, any other such Party emission reduction units resulting from projects aimed at reducing … emissions … of greenhouse gases in any sector of the economy … " Paragraph 3 of Article 6, goes on to say, "A Party included in Annex I may authorize legal entities to participate, under its responsibility, in actions leading to the generation, transfer or acquisition under this Article of emission reduction units." Article 17 states, "The Parties … *may participate in emissions trading for the purposes of fulfilling their commitments* under Article 3. Any such trading shall be supplemental to domestic actions for the purpose of meeting quantified emission limitation and reduction commitments under that Article" [emphasis added].

Renewable Energy Credits and Nicaraguan Development

3.34 GPS recommends that Nicaragua develop a separate market with the establishment of an RPS of 30 percent in 2006 and 40 percent by 2013[14]. Either CNE or Unión Fenosa could be chartered with the task of collector/holder of the RECs associated with new, renewable generation. In turn they would be expected to market the RECs to the highest bidder, with proceeds being used to offset the higher cost of renewables in the Nicaraguan market.

Standard Contracts

3.35 The current process for developing geothermal energy in Nicaragua is quite good and it appears that MARENA is excellent to work with. Currently, the greatest weaknesses are the lack of a standard vehicle to obtain a PPA and the poor creditworthiness of Unión Fenosa.

3.36 The present power demands in Nicaragua are for 440 MW of peaking demand and around 280 MW of baseload demand. The realistic available capacity ranges from 450 to 490 MW. The demand forecasts supplied by CNE show an annual increase in needed generating capacity of 30 to 50 MW through 2017. Unión Fenosa has already indicated publicly that it will need 20 MW of generation by November of 2004, plus an additional 20 MW by 2006, and the PPA presently in place with San Jacinto Power Company is not included in these projections.

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[14] Today Nicaragua has an *available capacity* of 94 MW of hydroelectric power plus 30 MW of geothermal power, out of a *total available capacity on paper* of around 504 MW, which represents 24.6 percent renewables.

Standard Contract Overview

3.37 The use of standard contracts will provide a consistent form of agreement for the various power projects. This will simplify many processes for Unión Fenosa, as well as for any developers that enter into more than one contract. The simplification should result in better understanding between the parties, with less opportunity for confusion between various contracts.

3.38 Standard, or at least similar, contracts have been used in the Philippines and Indonesia to facilitate the development of geothermal resources there in the past ten years. They were also used by the California Utilities – Southern California Edison, San Diego Gas and Electric and Pacific Gas and Electric to facilitate independent power production during the 1980s.

3.39 There may be some differences between the final contracts, due to differences between sites and the needs of each developer.

3.40 In concept, the developer must know there is a process by which it can sell its power, and Unión Fenosa needs to know that the pending power contracts that have been obtained but have not yet completed will expire on specific dates. The developer, the government and Unión Fenosa need to have a standard mechanism for the repetition of offering power purchase agreements.

3.41 GPS believes that a transfer arrangement (such as BOT, BOOT, or BLT) would probably be the most attractive arrangement for both parties and that the transfers should occur after ten to twenty years of commercial operation. The power price will be higher for shorter terms, because the plant cost would be amortized over a shorter period. A longer term might also increase the perceived risk of the developer, resulting in higher power sales prices to compensate. If Nicaragua does not want to own the plant at the time of transfer, it could arrange for an extension with the developer or sell the project to a third party. GPS's view is that an open auction to the highest bidder, with both the original developer and prospective third parties invited to bid, might provide the highest value to the government of Nicaragua. The auction should be considered at then market power rates and would be in lieu of royalties during the initial contract period.

Issuing Standard Contracts

3.42 Unión Fenosa and CNE could jointly establish a Standardized Contract (SC) program, which would periodically solicit bids for developers to supply power under a BOT arrangement, under the terms of the SC. The timing of the requests and the amount of capacity requested would be determined by a planning process, based on the growth in peak and baseload demand. The economies of scale are an important consideration in the size of the solicitations. Based on the expected load growth, GPS anticipates that solicitations would be made every two to five years for 50 to 100 MW. The planning process would need to anticipate the needs approximately five years ahead, since that would be approximately the time required to develop a power plant.

3.43 Some consideration should be given to allowing bidders to reserve for future expansion by reserving rights to bid at defined points in the future. This would allow a developer to take advantage of economies of scale and reduced risk through knowledge of the geothermal resource to provide a very competitive bid. Similarly, this could allow CNE to build the expected incremental capacity into transmission lines, thereby realizing its own economies of scale.

3.44 A bidders list should be compiled to specifically solicit certain developers, but the solicitation should be an open invitation for bids. The qualifications of bidders must then be reviewed to confirm which bidders can be relied upon to complete to project.

3.45 Each SC would be for project completion within five years. If a given SC solicitation is over subscribed, then Unión Fenosa/CNE would first negotiate with the lowest price offered. Otherwise, pricing would be negotiated into the SC or, pricing can be set in advance by the SC.

3.46 Nicaragua's power planning process should drive the timing, magnitude, and other aspects of each request for bids for new generation. This process should take into account the overall economics of the process and the limitations on resources to oversee numerous projects.

Principal Clauses of a Standard Contract

3.47 The SC must clearly establish the agreements between the Nicaraguan agencies and the developer. It is important to define the responsibilities and expectations of the parties under all foreseeable circumstances to minimize future disagreements and problems.

3.48 Assuming that the geothermal resource will be included in the developer's scope, the agreement will be in the form of a power sales agreement, rather than a tolling or energy conversion agreement. As such, the developer will be responsible for the development, operation, and maintenance of the geothermal resource, wells, gathering system, and injection system. Significant risks are associated with those responsibilities.

3.49 The terms and pricing must be attractive enough to induce bidders to acquire a concession and accept the costs and risks associated with exploration and development of the geothermal resource. Greater the perceived risk to the developer will translate into a higher expected rate of return, in the form of higher rates for capacity and/or energy.

3.50 The following list provides the basic clauses of a standard contract, based on similar developments in Indonesia, the Philippines, and the United States. Some of the most complex and/or important clauses are explained briefly.

Definitions – Descriptions of the key terms used in the contract, including details to preclude future misunderstandings under unusual circumstances.

Project Scope and Type – Descriptions of the location, facilities, purpose, ownership, overall legal arrangement.

Term and Schedule – Dates and times, financing and development milestones, interconnections, infrastructure, commercial operation, schedule bonus and penalty, operating period, transfer, sunset, termination, extension, delays.

Language – Requirements for information transmittal in all forms for documentation, data, correspondence, invoices.

Contingency Plans – An overview of contingency plans relative to financing, poor geothermal resource performance, force majeure, and so on.

General Rights and Responsibilities of the Parties – Descriptions of what the developer and the Nicaraguan agencies may and shall do under the contract. Address all major events, interactions, contingencies, and so forth. Include requirements for third-party assurances, such as parent guarantees, performance bonds, and letters of credit. Define responsibilities for damage and losses, compliance with laws, environmental regulations, and so on. Describe organizational requirements of both parties and coordination between the parties, such as an operating committee.

Geothermal Exploration and Development –

- Description of the geothermal concession and its status
- Information available to developer
- Demonstration of potential, composition, expected life,and so on
- Required level of effort and expertise by developer
- Involvement of Nicaraguan agencies
- Data recording, sharing, analysis
- Expert opinion of resource
- Risks and mitigation
- Reimbursement of costs
- Schedule
- Future drilling and work-over plans
- Disposal of waste material, fluids, and gas

Construction of the Power Facilities

- Milestones and schedule
- Transmission line and interconnection responsibilities and schedule
- Access rights of operator
- Equipment importation

- Permits
- Drawings, documents, data and instructions
- Penalty due to delays

Testing of the Facility

- Procedures, schedules, notices
- Acceptance test requirements
- Safety testing
- Performance testing
- Reliability testing
- Electrical interface testing
- Requirements for commercial operation
- Tests during operation period
- Tests at transfer
- Include overview procedure as appendix

Operation of the Facility

- Commercial operation date
- Power rates for initial deliveries
- Dispatch procedure
- Startup, shutdown, and load change requirements
- Normal and extreme ranges and fluctuation of operating parameters (power factor, frequency etc.)
- System stability
- Engineering standards
- Environmental standards
- Protective devices and settings

Maintenance and Outages

- Maintenance schedules
- Major overhauls
- Routine maintenance

- Operating records
- Forced outages

Delivery of Capacity and Energy

- Annual capacity nomination
- Availability and impact on revenue
- Minimum energy purchase
- Dispatch
- Obligations of the parties
- Sales to other parties
- Metering requirements, calibration, accuracy

Payments – Description of the payment structure. This can take various forms, but it is a general requirement that the developer receive a fee that is adequate to make debt payments without fluctuations due to dispatch. This is usually in the form of a capacity payment or an energy payment with a minimum purchase quantity. The structure should also include reductions in payments for unacceptable availability.

- Capacity payment
- Energy payment
- Availability penalty
- Minimum payment
- Terms of payment
- Invoice procedures and format
- Dispute of invoices and payments
- Taxes
- Payment procedures
- Interest
- Escalation or indexing of payments
- Currency and exchange rates

Environmental Compliance

- Applicable laws and regulations
- Changes in requirements
- Remediation of existing conditions

Infrastructure

- Include details as appendix
- Roads, railroads, bridges, waterways, ports, airports, water, interconnection, waste disposal

Buyout Option

- Criteria
- Terms and conditions
- Price formula

Transfer of Ownership

- Date and time
- Assets – buildings, structures, equipment, tools, spare parts, supporting offices, camps, compounds, and so on necessary to operate
- Documentation (quantities, language, format, condition)
- Training and information transfer
- Costs of transfer
- Condition of power plant on transfer (overhaul, maintenance, operability)

Force Majeure

- Events
- Notices
- Effect of force majeure on contractual obligations
- Mitigation and relief to parties
- Delays and extensions of time limits

Communications and Notices

- Operating committee
- Coordination meetings
- Communications, reports, and notices

Performance Assurances and Warrantees

- Guarantee by bidder's parent company
- Requirements for sovereign guarantee by Nicaraguan government

- Performance bonds, letters of credit, and so forth

Dispute Resolution

- Resolution process
- International arbitration
- Jurisdiction

Taxes and Duties

- Applicable taxes – income, property, equipment import, VAT, and so on
- Protection from changes in taxation

Other Provisions

- Protection from Change of Law
- Warranty against corruption
- Indemnification
- Assignment, termination, default, abandonment
- Accounting methods, audits, and reporting
- Compliance with laws, regulations, environment
- Insurance requirements

Site Information – An appendix of maps and other pertinent site information.

Geothermal Resource Information – An appendix of summary information and references to reports, data, and analysis.

Scope of Work and Specifications – An appendix with a description of the facilities to be built.

Government Guarantees And Backing – An appendix with the form of a governmental support for the obligations of the Nicaraguan agencies.

Development Models

3.51 It is a long, detailed, complicated and therefore expensive process for a geothermal developer to undertake the development of a greenfield geothermal project from start to commercialization. A few of the more general steps that must be undertaken are outlined herein.

Development Model as it Exists Today

3.52 The following are the basic steps that a private developer will have to undertake in Nicaragua today for a greenfield geothermal development project.

Introduction to Nicaragua – There has to be some reason for an international developer of geothermal energy to initially look at the opportunities in Nicaragua. Often another company owns a concession and needs a partner, or the developer has heard of a good experience from another company, either directly or through presentations at conferences, conventions or through publications.

Existing Data – Compile and review all exploration and geological data that can be found in the public domain, or from a potential partner or whomever is promoting the transaction. The Geothermal Master Plan prepared by GeothermEx is by far the most extensive work done on the resources of Nicaragua, and it references additional sources of exploration information on specific prospect areas. INE can also be contacted to inquire as to the availability of technical data. A thorough review and understanding of the *Ley de Exploración y Explotación de Recursos Geotérmicos No. 443* (November, 2002), and the regulations thereto, is very important at this early time in the development process.

Introductory Trip to Nicaragua – Any experienced geothermal developer will take a trip to Nicaragua very early in the due diligence process. This is invaluable so as to get a general understanding of the political and economic conditions of the country. During this initial trip it is critically important to go to the prospect area and look at the topography, general geology, hot springs and alteration, and associated infrastructure. While on this first trip, a developer will want to meet with potential in-country partners or representatives as well as important officials in INE and the government.

Geothermal Exploration Concession – The law mandates the authority to undertake active geothermal exploration surveys, programs, and operations a geothermal exploration concession. It is a straightforward process to obtain an exploration concession from INE. A developer must submit an application for a concession to INE and the application includes the basic information necessary for the government to understand who is the developer, what is his experience in geothermal development, what he wants to do, and where. An environmental study or plan is not required for the issuance of a geothermal exploration concession.

Exploration – The developer now has the authority to undertake requisite geological, geophysical and geochemical exploration programs and surveys. For any proposed exploration surveys involving surface access or impact a simple environmental report must be submitted to and approved by MARENA.

Results of Exploration Programs – After an extensive exploration program has been completed the results will be analyzed and modeled to determine if there is a high probability of commercial grade geothermal resources. Exploration is an ongoing tool and from time to time the developer will choose to conduct additional surveys and programs on an ongoing basis. At this phase of operations the developer will make one of three decisions:

i. Undertake additional surface exploration programs
ii. Implement a heat flow drilling program
iii. Plan a deep geothermal exploration well

Heat Flow Drilling – A complete heat flow drilling program will be designed and submitted to MARENA for their review. A small rig and equipment will certainly be available in country. Gradient holes will be drilled, completed and measured, and program results will be computer modeled.

Deep Exploration Well (1,000-2,000 meters) – After sufficient exploration and heat flow programs have been completed and analyzed, the developer will make the decision to continue exploration, abandon the project, or drill the first deep exploration well, sometimes termed a wildcat well. Permits will be filed and approved by MARENA; the drilling rig and specialized support equipment must be brought into the country (depending upon availability of a possible rig at either San Jacinto or Momotombo); the well drilled; and if steam and geothermal fluids are encountered then extensive flow testing will be modeled. Depending upon the proposed depth of this first well and logistical access to the drilling site, the first deep test may cost as much as $3 million, or possibly more. One hundred percent of these costs are at the risk of the developer because no bank will collateral or project finance these front-end, high risk costs.

Success versus Dry-Hole – If the first exploration well is a dry-hole then the developer must re-evaluate its program. The developer can undertake additional new exploration and/or repeat the previous technical steps until it decides where to drill a second exploration test well; the alternative is to abandon the project. If the well successfully encounters geothermal resources then the reservoir testing programs will compute what is the "proven" capacity of the resource. Based upon this modeling, the developer may chose to drill additional exploration wells so as to further analyze the capacity and nature of the proven geothermal reservoir.

Proven Geothermal Energy Reserves – After sufficient deep exploration test wells have been drilled and tested the overall proven reserves of the geothermal reservoir will be known. The capacity and projected life of the reservoir now becomes the key asset of the project and plant size and specifications, and project financing will all be based upon these proven reserves.

Exploitation Concession – The holder of a geothermal exploration concession has the "right inherent and preferential" to obtain a geothermal exploitation concession within the same geographical area, once commercial amounts of geothermal energy have been proven. An exploitation concession gives the developer the rights to produce commercial volumes of geothermal resources, but not the right to generate electricity.

Generation License – Once a geothermal exploitation concession has been issued by INE, at that time a developer can begin the procedures for obtaining an electricity generation license (concession). A generation license authorizes its holder to build, own and operate an electrical power plant and to generate electricity.

Power Purchase Agreement – This is now where significant problems and impediments to geothermal development first occur in Nicaragua. At this stage of the project a developer knows the overall capacity and production life of the geothermal resource. It owns the rights to commercially produce this resource and owns a license to generate power. However, until the developer can find an entity to purchase the developed power at acceptable pricing and terms, their investment to date is of no benefit. Power generated in Nicaragua really has only two potential buyers for large amounts of electricity (greater than 25 MW): either Unión Fenosa for distribution domestically; or exported power sold to countries that presently connect into the Nicaraguan national power grid (Honduras and Costa Rica). Under Nicaraguan law Unión Fenosa is allowed to purchase only large amounts of electricity for up to one year without a long term contract. At that time they are mandated to go out for competitive international bidding in order to sign long term contracts. There is no provision under the *Ley de la Industria Eléctrica No. 272* for a power developer to approach Unión Fenosa and directly negotiate a power purchase agreement. Additionally, the creditworthiness of Unión Fenosa is sufficiently weak that international financing institutions will require some sort of government support or backstopping guarantees in order to finance further project development.

Environmental Impact Statement – At this point in project development a complete and detailed environmental impact statement must be prepared and submitted to MARENA for its approval. This environmental program will address such issues as present and future field development, production and disposal of geothermal fluids, power plant construction and operation, and how the environment will be protected at the project site for the ensuing 30+ years.

Project Financing – Adequate resource testing has now been proven and all necessary permitting and power purchase contracting are in place. Negotiations will be undertaken with a large international financial institution, which will probably form a syndicate to place the debt, to project finance the balance of field development and plant construction. Ideally, with 20-30 percent of the project cost invested as equity in the project, the balance of necessary development funds can be collateralized by the assets of the project. Often, the at risk investment in exploration and drilling to date may be sufficient to satisfy the equity piece of the financing. A term sheet commitment will be provided by the financing syndicate.

Political Risk Insurance – Upon putting in place the balance of the project financing package, one of the first tasks is to acquire political risk insurance for the entire project (the developer will have normally secured political risk insurance for its equity at project inception). This is protection of both the developer’s equity capital as well as the balance of funds invested into project completion.

Production Drilling and Field Development – When financing is completely in place, the project now gears up toward completion. On the resource side, generally multiple drill rigs are brought in to drill the overall required number of production and reinjection wells. Ongoing reservoir testing and analysis continues to refine the long term production models as well as continued reinjection testing and modeling. The pipeline collection system is designed and constructed from the well field to the new plant site.

Plant Design and Construction – Simultaneously with field development, the power plant will now be designed and engineered in detail, and the construction process will begin. Plant and turbine design will take into account all the specifications and physical conditions of the geothermal fluids and steam as well as the overall reservoir parameters and characteristics. EPC contracts will be put out for private tender, negotiated and executed. Final engineering will be completed, procurement will take place, construction, and eventually the plant will be completed and tied into the well field collection system.

Ongoing Relations with INE and MARENA – Throughout the entire three to five year development life of a geothermal project, ongoing relations will be maintained (oftentimes on a day-to-day basis) with both INE and MARENA.

Transmission Inter-tie – While plant construction and field development are taking place the transmission line will be constructed tying the plant in with the Nicaraguan national electrical grid.

Commercialization – Upon completion of field development and drilling, construction of the steam collection system, construction of the plant, interconnection with the transmission lines, synchronization of turbines, etc. the power plant will go online and begin the commercial production of electrical power.

Operations – As the plant operates throughout its economic life additional makeup geothermal wells must be drilled, older wells worked over and abandoned, reinjection wells maintained, and routine maintenance and working over of the turbines and the plant undertaken.

Revenue – On a predetermined schedule the developer will invoice the power purchaser and in turn receive regular payments for electricity produced from the geothermal project.

Future Development Model Including SCs

3.53 The following are the basic steps that a private developer may have to undertake in the future in Nicaragua for a greenfield geothermal development project, providing that several of this study's suggestions, ideas and programs are ultimately implemented.

3.54 The following steps, which are represented in *italics,* are identical to the steps discussed in the previous section, "Development Model as it Exists Today." However, those steps which are not printed in italics represent possible new steps, or changes in the future development scheme for Nicaragua's geothermal energy.

Introduction to Nicaragua – GPS suggests CNE consider enhancing efforts to acquaint prospective developers with Nicaragua and any new approaches it takes in the future, including face-to-face meetings with prospective developers together with marketing/promotional presentations at international geothermal conferences and conventions.

Existing Data *– Compile and review all exploration and geological data that can be found in the public domain, or from a potential partner or whomever is promoting the transaction. The Geothermal Master Plan prepared by GeothermEx is by far the most extensive work done on the resources of Nicaragua and it references additional sources of exploration information on specific prospect areas. INE can also be contacted to inquire as to the availability of technical data. A thorough review and understanding of the Ley de Exploración y Explotación de Recursos Geotérmicos No. 443 (November, 2002), and the regulations thereto, is very important at this early time in the development process.*

Introductory Trip to Nicaragua *– Any experienced geothermal developer will take a trip to Nicaragua very early in the due diligence process. This is invaluable so as to get a general understanding of the political and economic conditions of the country. During this initial trip it is critically important to go to the prospect area and look at the topography, general geology, hot springs and alteration, and associated infrastructure. While on this first trip a developer will want to meet with potential in-country partners or representatives as well as important officials in INE and the government.*

Geothermal Exploration Concession *– The law mandates the authority to undertake active geothermal exploration surveys, programs, and operations a geothermal exploration concession. It is a straight-forward process to obtain an exploration concession from INE. A developer must submit an application for a concession to INE and the application includes the basic information necessary for the government to understand who is the developer, what is his experience in geothermal development, what he wants to do, and where. An environmental study or plan is not required for the issuance of a geothermal exploration concession.*

Exploration *– The developer now has the authority to undertake requisite geological, geophysical and geochemical exploration programs and surveys. For any proposed exploration surveys involving surface access or impact a simple environmental report must be submitted to, and approved by MARENA.*

Results of Exploration Programs *– After an extensive exploration program has been completed the results will be analyzed and modeled to determine if there is a high probability of commercial grade geothermal resources. Exploration is an ongoing tool and from time to time the developer will choose to conduct additional surveys and programs, on an ongoing basis. At this phase of operations the developer will make one of three decisions:*

i. *Undertake additional surface exploration programs*
ii. *Implement a heat flow drilling program*
iii. *Plan a deep geothermal exploration well*

Heat Flow Drilling *– A complete heat flow drilling program will be designed and submitted to MARENA for their review. A small rig and equipment will certainly be available in country. Gradient holes will be drilled, completed and measured, and program results will be computer modeled.*

Deep Exploration Well (1,000-2,000 m) *– After sufficient exploration and heat flow programs have been completed and analyzed the developer will make the decision to continue exploration, abandon the project, or drill the first deep exploration well, sometimes termed a* wildcat well. *Permits will be filed and approved by MARENA; the drilling rig and specialized support equipment must be brought into the country (depending upon availability of a possible rig at either San Jacinto or Momotombo); the well drilled; and if steam and geothermal fluids are encountered then extensive flow testing will be modeled. Depending upon the proposed depth of this first well and logistical access to the drilling site, the first deep test may cost as much as $3 million, or possibly more! One hundred percent of these costs are at the risk of the developer because no bank will collateral or project finance these front-end, high risk costs.*

Success versus ***Dry-Hole*** *– If the first exploration well is a dry-hole then the developer must re-evaluate their program. The developer can either undertake additional new exploration, and/or repeat the previous technical steps until they decide where to drill a second exploration test well; or they may decide to abandon the project. If the well successfully encounters geothermal resources then the reservoir testing programs will compute what is the "proven" capacity of the resource. Based upon this modeling, the developer may chose to drill additional exploration wells so as to further analyze the capacity and nature of the proven geothermal reservoir.*

Proven Geothermal Energy Reserves *– After sufficient deep exploration test wells have been drilled and tested the overall proven reserves of the geothermal reservoir will be known. The capacity and projected life of the reservoir now becomes the key asset of the project and plant size and specifications, and project financing will all be based upon these proven reserves.*

Power Purchase Agreement/Standardized Contract – SCs are intended to be offered every 2-5 years by Unión Fenosa and CNE; each would expire if commercial operation is not achieved within five years. This would allow a developer to obtain a 50-100 MW SC/power purchase contract at around the time of proving the reserves from the first exploration well and reservoir test, and then obtaining subsequent SCs as needed. By the design of SCs, these are standardized contracts at either negotiated or fixed pricing, where the geothermal developer will be given preference as a renewable energy source. Once a developer has proven its geothermal reserves, it is a relatively straightforward process to obtain subsequent SCs to match the proven size of the geothermal reservoir. If there is ever a conflict with other applicants, the geothermal developer will have sufficient proven resources to under price any competing projects for additional or new SCs.

Exploitation Concession *– The holder of a geothermal exploration concession has the "right inherent and preferential" to obtain a geothermal exploitation concession within the same geographical area, once commercial amounts of geothermal energy have been proven. An exploitation concession gives the developer the rights to produce commercial volumes of geothermal resources, but not the right to generate electricity.*

Generation License *– Once a geothermal exploitation concession has been issued by INE, at that time a developer can begin the procedures for obtaining an electricity generation license (concession). A generation license authorizes its holder to build, own and operate an electrical power plant and to generate electricity.*

Environmental Impact Statement *– At this point in project development a complete and detailed environmental impact statement must be prepared and submitted to MARENA for their approval. This environmental program will address such issues as present and future field development, production and disposal of geothermal fluids, power plant construction and operation, and how the environment will be protected at the project site for the ensuing 30+ years.*

Additional SCs/PPAs – Depending upon the proven size of the geothermal reservoir, the developer may apply for additional SCs in subsequent "calls" as needed.

Project Financing *– Adequate resource testing has now been proven and all necessary permitting and power purchase contracting are in place. Negotiations will be undertaken with a large international financial institution, who will probably form a syndicate to place the debt, to project finance the balance of field development and plant construction. Ideally, with 20-30 percent of the project cost invested as equity in the project, the balance of necessary development funds can be collateralized by the assets of the project. Often, the at risk investment to date of exploration and drilling may be sufficient to satisfy the equity piece of the financing. A term sheet commitment will be provided by the financing syndicate.*

Political Risk Insurance *– Upon putting in place the balance of the project financing package one of the first tasks is to acquire political risk insurance for the entire project (the developer will have normally secured political risk insurance for its equity at project inception). This is protection of both the developer's equity capital as well as the balance of funds invested into project completion.*

Production Drilling and Field Development *– When financing is completely in-place, the project now gears up towards completion. On the resource side, generally multiple drill rigs are brought in to drill the overall required number of production and reinjection wells. Ongoing reservoir testing and analysis continues to refine the long* *term production models as well as continued reinjection testing and modeling. The pipeline collection system is designed and constructed from the well field to the new plant site.*

Plant Design and Construction *– Simultaneously with field development the power plant will now be designed and engineered in detail, and the construction process begun. Plant and turbine design will take into account all the specifications and physical conditions of the geothermal fluids and steam as well as the overall reservoir parameters and characteristics. EPC contracts will be put out for private tender, negotiated and executed. Final engineering will be completed, procurement will take place, construction, and eventually the plant will be completed and tied into the well field collection system.*

Ongoing Relations with INE and MARENA *– Throughout the entire three to five year development life of a geothermal project, ongoing relations will be maintained (often times on a day-to-day basis) with both INE and MARENA.*

Transmission Inter-tie *– While plant construction and field development are taking place the transmission line will be constructed tying-in the plant with the Nicaraguan national electrical grid.*

Commercialization *– Upon completion of field development and drilling, construction of the steam collection system, construction of the plant, interconnection with the transmission lines, synchronization of turbines, etc. … the power plant will go online and begin the commercial production of electrical power.*

Operations *– As the plant operates throughout its economic life additional make-up geothermal wells must be drilled, older wells worked-over and abandoned, reinjection wells maintained, and routine maintenance and working-over of the turbines and the plant.*

Revenues *– On a predetermined schedule the developer will invoice the power purchaser and in turn receive regular payments for electricity produced from the geothermal project.*

Future plant and project expansions – With the availability of an SC program the developer can acquire additional SCs in future years after the project has gone into commercial production. As new wells are drilled and tested, and the reservoir has established a proven production history, the developer will have the option of expanding the project through the means of obtaining future SCs.

4

Strategy and Plan for the Promotion of Geothermal Resources

Introduction

4.1 Reports and studies such as are being undertaken for the Energy Strategy Management Assistance Program (ESMAP) find their real value when they can be implemented in the real world and their most pertinent and valuable recommendations can be put into effect. With this in mind, the attempt is to formulate a program that is both constructive and can be readily implemented.

4.2 The previous chapters of this study have outlined what other countries are doing to promote private investment in geothermal energy; what the incentives and impediments to geothermal development are currently in Nicaragua; a brief look at Nicaragua's specific geothermal resources and opportunities; and what can be done to make private investment in Nicaragua's geothermal industry more attractive to international developers and financiers. The purpose of this final chapter 4 is to suggest a plan for implementing the proposed changes and steps that will lead to investment in and expansion of geothermal energy projects in Nicaragua.

4.3 In this section GPS suggests how the political and governmental resources of Nicaragua might be mobilized and directed toward three simultaneous strategies as a way to quickly get significantly more private investment in geothermal development. The company believes these three areas for implementing geothermal promotion should be:

a. Strategy and policy for drafting and implementing new legislation in the Asamblea Nacional (parliament)

b. Promotion and marketing of Nicaragua's geothermal opportunities to the international development and financial communities

c. Exploring the possibilities for marketing and sales of Renewable Energy Credits to countries that could use credits to achieve compliance with the emissions requirements of the Kyoto Protocol

4.4 GPS's proposed implementation program includes the following:

Energy Policy Changes

4.5 There are three principal areas that need immediate and substantive changes or additions to Nicaragua's national energy policy. These would include i) changes in the tax laws, ii) establishing Renewable Portfolio Standards, and iii) mandating a Standard Contract power purchase program.

4.6 The tax law changes and the RPS are not both necessary, but one or the other is necessary in order to incite the development of renewable energy sources, rather than continuing to use fossil fuels. While not necessary, it would be possible to implement both the tax law changes and an RPS program.

Changes in the Tax Law

4.7 As discussed in paragraph 2.107-2.110 in chapter 2, there is inequity in taxation between fossil fuel generation and renewables, including income tax, property tax, and other taxes such as the equity tax. Unless an RPS is established, equity in taxation must be accomplished through a combination of law changes or tax credits and other benefits such as depletion allowances. A detailed study of all taxes should be completed to determine how best to provide tax parity between technologies before making appropriate adjustments. A few sample ways that parity can be accomplished are provided below:

4.8 The Nicaraguan Asamblea should review the ramifications of the equity tax law as they impact renewable energy development; one of the principal goals in the implementation of this study is for the Asamblea to waive the equity tax law as it applies to the assets of renewable energy projects.

4.9 In light of municipal infrastructure improvements that are already necessary for the development and construction of geothermal projects, the municipality tax should either be repealed or significantly reduced. As a further stimulant to renewable energy investment, it is recommended that import duties be waived on geothermal development and construction for the life of the project.

4.10 The petroleum and mining industries have tax benefits allowing for depletion of the mineral resources. It is recommended that a new addendum be drafted to the Nicaraguan tax codes granting depletion allowances to geothermal resources.

4.11 Though technically a Granting Right fee for an electrical power-generating license would not be considered a change in the tax laws, it is still an important issue when looking at the economics of geothermal development. Paragraphs 2.88-2.91 in chapter 2, Generation License*,* discuss in detail both the required Granting Right fee and the guarantee bond, which must be paid to the government prior to issuing a generation license so a developer can begin generating power. Since both these fees are percentages of the tangible asset base of a project, renewable energy sources generally will pay more than twice the fees of a standard thermal venture. The Granting Right fee for a 50 MW geothermal plant could be as high as $135,000, with the guarantee bond exceeding $1.3

million. The law needs to be amended for renewable energy projects whereby these fees are cut by more than 50 percent, which would bring them on a par with thermal projects.

4.12 Duties are typically levied on imported goods. However, exceptions are common when a country is trying to attract capital-intensive foreign investment. Eliminating such duties would reduce the initial investment by the developer, thereby decreasing its risk, insurance costs, and administrative efforts. The elimination of the duties should reduce the costs that Nicaraguans must pay for electrical power from the projects.

Renewable Portfolio Standard

4.13 GPS recommends that the Asamblea Nacional enact new laws establishing an RPS for the reasons presented in chapter 3 under the heading, "Renewable Energy Credits and U.S. Development". Such standards are typically the percentage of the energy supply that must be supplied by renewable sources for years in the future. From a review of the energy generation sources in Nicaragua it is the company's recommendation that these laws reflect a goal that 30 percent of Nicaragua's electrical generation be from renewable energy sources by the year 2006, and a level of 40 percent be achieved by 2013. CNE will want to review GPS's recommendation and supply its own recommendations for RPS levels. Perhaps CNE should be chartered with the task of establishing the RPS levels for up to 20 years hence.

4.14 The standards must be written in such a way that development is shifted from non-renewable to renewable technologies in an achievable schedule. The definition of "renewable" must also be carefully stated to achieve the desired result.

"Standard Contract" Power Purchase Agreements

4.15 The weakest link in Nicaragua's geothermal development process continues to be in obtaining long-term power purchase contracts. Legislation should be drafted and lobbied through the political process in order to enact the Standard Contract program into law as previously outlined in chapter 3 under the heading, "Standard Contracts". This new Standard Contract legislation, combined with changes to Nicaragua's tax code, and implementing RPS, will immediately impact positive incentives for the private investment in geothermal development.

Supplemental Changes Needed in Nicaragua

4.16 A significant obstacle to geothermal development in Nicaragua involves land use. Geothermal development will be severely impeded if the Nicaraguan government enacts the decrees that expand many of the existing nature preserves and establish the proposed national parks and the municipal parks without provisions that allow for geothermal development. A review of the discussions in paragraph 2.73-2.76 in chapter 2, "Summary of Revised Resource Projections" reveals that virtually all ten of Nicaragua's prime geothermal development areas lie within lands that have existing or pending legislation to expand them into national parks or nature reserves. Geothermal development and production can be done with minimal environmental impact, as in

Kenya at Olkaria. Meetings should be held immediately with members of the Asamblea as well as those environmental groups promoting the legislation for these set-aside lands, and plans must be made for joint land use with geothermal development or realign the projected boundaries of these reserves such that the prime geothermal drilling targets can be drilled and surface construction take place.

4.17 The previously mentioned actions and tasks are by far the most critical when it comes to energy policy and strategy for attracting new private investment in Nicaragua's geothermal industry. However, there is still the need for supplemental changes to further enhance the geothermal development process in Nicaragua, including the following:

- Streamlining the permitting and concession process
- Re-evaluation of the *normativas* to the *Ley de la Industria Eléctrica*
- Changing INE's focus from that of a regulator to a facilitator
- Government funding of additional exploration, drilling and resource evaluation

Gaining the Commitment of Political Leaders and Individuals

4.18 The very first action in the implementation phase of this project is to write up a policy statement describing the government's promotion of geothermal energy. This document should very briefly lay-out the unlevel playing field problems as discussed in the previous sections and explain that the way to rectify this problem is through a promotional program combining tax relief, RPS and a Standard Contract program.

4.19 One of the first actions to begin implementing the policy statement and geothermal promotional program is to have a private meeting with the President of CNE. At this meeting all of the aspects of the overall promotional program that are being proposed herein, including energy policy legislation, promotion of Nicaragua's geothermal resources to the international development and finance communities, and the marketing of Renewable Energy Credits, should be discussed. It is important to get the CNE President's advice and comments on how to proceed with the implementation from practical and political perspectives. In the course of initial meetings with the CNE President, his personal commitment to geothermal development in Nicaragua must be solicited as well as his pledge to promote these implementation efforts to other political leaders in the government.

4.20 Immediately upon getting the commitment of the CNE President, with his help, assistance and direction the following leaders must then be approached:

President of the Republic
Minster of Hacienda
Vice Minister of Hacienda
President of INE
President of the Consejo Superior de Empresas Privadas (COSEP)
Any other political and business leaders as suggested by CNE

4.21 The above leaders should each be presented with the same agenda that was outlined and discussed with the CNE President. In addition to obtaining their advice, direction and personal commitments of support, it is advised to have a public campaign of press conferences and short, compelling advertisements on television and radio to show their commitment to geothermal energy and other renewables.

4.22 In all of these discussions with these leaders it is essential to gain their commitment for what is needed for geothermal development. The current administration must get the most from the public relations exposure and all of the political positive benefits from this public promotion while others work on the actual implementation.

Drafting Legislation and Lobbying

4.23 The specific changes and actions that GPS recommends to the Asamblea Nacional involve adding, repealing, or changing legislation, including the following:

- Waiver of the tax equity law as it applies to renewable energy projects
- Repeal of the geothermal municipality tax
- Suspension of all import duties for the duration of construction and development of geothermal projects
- Equalizing income tax impacts (if no RPS is to be established)
- Providing geothermal depletion allowances
- Creating renewable portfolio standards for the nation
- Establishing a Standard Contract program
- Reducing the Granting Right fees and size of the guarantee bond for the electricity generation license
- Some sort of joint land use or set-aside lands for geothermal development adjacent to proposed national parks and nature preserves

4.24 Rather than make these into several separate pieces of legislation that must be written, lobbied through, and debated in the Asamblea individually, GPS recommends that they all be incorporated into one piece of legislation in which a much more focused and stronger political lobby can be directed. The company's preference would be to make all of these changes as an addendum or an amendment to the existing geothermal law. However, the Bolaños administration may want to consider writing and promoting an entirely new *Ley de Equidad para Energía Recursos Geotérmico y Renovables* (or "Geothermal and Renewable Energy Resource Equity Law"), or possibly something such as the *Ley Desarrollo de Recursos Renovables* (Renewable Resources Development Law) to stimulate renewable development and within which all of the proposed changes, additions and waivers can be incorporated.

Promotional Plan for Geothermal Opportunities in Nicaragua

Streamlining the Process

4.25 A simple program should be outlined for streamlining the entire permitting and concession process for geothermal energy development. This could include setting up a small, efficient organization within INE to administer the permitting and concession process, provide information to inquiries, communicate with interested parties, collect information, coordinate dissemination and receipt of forms, permits and applications and basically to handle all liaison with developers who are inquiring as to geothermal development projects.

4.26 The first phase of this streamlining process would be to hold meetings and discussions with CNE, INE and MARENA,discuss the outlined streamlining process, and walk everyone through the procedures. These ministries' input, comments, objections, and so forth must be taken into account while finding consensus in the overall process.

4.27 Once the new streamlining process has been reviewed and approved by CNE, INE and MARENA it is unclear as to if it is merely accepted into policy and implemented, or if it must now go through a legislative amendment or *normativa*-type procedure.

International Promotion of Nicaragua's Geothermal Opportunities

4.28 Over the past couple of years INE's Dirección General de Hidrocarburos (INE-DGH, its petroleum group) put together an extensive promotional campaign to interest international petroleum exploration and development companies in tendering offers for oil and gas concessions in Nicaragua. INE-DGH did a professional job in marketing Nicaraguan oil & gas opportunities to entice companies to compete for petroleum concessions. It held introductory seminars in Managua, contracted for seismic and exploration technical surveys, sold data packages, opened up a data room for all interested parties, put advertisements in international trade journals, went on several trips making promotion presentations, often referred to in financial communities as a road show, to major oil industry cities in North America, Europe and South America, and presented papers at international petroleum meetings and conferences. The result of this promotional campaign is that four independent international petroleum companies submitted tender offers on more than 2,300,000 hectares (greater than 5 million acres) of petroleum concessions (off-shore Caribbean, off-shore and on-shore Pacific) with bonded commitments of investments over $25 million in exploration and drilling over the next few years. And these bonded commitments are in advance of the discovery of commercial petroleum reservoirs.

4.29 Since these sorts of promotional tools were utilized with such excellent success in an industry with little proof of commercial resources in Nicaragua, the success in promoting proven geothermal resources should be even greater.

Promotional Materials

4.30 As part of INE-DGH's promotional campaign, a series of materials were professionally prepared. These principally outlined the key clauses of Nicaragua's petroleum law plus the geological and drilling history of the country. They were prepared in English to attract a wide audience. GPS recommends that CNE prepare similar materials as part of the geothermal promotional campaign.

4.31 These materials should include brochures, position papers or white papers, instructional guides, etc. that should be produced in digital format for distribution through web sites, emails, CD-ROM, and other electronic media as well as paper versions, as needed. Electronic versions can be produced, maintained, and distributed for a fraction of the cost and effort associated with paper materials.

4.32 A brochure should focus on the geology and geothermal resources of Nicaragua with a brief history of geothermal exploration, development and commercialization over the past twenty years. Of course, several graphs, tables and photographs should be included as well.

4.33 Another brochure might highlight section-by-section both Nicaragua's geothermal law and electric industry law. This brochure could also touch upon legislation currently in the Asamblea Nacional and how it will potentially effect geothermal and renewable energy development, such as tax equalization and RPS legislation.

4.34 Guidelines should be produced to show developers the steps to take to obtain a concession and proceed with development. They should include all of the contact information, references to appropriate laws, and so on. The legislation relating to the development of renewables should be available as PDF files for download.

4.35 The government should publish one or more white papers describing the benefits of using renewable energy sources, why development has not occurred, and what should be done to promote development.

4.36 Additional materials could be prepared outlining required permitting, concessions and licensing and even discussing the overall development process and procedures that will be necessary in Nicaragua.

Managua Conference – "Introduction of Nicaragua's Geothermal Development Opportunities"

4.37 One of the key promotional tools to re-introduce Nicaragua to the international geothermal community will be a two-day conference in Managua. The sole purpose and intention of this conference is to once again introduce private geothermal development opportunities to international developers, financial institutions, and anyone potentially interested in investing in geothermal energy in Nicaragua. This opportunity will be used to officially begin the new geothermal promotional campaign of the government, with perhaps a new logo and slogan.

4.38 The conference should: 1) show that Nicaragua is strongly committed to developing its geothermal resources, 2) explain the steps for developers to take, 3) show the information that is available, and 4) solicit interest and feedback from the attendees.

4.39 GPS recommends that the first day of the conference be held at one of Managua's best hotels and suggests presentations by:

- President of the Republic

  Presents a welcome and keynote address showing the country's commitment to geothermal development and renewable energy.

- President of CNE

  Introduces the promotional campaign, slogan, logo, and the government's programs to develop geothermal energy.

- A representative of INE

  History of geothermal development in Nicaragua.

- GeothermEx, Inc.

  Geothermal Master Plan study and geothermal resource potential of Nicaragua.

- Global Power Solutions, LLC

  The step-by-step process for developing a geothermal project in Nicaragua, including permitting and concessions, licenses and contracts.
  Introduction of the Standard Contract power purchase program and its function.
  Discussion of Renewable Energy Credits

- A representative of MARENA

  Environmental requirements and permitting.

- Minister or Vice Minister of Hacienda

  Tax ramifications of geothermal energy in Nicaragua and legislation presently working its way through the Asamblea Nacional.

- A representative of a major international bank

  Financial tools, risks, and what banks would be looking for in Nicaraguan projects.

- A representative of a political risk lender

  Financial tools, risks, and what banks would be looking for in Nicaraguan projects.

- Centro Nacional de Despacho de Carga

  Present the status and potential of SIEPAC and what it will mean to future power generation markets throughout Central America.

4.40 In the evening after the first day of presentations and meetings there will be a reception that will be attended by major Nicaraguan leaders and policy makers, as well as the attendees of the conference, and members of the press. The intention of this reception will be to give the attendees (potential investors) an opportunity to introduce themselves and casually visit with Nicaragua's decision makers and get their opinions regarding future geothermal opportunities.

4.41 The second day of the conference will be a field trip to various geothermal sites in Nicaragua, giving the attendees the opportunity to see existing geothermal development and prospective sites for future development. The field trip will visit Volcán Masaya, show the Cordillera de los Marrabios, the Momotombo geothermal field and plant, the well field at San Jacinto (including a blow-down test of the 20 MW well SJ-4) and briefly drive through the geothermal prospect areas of Masaya/Apoyo/Mombacho, Chiltepe, El Hoyo-Monte Galán, Momotombo, San Jacinto, El Ñajo, and San Cristóbol.

4.42 This conference should be open to the public and announcements should be placed in professional journals and on websites throughout the world. However, personal invitations should be extended to major international geothermal developers and financial institutions, which should include:

Ormat International
Enel-Italy
Gesal (Geotérmica Salvadoreña)
CalEnergy Company
Calpine Corporation
Marubeni Corporation
Davenport Resources, Ltd.
Chile/ENAP investment group
Deutsche Bank Capital Partners
Energy Investment Fund – Dresdner
West Japan Engineering Consultants

4.43 One month after this conference there should be direct and personal follow-up contacts with all the attendees and corporations in order to answer questions and further stimulate interest in Nicaragua's geothermal development opportunities.

Promotional Presentation

4.44 Most international financings include a promotional presentation where promoters of the investment entertain prospective participants in selected cities with a meal and short presentation, followed by a question and answer session.

4.45 The geothermal promotional campaign should replicate what INE-DGH has previously done to entice interested international investors and developers to the petroleum concessions of Nicaragua. Information presented at the two-day Managua promotional conference should be condensed down to a concise, efficient two hour presentation for presentations in selected cities.

4.46 These promotional presentations should then be offered in selected cities such as New York, San Francisco, Tokyo, London and Rome with specific individual companies, financial institutions, and investment groups personally invited to attend. The intention would be to keep each audience small enough to gain familiarity and intimacy with the attendees. Even with a small group in attendance, some attendees will be reluctant to divulge their intentions or discuss key details in front of their competitors. This would make it attractive to schedule private meetings with each key organization.

4.47 This presentation will be further abbreviated and condensed and presented at international conferences and symposiums for the geothermal industry, renewable energy, power conferences, and if applicable to meetings of the World Bank, IMF, OAS, and so on. It may be advisable to present papers or set up trade show booths at several international petroleum conferences and trade shows as well. We strongly recommend the annual meeting of the Geothermal Resources Council, held in the autumn each year. (More information about the meeting is available at http://www.geothermal.org/meet.html) GPS recommends that appropriate individuals attend that meeting to meet developers, gather information, distribute preliminary promotional materials, and show a presence to the geothermal community.

Other Promotional Tools

4.48 GPS recommends a website be set up to focus on promoting Nicaragua's geothermal development opportunities. It could be an expansion of the INE or CNE website or linked to those sites. These websites could make available much information, including geothermal reports, standard contracts, laws, concession application forms, resource overviews, maps, persons to contact, and so on. The user should be able to view and download the information on the site. This medium is vital in today's world of e-commerce and it shows an astute and modern commitment by Nicaragua to the international investment and development community. Other promotional tools might include articles and advertisements in international trade journals for the energy industry, geothermal industry, Latin Trade, and so on.

4.49 GeothermEx's Geothermal Master Plan can be converted into an electronic format (such as Adobe's PDF) and made available to interested parties who might wish to purchase it for a nominal price. INE-DGH offered to sell petroleum data packages of geological, seismic, exploration and drilling data which ranged in price from a few thousand dollars up to complete packages as high as $65,000. Similarly, this could be done for the Geothermal Master Plan, although GPS believes that $65,000 is probably more than most geothermal developers might be willing to spend.

4.50 The support of the citizens of Nicaragua is an important part of the country's geothermal development. Nicaragua's geothermal resources are owned by, and are for the ultimate benefit of, the people of the nation. There should be domestic promotional advertisements, press releases, and interviews on television, radio, the Internet, and in the printed press.

4.51 GPS recommends that a booth be set up at the GRC meeting, where key individuals could talk with potential developers and materials could be distributed. This would demonstrate a commitment to the geothermal power industry.

International REC Marketing

4.52 As discussed in chapter 3., though the marketing, sale and trading of Renewable Energy Credits may be a new concept to Nicaragua, it is becoming readily accepted throughout the world and international power development communities. All of the potential development parties who will express an interest in Nicaraguan investment likely already understand the benefits, politics and markets for the sale and acquisition of green tags.

4.53 Working with the World Bank, CNE should first investigate the market for selling geothermal RECs to countries signatory to the Kyoto Protocol. GPS recommends that CNE work with the World Bank, to investigate sales mechanisms, including ways to perhaps monetize or capitalize this valuable benefit, perhaps through loans or grants, such as the government of the Netherlands is offering through the International Finance Corporation wing of the World Bank.

REC Supply and Demand

4.54 GPS recommends a program of identifying which Kyoto signatory countries are out of compliance with targeted reductions and investigate the potential for selling REC benefits to the candidate country. There are 35 countries attached to the Kyoto Protocol and referred to as the Annex I Countries. While not all of these 35 countries have ratified the Kyoto Protocol, many have.

4.55 Of the Annex I Countries, 25 of them need to reduce their carbon dioxide equivalent emissions by a total of 2,697 million metric tons by the year 2013, in order to come into compliance with the Kyoto Protocol. Apparently, only nine of the Annex I Countries have excess RECs available for purchase, and these merely total an estimated 403 million metric tons of carbon dioxide equivalents.

4.56 Those Annex I Countries which need to considerably reduce their levels of CO_2 equivalent emissions (or purchase RECs) include:

United States at reductions/purchases of 1800 million metric ton equivalents
Japan at 310 million metric ton equivalents
Both Canada and Poland each at 130 million metric ton equivalents
Australia at 90 million metric ton equivalents
United Kingdom at 45 million metric ton equivalents
Netherlands at 27 million metric ton equivalents

4.57 The only three Annex I Countries with significant RECs available (the other six Annex I Countries with available RECs have very small amounts) are Ukraine (175 million metric ton equivalents), Russia (100) and Romania (80).

Nicaragua REC Marketing Plan

4.58 Following discussions with the World Bank and gaining insight they may be able to provide, GPS recommends contacting consulates of the candidate Kyoto signatory countries that might be in the market to purchase RECs. Countries such as Japan, which market geothermal steam turbines (made by Fuji Electric, Mitsubishi Heavy Industries and Toshiba) and other geothermal plant components, may see the synergy of buying RECs, while at the same time selling products and services to the project(s). This would allow them to not only help meet the Kyoto commitments, but also increase their foreign trade at the same time.

Implementation of Recommendations

4.59 The following is a step-by-step outline of the specific actions and responsibilities it is going to take to implement the programs which have been outlined in chapter 4. Further, Appendix C is a chronogram showing these tasks, the approximate amount of time which will need to be committed to each assignment, and a timeline over the next nine months showing when each step may be undertaken.

Step 1 - Financing

Obtain financing for this implementation and promotional program from non-governmental financial organizations such as the World Bank, IMF, and IADB.

Coordination with the Bolaños Administration

Step 2 - Policy Statement

Draft the policy statement (or white paper) for the implementation/promotional program.

3 - Meet with the President of CNE

Private meeting with the President of CNE to discuss the entire program, receive his input and suggestions, and obtain his approval.

4 - President Bolaños and his Economic Cabinet

The same as Step 3, but to obtain the input and commitment of the President and his cabinet.

5 - Minister or Vice Minister of Hacienda

Same as Step 3.

6 - President of INE

Same as Step 3.

7 - President of COSEP

Same as Step 3.

8 - Press Releases

Follow-up press releases of government commitment for geothermal energy.

Geothermal and Renewable Energy Resource Equity Law

9 - Asamblea Committee

First submit written Policy Statement and then meet with the appropriate committee(s) of the Asamblea to discuss the necessary track for drafting, lobbying and passing the law.

10 - Draft Explanation of Intent

Write-up the Explanation of Intent as the introduction to the law, utilizing the Policy Statement as the foundation document.

11 - Draft Text of the Law

Develop the text for the draft new law.

12 - Submit to the Economic Cabinet

Submit the drafts of the Explanation of Intent and the text of the law to the Economic Cabinet for their input and comments.

13 - Submit to the Appropriate Asamblea Committee

Submit the drafts of the Explanation of Intent and the text of the law to the appropriate committee(s) in the Asamblea, for their input and comments.

14 - Interface

Ongoing interface with committee members, Asamblea members at-large, members of the Bolaños administration, environmental groups, and interested parties in general – making sure input is obtained and questions are answered.

15 - Re-Draft

Take the comments and input from the Economic Cabinet and the Asamblea committee and re-draft the Explanation of Intent and the text of the law, as needed.

16 - First Vote

Send the bill to the floor of the Asamblea Nacional for the first vote.

17 - Back to Committee

Based upon the debate on the floor of the Asamblea, and the Asamblea's comments and recommendations thereto, make the suggested changes to the bill and send it back to committee for revision.

18 - Second Vote

Send the bill to the floor of the Asamblea for a second vote. Assuming the motion/bill is carried it then continues along the legislative process into law.

19 - Signed by the President

President Bolaños signs the bill.

20 - La Gaceta

The bill becomes law immediately upon its publication in La Gaceta, the daily periodical of the government.

21 - Draft the Normativas to the New Law

The *normativas* are the regulations to the law. They describe how the law will mechanically function and be implemented. In reality, they are probably more definitive and detailed than the law itself.

22 - Repeat above Process specifically for the Normativas

Steps 11 through 20 will be repeated for the drafting and passing of the *normativas* to the Geothermal and Renewable Energy Resource Equity Law.

23 - Normativas into Law

Once they have been passed by the Asamblea, signed by the President, and published in La Gaceta, then the *normativas* to the new bill are considered law as well.

Streamlining the Permitting and Concession Process

24 - Outline

Draft an outline of how the overall permitting and concession process is proposed to be streamlined.

25 - Meetings with CNE, INE, MARENA

Hold discussions and meetings with CNE, INE, and MARENA and walk through the proposed streamlining process. Obtain their input, comments, objections, and so on. Secure their support for the proposed streamlining.

26 - Re-Draft Outline

After receiving CNE's, INE's, and MARENA's input and support, redraft the overall outline of the streamlining process.

27 - Approval from CNE, INE, MARENA

Get their approvals and commitments to the overall process.

28 - New Policy

Once the entire streamlining process has been drafted and approved by the necessary agencies it is unclear as to if it is merely accepted into policy and implemented, or whether legal amendments will be required.

29 - Amendment or Normativas

Determine if the plan for streamlining must now go through a legislative amendment or *normativa* procedure. In the alternative, Steps 24-29 could be performed early in the overall process, so that any required legislation could be included in the Geothermal and Renewable Energy Resource Equity Law process described above.

Geothermal Promotional Campaign

30 - Outline Managua Promotional Conference

Prepare a detailed outline/plan for a two-day conference in Nicaragua to introduce and promote Nicaragua's geothermal opportunities.

31 - Obtain Financing

Obtain financing for the conference[15] from NGOs. The intent is to have attendees cover no more than their travel arrangements to/from Nicaragua, and hotels and meals in country.

32 - Conference Logistics

Plan and setup all necessary logistics for the conference and field trip.

33 - Speakers

Invite and confirm speakers. The majority of speakers will already be associated with the geothermal promotional campaign.

[15] A recent, similar regional conference was held in April in Nairobi, Kenya related to East African geothermal development opportunities. Many NGOs may wish to see that the conference is a regional one rather than just for Nicaragua, so this condition on funding may need to be evaluated.

34 - Advertising

Advertise and promote the conference in professional trade journals and geothermal, petroleum, and renewable energy industry publications.

35 - Registration and Private Invitations

Begin the registration process at-large. Several private invitations will be solicited and personally promoted to the larger international developers.

36 - Conference and Field Trip

The two-day conference and field trip will be held.

37 - Follow-Up

About a month after the conference, individual, one-on-one contacts will be made with each of the attendees to get their feedback on the conference and find out what can be done to further enhance their interest in Nicaraguan geothermal development.

38 - Draft Brochures and Materials

Draft promotional materials and brochures highlighting the geothermal resources of Nicaragua, laws and permitting, in-country procedures for development, and so on.

39 - Input from CNE, INE, MARENA

Go to CNE, INE, and MARENA for their input and comments on the promotional materials.

40 - Printing

Upon approval from the various ministries, have the promotional materials printed.

41 - INE-DGH Promotional Presentations

Hold working meetings with INE-DGH so as to get all their professional experience as to putting together international presentations for Nicaraguan geothermal energy.

42 - Planning the Promotional Presentations

Detailed planning of the promotional presentation logistics.

43 - Prepare Presentation

Prepare the complete presentation, PowerPoint™ and graphics.

44 - Schedule Appointments

Contact potentially interested parties and set up appointments with specific companies and groups in designated cities.

45 - Travel Arrangements

Make travel plans, reservations, and coordinate logistics.

46 - Promotional Presentations

Make the promotional presentations in selected cities, such as New York, San Francisco, Tokyo, London and Rome and/or make numerous private and semi-private presentations.

47 - Follow-Up

Around one month after the promotional presentations are completed, make individual, one-on-one contacts to find out what can be done to further enhance interest in Nicaraguan geothermal development.

48 - Prepare Print Advertising

Prepare the print advertising campaign to promote geothermal development in Nicaragua, what is available, and announce the Managua conference and the promotional presentations.

49 - Publish Advertising Campaign

Publish the advertising campaign in professional journals and symposium/conference announcements throughout the world. Consideration should be given to supplying an article for the Geothermal Resource Council's *Bulletin* and/or including an advertisement, together with publications of the International Geothermal Association (see also http://iga.igg.cnr.it/index.php) such as its quarterly *Newsletter*.

50 - Speakers to International Conferences

Send speakers to numerous international conferences on geothermal and renewable energy. Present an abbreviated version of the promotional presentation to continue promoting Nicaraguan geothermal development.

51 - Website

Design, build and implement a special website specifically targeted at promoting geothermal development in Nicaragua. This can either be a standalone, independent website or a link to, or part of the existing CNE and INE websites.

52 - Data Packages

Outline a plan for the packaging and selling of data and information packages. This would be a mechanism to sell the Geothermal Master Plan to the industry at nominal cost.

53 - Promotion and Sales

Promote the availability and sales of data packages through the printed advertising campaign, at the Managua conference and during promotional presentations and international conferences.

54 - Domestic Promotion

Promote the entire geothermal development campaign to the people of Nicaragua through local television and radio, news programs and in the press. Do not lose sight of who this entire energy development campaign targets.

International REC Marketing

55 - Explore Marketing RECs

Explore the possibilities for marketing and sales of Renewable Energy Credits to countries that could use credits to achieve compliance with the emissions requirements of the Kyoto Protocol.

56 - World Bank Monetizing RECs

Work the World Bank to investigate sales mechanisms, including ways to perhaps monetize or capitalize this valuable benefit, perhaps through loans or grants, such as the government of the Netherlands is offering through the International Finance Corporation wing of the World Bank.

Appendix A

History and Future of Philippine Geothermal Development

Philippines

Present and Future Geothermal Development in the Philippines - Part 1 –Nazario C. Vasquez, Samson P. Javellana and Hermes P. Ferrer, PNOC Energy Development Corporation (PNOC-EDC),

The Philippines has a considerable number of high quality geothermal resources. These are all island arc volcanic systems as typically found in the Circum-Pacific region and show close similarities with geothermal systems in Indonesia and Japan. All the fields drilled to date are liquid dominated in the natural state, with or without two-phase conditions in the central parts. Maximum temperatures in these systems tend to be high, in the range of 300 to 340°C. Fracture permeability is invariably dominant over primary permeability. The most exploitable of these systems are found in mature volcanic complexes that over geologic time have reacted out acidic volcanic gases derived early in their genesis, from degassing magmatic intrusives. A number of younger volcanic systems are still influenced by acid gases and are considered nonexploitable within the limits of today's technologies.

Philippine geothermal fields are all associated with volcanism developed above trench and subduction zone systems. From north to south, these trench systems and volcanic belts include the following:

1) The Manila trench lying to the west of Luzon has an associated on-shore volcanic belt ranging from the Cordilleras in northern Luzon to Mt. Mariveles west of Manila. The highly productive Makiling-Banahaw geothermal field is located at the southern end of this belt. Elsewhere to the north, there are a number of high temperature geothermal prospects that have not yet been developed due to poor permeability, and, in the case of Mt. Pinatubo, the presence of pervasive acidic and magmatic fluids.

2) The Philippine trench running parallel to the eastern coasts of Luzon, Samar and Leyte defines several major onshore volcanic belts which host the biggest geothermal developments in the Philippines. These include the Tiwi and BacMan fields in southern Luzon and the Greater Tongonan geothermal field in Leyte.

3) The Negros trench to the west of Negros Island also defines a volcanic belt. This is composed of the mature and dissected volcanic complex of Cuernos de Negros in Southern Negros, where we have developed the Palinpinon geothermal field, and the active Canlaon Volcano in Northern Negros where we are now undertaking development activities.

4) In Mindanao, there are several trench and subduction zone systems. The most significant of these systems is an extension of the Sangihe volcanic arc from Indonesia northwards into central Mindanao. Volcanic activity on this arc has given rise to the Mt. Apo volcanic complex, where we are in the late stage of developing the second 52 MWe power facility.

The widely distributed nature of the geothermal resources in the Philippines has long been an impediment to geothermal power development. With the exception of Makban, the most productive fields are all located at considerable distance from the major load centres of Manila and Cebu, and are frequently isolated from these markets by sea passages. However, a series of inter-island submarine EHV transmission projects is now complete which links the Visayan islands to Luzon via a hub in Leyte, and provides a much increased market for geothermal power in the Philippines.

With over 20 years of experience in geothermal development and power generation, the geothermal industry in the Philippines is now in a mature state. We currently have 1848 MWe of installed geothermal power capacity. Later this year, this will increase to 1900 MWe as we commission an additional 52 MWe of plant, which is now in the late stage of construction. With this level of capacity, we now lead the world in terms of wet steam field capacity, and we rank just behind the US in terms of geothermal power generation.

Clearly this amount of development has taken a lot of effort and involved a lot of history. The following events have represented milestones in the history of geothermal development:

1) Pre-Geothermal Development (prior to 1977)

The foundation for the commercial utilization of geothermal energy was laid by the Philippine Commission on Volcanology (COMVOL) between 1952 and the late 1960s. This group studied and inventoried geothermal activity at a number of localities, particularly at the Makban, Tiwi, Tongonan and Southern Negros areas. In the latter part of this period, COMVOL's work aroused interest both in the US and New Zealand. In 1971, Union Oil of California (UNOCAL) signed a geothermal service contract with the Philippine National Power Corporation (NPC) to explore and develop geothermal resources at Tiwi and Makban. UNOCAL formed a local subsidiary, Philippine Geothermal Inc. (PGI), to undertake this work. In 1972, the New Zealand Government entered into a bilateral energy co-operation programme with the Philippine Government. This led to exploratory drilling at Tongonan and Southern Negros by NPC starting in 1973.

2) First commercial power generation in the Philippines (1977)

In 1976, the PNOC-Energy Development Corporation was created in response to the energy crisis of the early 1970s. This group was mandated by Government to undertake accelerated development of indigenous energy sources to reduce the country's dependence on imported fossil fuels. PNOC-EDC assumed NPC's interests at Tongonan and Southern Negros, and commenced deep exploration drilling at Tongonan in December 1976. This was successful and quickly led to the commissioning of a NPC owned 3 MWe power plant at Tongonan in July 1977 - the first commercial geothermal power generation in the Philippines.

3) First Major Phase of Geothermal Development (1978-1983)

A very rapid build-up in geothermal generating capacity occurred between 1978 and 1983 as NPC and PGI sequentially commissioned 12 x 55 MWe units and associated steam field facilities at the Tiwi and Makban projects. PNOC-EDC and NPC followed in 1983 with the commissioning of 3 x 37.5 MWe units at Tongonan and 3 x 37.5 plus 3 x 1.5 MWe at the Palinpinon field in Southern Negros. By the end of 1983, geothermal capacity in the Philippines reached 896 MWe of which:

- NPC owned 100 percent of the generating capacity
- NPC and PGI owned and operated, respectively, 74 percent of the total steam field capacity, and
- PNOC-EDC owned and operated the 26 percent balance of steam field capacity.

4) Hiatus (1983-1991)

There was a decade long hiatus in geothermal development from 1983 to 1993 due to a combination of political, funding and institutional problems. In spite of these difficulties, a major exploration drilling program was pursued by PNOC-EDC at Luzon and elsewhere. These programs confirmed the development potential of BacMan, Mt. Apo and a number of prospects in Leyte.

5) Revived Institutional Interest in Geothermal Development (1991-1993)

In the early 1990s, there was a strong revival of interest in geothermal development in the wake of:

- an energy crisis on Luzon which led to severe electricity shortages and rationing in the capital city of Manila. This eventually led to the state owned National Power Corporation (NPC) relinquishing sole control on power generation;
- introduction in 1990 of Build-Operate-Transfer legislation (Republic Act 6957) allowing for private sector development of geothermal and other types of power plant and infrastructure facilities;

- the resurrection in late 1992 of the Department of Energy which had been disbanded six years earlier. This allowed the Government to develop important initiatives in the energy sector and implement a countrywide Master Energy Plan (Department of Energy, 1993).

6) Second Major Phase of Geothermal Development (1993-1997)

As a result of the changed institutional and commercial climate, there was a very rapid upswing in geothermal power development. This led us to add 1000 MWe of geothermal capacity between 1993 and the end of 1997. Ninety percent of this consists of development projects undertaken by PNOC at Bacman, Mt. Apo and particularly at Leyte. NPC and PGI have provided the balance by completing in 1994 and 1995 an 80-MWe-infield expansion at Makban, and a 16 MWe binary unit using heat from waste brine.

Build-Operate-Transfer (BOT) legislation in the Philippines was a crucial component in realizing the recent geothermal development expansion program. It allowed for the entry of international power utilities to fund, construct and operate geothermal power plants. The Philippines was therefore able to rapidly increase much needed electrical generation without increasing national debt.

The commercial strategy adopted for the Leyte and Mt. Apo projects by PNOC-EDC was to move from its traditional role as steam field developer and operator, and instead sell wholesale electricity to NPC. PNOC-EDC subcontracted conversion of steam to electricity to third parties through BOT contracts. This approach resulted in the Philippine Government assuming control of resource development and exploitation (through PNOC-EDC), and guaranteeing the purchase of power (through NPC), thus relieving the BOT power plant partner of any significant resource and market risks.

Since mid-1993, PNOC-EDC has already signed six BOT contracts for the construction and operation of 10 individual power plants with an aggregate total of 690 MWe. These BOTpower plants achieved commercial operation within 35 months of the BOT partners signing Energy Conversion Agreements with PNOC-EDC, and within 43 months from the time bids for the BOT projects were first advertised.

The 1900 MWe of countrywide geothermal capacity, which will be in place by mid-1999, is located at six fields (Table 1). These include Makban with 426 MWe (representing 22 percent of the total national geothermal plant capacity), Tiwi with 330 MWe (17 percent), Bacman with 150 MWe (8 percent), Leyte with 698 MWe (37 percent), Palinpinon with 193 MWe (10 pecent) and Mt. Apo with 104 MWe (6 percent). Of this total capacity, NPC owns and operates 1211 MWe (64 percent). The balance of 689 MWe (or 36 percent) is owned and operated by private sector companies holding BOT contracts with PNOC-EDC. The ownership of these capacities relative to the total national capacity is CalEnergy holding 536 MWe .or 28 percent, Ormat with 49 Mwe. or 3 percent, and Oxbow currently with 104 Mwe. or 5 percent. Ownership of these plants will revert to PNOC-EDC at the conclusion of the 10-year BOT co-operation period.

An analysis of geothermal plants in the Philippines in terms of turbine manufacturers shows that the three leading Japanese manufacturers obtained the major share of the Philippine market, supplying 82 percent of the total installed capacity. Individually, each of these companies achieved very similar levels of sales, with Mitsubishi supplying 30 percent, Toshiba 27 percent and Fuji 25 percent of total capacity. Three other turbine suppliers are represented in the Philippines:

- Ansaldo GIE with 2 x 55 MWe condensing steam turbines at Bacman, and
- Ormat, which supplied a number of turbines manufactured by both itself and GE, with an aggregate total of 2.5 percent and 7 percent, respectively, of the total country capacity.
- In terms of steam field production capacity in the Philippines, PNOC-EDC currently owns and operates 60 percent of the total country capacity with the balance of 40 percent owned by NPC and operated by PGI.

Leyte Geothermal Power Project

The Leyte geothermal power project is the largest geothermal development in the Philippines. It involves the commissioning of 600 MWe of power plant in the Mahiao, Malitbog and Mahanagdong sectors at Tongonan, split over three phases of development:

1) A 200 MWe plant commissioned in mid-1996, for exporting electricity to Cebu via an EHV AC submarine cable from Leyte. This generation comes from two power plants:

Table 1
Presently Installed and Committed Future Geothermal Generation Capacity in the Philippines (to 1998)

Field	Location/ Sector	Unit #	Unit Capacity (MWe)	T/G Manufacturer	Installed Capacity (MWe)	For Installn (MWe)	Totals (MWe)	Commission Date	Power Plant Operator	Steam Field Operator
Makban	Bulalo	1 to 6	55	Mitsubishi	330			1979-1984	NPC	PGI
	Bulalo	7 to 9	5.2	Ormat	15.7			1994	NPC	PGI
	Bulalo	10 to 13	20	Mitsubishi	80			1996	NPC	PGI
							426			
Tiwi	Tiwi	1 to 6	55	Toshiba	330		1979-1982	NPC	PGI	
							330			
Bacon Manito	Palayan	1 & 2	55	Ansaldo	110			1993/94	NPC	PNOC-EDC
	Cawayan	3	20	Fuji	20			1994	NPC	PNOC-EDC
	Botong	4	20	Fuji	20			1998	NPC	PNOC-EDC
							150			
Leyte	Tongonan I	1 to 3	37.5	Mitsubishi	112.5			1983	NPC	PNOC-EDC
	Upper Mahiao	4 to 7	118	Ormat	125			1996	Cal Engy/BOT	PNOC-EDC
	Malitbog	8	77	Fuji	77			1996	Cal Engy/BOT	PNOC-EDC
	Sambaloran	9,10	77	Fuji	154			1997	Cal Engy/BOT	PNOC-EDC
	Mahanagdong	13-15	60	Toshiba	180			1997	Cal Engy/ BOT	PNOC-EDC
	Tongonan I	16T	17	GE	17			1998	Ormat/ BOT	PNOC-EDC
	Malitbog	17B	14	GE	14			1998	Ormat/ BOT	PNOC-EDC
	Mahanagdong	18-20T	6	GE	18			1998	Ormat/ BOT	PNOC-EDC
							698			
So. Negros	Palinpinon I	1 to 3	37.5	Fuji	112.5			1983	NPC	PNOC-EDC
	Palinpinon II	4 & 5	20	Fuji	40			1994	NPC	PNOC-EDC
	Palinpinon II	6 & 7	20	Fuji	40			1995	NPC	PNOC-EDC
							193			
Mindanao	Matingao	1	52	Mitsubishi	52			1997	Oxbow/BOT	PNOC-EDC
	Sandawa	2	52	Mitsubishi		52		1999	Oxbow/BOT	PNOC-EDC
							104			
T = topping cycle plant B = bottoming cycle plant					**1848**	**52**	**1900**			

Notes on Operators:

NPC	National Power Corporation	Cal Engy	California Energy
PGI	Philippine Geothermal Inc.	Magma	Magma Power Company
PNOC-EDC	PNOC - Energy Development Corporation	Oxbow	Oxbow Geothermal Corporation

Upper Mahiao 125 MWe Plant:

Ormat obtained in August 1993 a BOT contract to construct and operate a 125 MWe power plant for 10 years. Ormat subsequently contracted the operation of this plant to CalEnergy. The plant comprises four Ormat GCCU turbines of 29.9 MWe capacity each, and one brine OEC binary unit with a capacity of 5.5 MWe. Each GCCU consists of one GE non-condensing steam turbine that exhausts to three OEC binary cycle turbines. Construction commenced in August 1994 and the plant, the largest that Ormat has built to date, was commissioned in July 1996.

Malitbog Power Plant - 1 x 77 MWe unit in a staged development:

A 10 year BOT contract was awarded in September 1993 to Visayas Geothermal Power Corporation, a Philippine subsidiary of Magma Power, to construct and operate the first unit in a 3 x 77 MWe power plant located in the Malitbog sector.

CalEnergy subsequently bought out Magma Power and thus acquired VGPC. The Malitbog turbines are conventional single pressure Fuji units with direct contact condensers. Plant construction commenced in September 1994 and commercial operation of this unit was attained in July 1996.

2) A 400 MWe plant for exporting electricity via a DC EHV cable from Leyte to Luzon in 1998. This generation is being obtained from six power plants:

Malitbog Power Plant - 2 x 7 7 MWe, in one station:

This block of power is from Fuji units # 2 and 3 in the Malitbog power plant. VGPC started commercial operation in mid-1997.

Mahanagdong A and B Power Plants - 3 x 60 MWe, at two stations:

In July 1994, CalEnergy won a 10-year BOT contract to construct and operate three 60-MWe generation facilities split over two sites. The plant consists of Toshiba turbines with surface condensers. Commercial operation commenced in July 1997.

Optimisation Plants - 51 MWe, at 3 stations:

A further 51 MWe of geothermal power is being obtained from topping and bottoming plants resulting from field optimization studies. These comprise:

- a single 17.3 MWe non-condensing HP turbine upstream of the existing Tongonan 1 power plant;
- three 6.4 MWe non-condensing steam turbines upstream of each of the Mahanagdong A and B power plants;
- a 14.6 MWe low pressure condensing steam turbine downstream of the Malitbog power plant,
- All of these optimisation plants were bidded out as a single BOT package that was awarded to Ormat, offering GE turbines. These plants were progressively commissioned between September 1997 and January 1998.

(*From: IGA News #37, July-September 1999*)

Appendix B

Meetings in Nicaragua

Messrs. Tucker and Dick met with the following groups and individuals in Nicaragua during the week of May 25-31, 2003:

Comisión Nacional de Energía
Ing. Raúl Solórzano, President
Lica. Gioconda Guevara, Directora de Políticas Energéticas
Ing. Ricardo Mendoza, Manager of Projects
Amalia López, Economist
Victor Valencia, Economist

Ormat Momotombo Power Company
Roger Arcía, Manager

Empresa Nicaragüense de Electricidad
Mario Montenegro, President
Ing. Justo Sandino, General Manager, Generadora Eléctrica Central, SA
Inga. María Su, geothermal specialist

Ministerio del Ambiente y Recursos Naturales
Lic. Helio C. Zamora, Jefe, Depto. de Calidad Ambiental
Milton Madina, geologist

Instituto Nicaragüense de Energía
Ing. Octavio Salinas, President
Ing. Ariel Zúñiga, geothermal specialist

San Jacinto Power Company, SA
Dr. Erwin J. Krüger, President
Ing. Walter M. Krüger, Vice President
Ing. Oscar Sáenz, Sr. Engineer

Centro Nacional de Despacho de Carga

Rudolfo López, Manager
Iván Cortez, Economist
René Gonzáles

Casa McGregor, SA

Donald A. McGregor, President

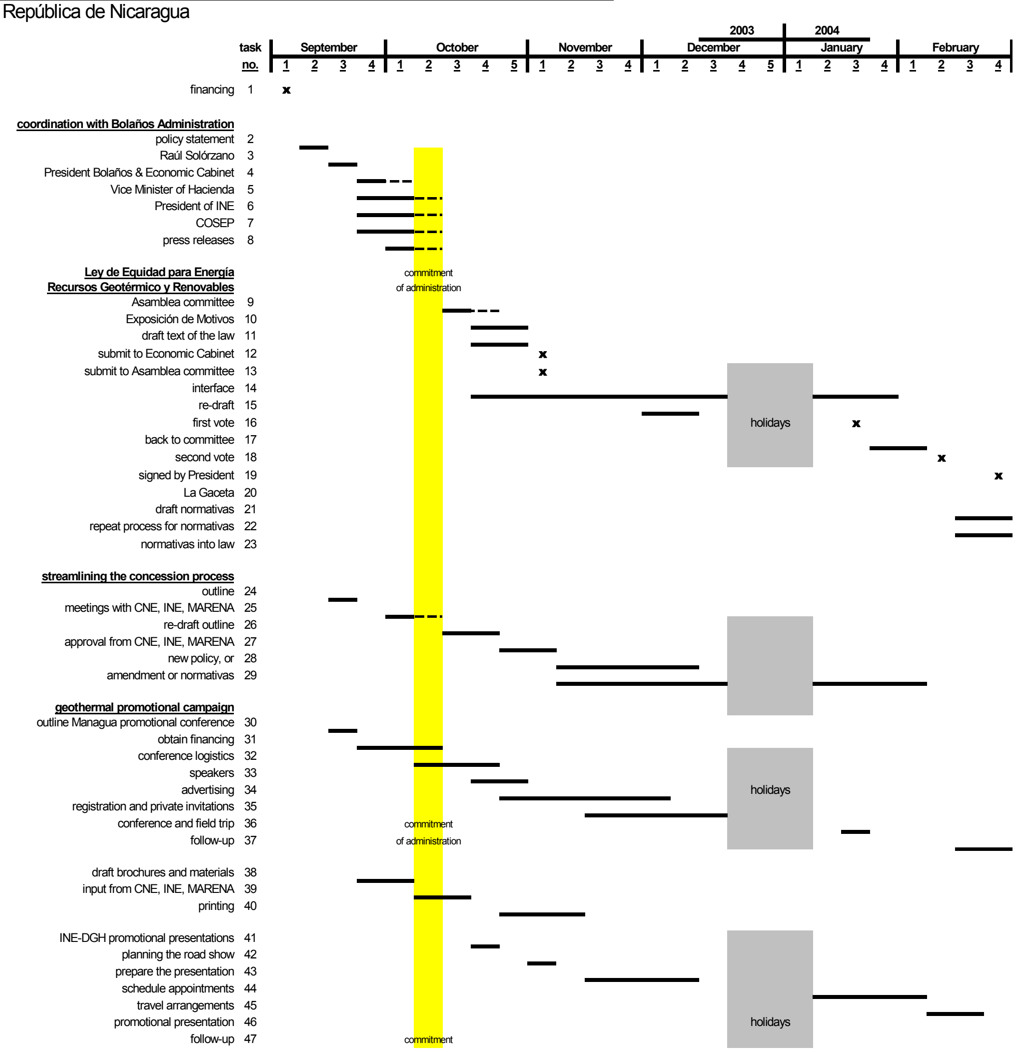
Unión Fenosa

Fernando Bárcenas, Gerencia Gestión de Energía

Appendix C

Implementation Plan for Geothermal Development and Promotion

Appendix "A"
Implementation plan for geothermal development and promotion
República de Nicaragua



Appendix D

Frequently Asked Questions on RPS

As there are often questions concerning Renewable Portfolio Standards, we are providing a copy of the answers to Frequently Asked Questions regarding RPSs, as provided by the The Union of Concerned Scientists. While these questions and answers are specific to a proposed national RPS in the United States, it appears relevant to our proposed program for Nicaragua.

Frequently Asked Questions

The Renewable Portfolio Standard[16]

- Is it feasible to supply 20 percent of US electricity with non- hydro renewable sources by 2020?
- Can we afford to supply 20 percent of electricity with non-hydro renewable sources by 2020?
- Aren't renewable energy technologies more expensive?
- Why not let customers who want more renewable energy pay the extra costs?
- Why not rely just on incentive-based approaches, such as tax credits?
- How does the RPS reduce renewable energy costs?
- What are renewable energy credits and why should credit trading be used to meet an RPS?
- Should hydropower qualify for the RPS?
- Renewable sources like solar and wind have variable output. Would an RPS affect the reliability of the energy system?
- How would the RPS affect national energy security?
- We've spent billions subsidizing solar and wind and they still aren't competitive. Is it time to look elsewhere?

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[16] Obtained from The Union of Concerned Scientists website, at: http://www.ucsusa.org/clean_energy/renewable_energy/page.cfm?pageID=46

- Would we have to restructure the electricity industry in order to adopt an RPS?
- Why not rely just on emission caps and trading programs to meet environmental goals?

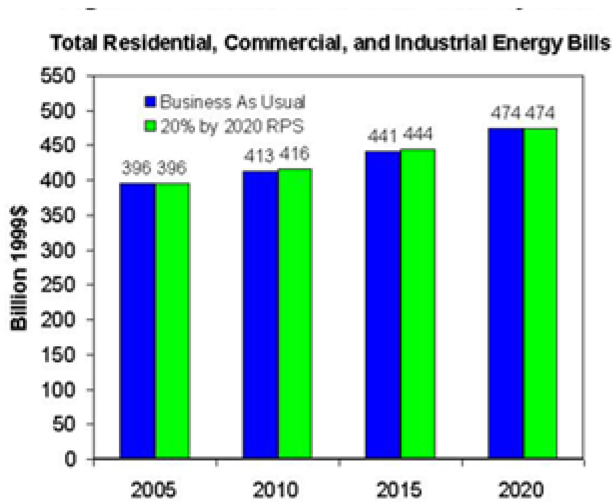
Is it feasible to supply 20 percent of US electricity with non-hydro renewable sources by 2020?

The United States is blessed by an abundance of renewable energy resources from the sun, wind, and earth. The technical potential of good wind areas, covering only 6 percent of the lower 48 state land area, could theoretically supply more than one and a third times the total current national demand for electricity. An area 100 miles square in Nevada could produce enough electricity from the sun to meet annual national demand. We have large untapped geothermal and biomass (energy crops and plant waste) resources. Of course, there are limits to how much of this potential can be used economically, because of competing land uses, competing costs from other energy sources, and limits to the transmission system. The important question is how much it would cost to supply 20 percent of our electricity from renewable energy sources other than hydroelectric power.

Can we afford to supply 20 percent of electricity with non-hydro renewable sources by 2020?

Recent studies have shown that an RPS of 20 percent by 2020 is easily affordable. A June 2001 study by the US Energy Information Administration (EIA)-using very high estimates of renewable energy costs-shows that an RPS of 20 percent by 2020 would cost roughly the same as business as usual through 2006 and only $2.8 billion or 0.7 percent higher in 2010.[1] By 2020, total bills would be $580 million (0.1 percent) lower with a 20 percent RPS. With ongoing natural gas savings after 2020, an RPS would likely produce net savings for consumers. Because an RPS creates a more diverse and competitive market for energy supply, EIA found that these market forces would reduce natural gas prices and bills, offsetting small electricity price. Other studies, using more realistic assumptions developed by the Department of Energy's Interlaboratory Working Group, consisting of the five national energy research labs, have found that a 20 percent RPS, when combined with energy efficiency programs, could save consumers billions of dollars.[2]

Figure D.1: National RPS Cost – 20% by 2020

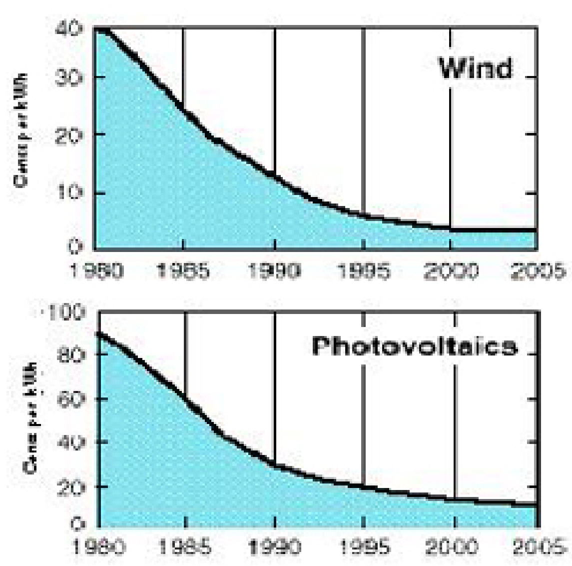


Source: EIA,[1] Appendix E, Table E3.

Aren't renewable energy technologies more expensive?

Renewable energy has made great strides in reducing costs, thanks to research and development and growth in domestic and global capacity. The cost for wind and solar electricity has come down by 80- 90 percent over the past two decades (Figure D.2).[3] The Electric Power Research Institute projects that the cost of renewable energy will continue fall to levels that are competitive with conventional energy sources over the next 5- 15 years.[4]

Figure D.2: Renewable Energy Cost Reductions



Source: DOE [3]

Why not let customers who want more renewable energy pay the extra costs?

Buying "green power" can help stimulate the market for renewable energy. But renewable energy provides environmental, fuel diversity, national security, and economic development benefits to everyone, not just to those who volunteer. Increasing renewable energy will reduce the risks to the economy posed by over-reliance on a single source of new power supplies, such as natural gas. A study by the National Renewable Energy Laboratory shows that by 2010 voluntary programs could increase renewable energy generation from 2 percent of electricity sales today to less than 3 percent of sales.[5] As discussed above, EIA and others have shown that an RPS of 20 percent of sales by 2020 would be achievable and affordable if everyone shares the cost. Surveys show that a large majority believes that everyone should share in the costs of increasing renewable energy. An RPS would create a minimum national standard that allows individuals who want to buy more renewable energy to do so.

Why not rely just on incentive-based approaches, such as tax credits?

Production tax credits are vital for leveling the tax playing field with fuel-intensive technologies that pay lower property taxes and can deduct fuel expenses, but do not necessarily overcome other critical market barriers. In order to ensure the tax credits are effective, there needs to be a policy that creates a market for the technologies. For example, the production tax credit for wind has produced most new wind capacity in states that also have a state RPS. (The tax credits also need to be extended for a long enough period for investors to rely on, expanded to include other renewable resources, and available to public power and rural electric cooperatives.) The RPS creates a market for renewable technologies that are commercially viable or close to viable and helps reduce their costs (see below). Other complementary policies, including net metering and other financial incentives, are also needed to encourage the development of higher cost renewable emerging technologies with significant long term potential such as customer-sited solar photovoltaics.

How does the RPS reduce renewable energy costs?

The RPS is the best policy to ensure we meet resource diversity and environmental goals at the lowest cost. By stimulating a long-term market for renewable energy, the RPS reduces the investment risk associated with building renewable facilities. Lower investment risk promotes cost-effective financing of new projects. Increasing the deployment of renewable technologies reduces manufacturing, installation, maintenance, and other costs over the long term. At the same time, competition among a variety of renewable sources to meet the RPS also helps drive renewable energy prices down. Using renewable energy credits (see below) creates additional savings.

What are renewable energy credits and why should credit trading be used to meet an RPS?

A system of tradable renewable energy credits provides electricity generators with a simple and flexible means for achieving renewable energy targets. One REC is created for every unit of renewable electricity generated. Renewable energy generators earn

RECs and then sell them to those who need them to meet the RPS requirements. A national RPS with RECs trading will reduce the cost of renewable energy technologies by creating a national market for the most cost-effective renewable energy sources. This approach is very similar to the successful credit-trading program established for sulfur dioxide emissions under the Clean Air Act.

Should hydropower qualify for the RPS?

Hydropower is a mature technology, as it comprises approximately 10 percent of our nation's current supply of electricity. It is often the least expensive generation available, and existing hydro facilities generally do not need the support of an RPS to continue operating. There are also only limited opportunities for environmentally sensitive expansion of hydropower generation. Some proposed approaches would allow incremental hydroelectric generation at existing dams to qualify for an RPS.

Renewable sources like solar and wind have variable output. Would an RPS affect the reliability of the energy system?

The electric system is designed to handle unexpected swings in energy supply and demand, such as significant changes in consumer demand or even the failure of a large power plant or transmission line. There are several areas in Europe, including Spain, Germany, and Denmark, where wind power already supplies over 20 percent of the electricity with no adverse effects on the reliability of the system. Several important renewable energy sources, such as geothermal, biomass, and landfill gas systems can operate around the clock. Studies by the EIA and the Union of Concerned Scientists show these renewable plants would generate over half of the nation's non-hydro renewable energy under the 20 percent RPS in 2020. Renewable energy can increase the reliability of the overall system, by diversifying our resource base and using supplies that are not vulnerable to periodic shortages or other supply interruptions. Solar energy is also generally most plentiful when it is most needed-when air-conditioners are causing high electricity demand.

How would the RPS affect national energy security?

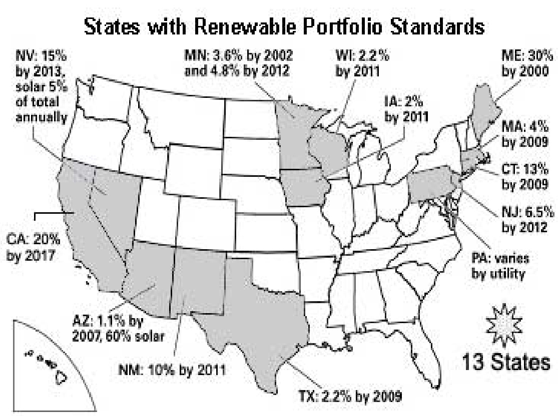
Much of the US energy system-power plants, dams, refineries, pipelines, tankers, and the electricity transmission grid-presents significant safety and security risks. Renewable energy facilities are small, geographically dispersed, and do not require transporting or storing radioactive or combustible materials. Increasing renewable energy would reduce the number of vulnerable facilities over time. Renewable energy can also reduce the need to expand imports of liquefied natural gas (LNG). LNG imports from non-NAFTA countries, including OPEC members- Algeria, Indonesia, Iran, Nigeria and Qatar-are projected to grow from less than 1 percent of gas supply today to up to 12 percent by 2010. Renewable fuels can also displace oil. Among the experts calling for a federal RPS to increase energy security are James Woolsey, former head of the CIA, Robert McFarland, former national security advisor to President Reagan, and Admiral Thomas Moorer, former head of the Joint Chiefs of Staff.

We've spent billions subsidizing solar and wind and they still aren't competitive. Is it time to look elsewhere?

As discussed above, DOE investments in R&D and state and federal incentives have reduced the cost of renewable energy generation as much as 80-90 percent. But renewable energy technologies still do not compete on a level playing field with conventional energy sources. Federal subsidies for renewable energy have been and continue to be much less than government subsidies for the fossil fuel and nuclear power industries.[8] A recent study by the Renewable Energy Policy Project showed that between 1943 and 1999, the nuclear industry received over $145 billion in federal subsidies vs. $4.4 billion for solar energy and $1.3 billion for wind energy.[9] Another study by the non-partisan Congressional Joint Committee on Taxation projected that the oil and gas industries would receive an estimated $11 billion in tax breaks and loopholes that subsidize exploration and production activities between 1999 and 2003.[10] Legislation passed by the House of Representatives in 2001 (H.R. 4) would authorize as much as $38 billion over ten years in new and expanded subsidies for the oil, coal, gas, and nuclear power industries.

Would we have to restructure the electricity industry in order to adopt an RPS?

No, an RPS is compatible with both a regulated or restructured industry. Iowa, Minnesota, and Wisconsin adopted renewable energy requirements outside of restructuring. Nevada adopted a small RPS during restructuring, but greatly expanded it later. Eight other states, including Texas, have enacted an RPS during restructuring.



Why not rely just on emission caps and trading programs to meet environmental goals?

Emission cap and trading programs are critical for reducing harmful pollution from power plants. But they do not necessarily help new technologies that provide long-term benefits overcome market barriers. An EIA study found that a 20 percent RPS would reduce the cost to consumers of meeting four-pollutant reductions from power plants by $4.5 billion in 2010 and $31 billion in 2020 compared to meeting the emission reductions without an RPS.[11] By providing additional alternatives to switching from coal to natural gas, renewable energy sources restrain price increases in natural gas to power plants and other users.

References

[1] Energy Information Administration, Analysis of Strategies for Reducing Multiple Emissions from Electric Power Plants: Sulfur Dioxide, Nitrogen Oxides, Carbon Dioxide, and Mercury and a Renewable Portfolio Standard, SR/OIAF/2001-03, June 2001. http://www.eia.doe.gov/oiaf/servicerpt/epp/pdf/sroiaf(2001)03.pdf

[2] For more detail, see UCS Fact Sheet: "EIA Study: National Renewable Energy Standard of 20 percent is Easily Affordable. /clean_energy/renewable_energy/page.cfm?pageID=45

[3] U.S. Department of Energy National Laboratory Directors, Technology Opportunities to Reduce U.S. Greenhouse Gas Emissions, October 1997. http://www.ornl.gov/climate_change

[4] Electric Power Research Institute and the US Department of Energy, Renewable Energy Technology Characterizations, EPRI-TR-109496, December 1997. http://www.eren.doe.gov/power/techchar.html

[5] Lawrence Berkeley National Laboratory and National Renewable Energy Laboratory, Forecasting Growth of Green Power Markets in the United States, NREL/TP-620-30101, LBNL-48611, October, 2001. http://www.eren.doe.gov/greenpower/pdf/30101.pdf

[6] Energy Information Administration, ibid.

[7] Union of Concerned Scientists, Clean Energy Blueprint: A Smarter National Energy Policy for Today and the Future, October 2001. /clean_energy/renewable_energy/page.cfm?pageID=44l

[8] Doug Koplow and John Dernbach, "Federal Fossil Fuel Subsidies And Greenhouse Gas Emissions: A Case Study of Increasing Transparency for Fiscal Policy," Annual Review of Energy and Environment, 2001. 26:361-89. http://energy.annualreviews.org/cgi/content/full/26/1/361?ijkey=2zGcFva7fLEMA&keytype=ref&siteid=arjournals

[9] Goldberg, Marshall, Federal Energy Subsidies: Not All Technologies are Created Equal, Renewable Energy Policy Project, July 2000, http://www.repp.org/articles/resRpt11/subsidies.pdf.

[10] Joint Committee on Taxation, Estimates of Federal Tax Expenditures for Fiscal Years 1999-2003, 1998.

[11] Energy Information Administration, ibid.