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A NATIONAL STRATEGY FOR THE EXPORT OF U.S. GEOTHERMAL TECHNOLOGY

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U.S. GEOTHERMAL EXPORT STRATEGY

The world market (non-U.S.) for geothermal goods and services over the next 11 years is estimated to be \$3-\$6 billion. The projected 1500 MWe - 3000 MWe increase in installed capacity represents a 4.5 - 7.5 percent annual growth rate. A one-third share of this market for the U.S. geothermal industry would represent an export market of \$100 - \$200 million per year during the 1990 - 2000 time frame.

As the worlds leader in the technology, know-how, and experience in the development of geothermal energy for power production, the U.S. geothermal industry has the capability and motivation to capture this lucrative market. An explicit, concerted, coordinated, and sustained national strategy must be implemented by both the private and public sectors to realize this "window of opportunity".

The "U.S. Geothermal Export Strategy" defines a five-point approach to penetrating the international geothermal power generation market. These five points are focused around:

- 1) Developing a strong joint industry-government support base.*
- 2) Targeting clear market segments.*
- 3) Targeting specific countries, regions, and projects.*
- 4) Increasing U.S. bilateral tied-aid and mixed-credit opportunities.*
- 5) Defining a coherent, cohesive industry-wide marketing plan.*

FIVE POINT STRATEGY

POINT ONE - Develop a strong industry backed government-supported export promotion base.

It is recognized that, with a handful of notable exceptions, the U.S. geothermal industry does not have significant international experience. The capabilities of the U.S. industry are not as well known to the international funding and development organizations, and to Lesser Developed Country (LDC) decision-makers; neither are they much known to U.S. federal and state agencies charged with export assistance. The U.S. geothermal industry must form a strong, cohesive industry spokes-organization and must work in concert with the U.S. federal and state agencies to market, finance, and penetrate geothermal project opportunities overseas.

A. INDUSTRY ORGANIZATION

U.S. companies interested in exporting geothermal goods and services must firmly support the National Geothermal Association (NGA) as the industry representative on exports. With strong industry backing, NGA will be better able to open doors and be heard by U.S. federal agencies, international funding and development organizations, and LDC decision makers.

- Encourage all geothermal firms interested in exports of goods or services to join and support the NGA.

- Rely on NGA to be the industry-wide focus with U.S. agencies, international funding and development organizations, and LDC buyers.
- Charge NGA with the mission of educating potential buyers, financiers, and government assistance agencies on geothermal technology, U.S. industry capabilities, and export opportunities.
- Charge NGA with spearheading lobbying efforts to promote expansions of existing or creation of new U.S. bilateral tied-aid and mixed-credit programs.

B. U.S. GOVERNMENT SUPPORT

The nature of overseas geothermal project opportunities and the business and political environments within which project decisions are made necessarily dictates that the U.S. geothermal industry cannot succeed substantively without the support and assistance of the U.S. government. From risk insurance to bilateral tied-aid or mixed-credits to export regulations and mitigating unfair trade practices, the U.S. government must be a partner with the industry.

- Utilize the Committee On Renewable Energy Commerce and Trade (CORECT) as the lead federal liaison organization in implementing the export strategy. With 13 member agencies and a modest budget, CORECT can work with NGA to increase probabilities of U.S. geothermal export success.

- Charge CORECT with the lead responsibility in ensuring that the appropriate U.S. export agencies are knowledgeable about the technology and the capabilities of the U.S. industry.
- Charge CORECT with being a partner in promoting the U.S. industry in the international community.
- Charge CORECT with the lead responsibility in effecting trade regulations and policies to be favorable to geothermal exports.

C. INDUSTRY-GOVERNMENT EXPORT TASK FORCE

A mechanism needs to be developed to provide an explicit channel for information exchange and coordination in implementing the U.S. Geothermal Export Strategy. An Export Task Force comprised of both industry and government representatives will provide much needed visibility and a clear mechanism to coordinate industry and government initiatives.

- *Institute an "Export Task Force" comprised of representatives from NGA and CORECT.*
- *Secure the services of a Task Force "secretary" to provide day-to-day operational and coordination assistance.*
- *Consider developing mechanisms to pool industry and government resources to conduct joint initiatives.*

- *Hold periodic meetings in implementing the U.S. Geothermal Export Strategy.*

POINT TWO - *Define clear market segments that are keyed to near-term opportunities and U.S. industry capabilities, and identify optimum approaches and objectives for each relevant market segment.*

A. FIRST PRIORITY - SMALL POWER PLANTS

The most promising international market segment is for small power plants for mini- and off-grid application. The optimum sizes are in the 3-10 MWe range with potential multiple units combining to 25 MWe. The U.S. industry can dominate this market segment in the next 10 years.

- *Mount an aggressive campaign to promote U.S. small power plant capabilities with LDC decision-makers and multilateral lending and assistance agencies (eg. World Bank, Inter-American Development Bank, Asian Development Bank, and United Nations Development Program).*
- *Form small joint ventures or bidding teams to target and market specific countries and projects.*
- *Concentrate on mini- and off-grid industrial and commercial applications. They are easier to conclude since, in general, they provide captive power to a facility and do not require substantive involvement of government-owned utility companies.*

- Mobilize industry and government resources to convince LDCs and international funding and development organizations to support more small power projects (at the expense of large, grid-connected power plants).
- Educate commercial lenders and private investors on international opportunities.
- Secure commercial sources of financing to build-own-operate (or build-own-train-turnover) small power generators.
- Work with CORECT to secure more U.S. bilateral funding (tied-aid loans and grants, and mixed-credit support) for small power plants.

B. SECOND PRIORITY - EXPLORATION AND FIELD DEVELOPMENT

This market segment is primarily service-based, where technique and know-how are the discriminators. The U.S. geothermal industry has more experience in this area than any other national group and enjoys a good reputation in the world geothermal community. The potential to perform exploration and field development in increments makes this market segment ideal for U.S. bilateral tied-aid. U.S. industry penetration of this market will provide an excellent entree to capturing and dominating the small power plant market segment.

- Work with CORECT to aggressively promote U.S. industry capabilities with both domestic bilateral and multilateral assistance agencies.
- Work with CORECT to secure U.S. bilateral grants for surveys and feasibility studies.
- Develop a network of in-country consultants who can assist in defining and obtaining the projects for U.S. firms.
- Promote the collective U.S. industry capability and technological edge with LDC decision-makers.
- Include training as an integral part of the strategy to penetrate this market segment.

C. THIRD PRIORITY - LARGE POWER PLANTS

Projects in this market segment are large and therefore potentially more lucrative. However, due to their size, financing is almost always done under loans - either by the international banks, or bilateral aid from donor nations. While poorer LDCs may have a bias for multilateral loans, the more developed LDCs prefer bilateral loans since they can get mixed-credits with terms more favorable than those from the international and regional banks. Since the U.S. government does not currently provide significant mixed credits, U.S. industry is likely to get locked out. However, limited potential exists for multilateral-funded projects

available for open bids. Some portion of this market segment can be penetrated by the U.S. industry.

- Develop project-specific consortia or joint ventures approaches to marketing and bidding on multilaterally-funded open solicitations.
- Target specific projects significantly in advance to market the consortium/joint venture to the LDC.
- Work with CORECT to secure U.S. bilateral grants to perform engineering feasibility studies and secure mixed-credit backing.
- Pool resources to track specific projects and promote U.S. consortia or joint ventures.

POINT THREE - *Select specific regions, countries, and geothermal fields and conduct sustained marketing and project development effort.*

A. FIRST PRIORITY - CENTRAL AMERICA

Central America is the primary target for geothermal energy project development and the exports of U.S. goods and services. This region is rich in geothermal resources and work has already been done in many of these fields. Since most of the countries are facing serious capacity shortfalls geothermal power is likely to be the least cost alternative in meeting the demand. Moreover, U.S. industry generally enjoys a good

reputation: some U.S. firms have been or are already involved in the region, and there are cost advantages due to the geographic proximity. Finally, U.S. foreign policy places high importance to this region. On the down-side, the credit worthiness of Central American countries is low; current Eximbank guidelines make most Central American countries unacceptable risks. However, there is enough momentum for near-term power development in these countries that the U.S. industry can compete well in the field development and small power plant market segments.

- Work collectively with the CORECT member agencies and state agencies (such as California Energy Commission [CEC]) to aggressively track project opportunities and maintain a sustained presence with the LDC buyers.
- Identify and pursue opportunities for off-grid small power plants. Consider combined power generation/direct-use facilities.
- Work with CORECT to educate U.S. agencies and commercial financiers on the geothermal investment opportunities in Central America.
- Establish a foothold in one Central American country with a successful project and use it to expand to other countries in the region and into South America.
- Invest funds to allow Central American buyers to visit and observe U.S. technology in the field.

- Develop and conduct focused geothermal training sessions that highlight U.S. technology.

B. SECOND PRIORITY - SOUTHEAST ASIA

Southeast Asia is a close second as a target for the export of U.S. geothermal goods and services. In particular, the Philippines, Indonesia, Thailand, and some of the Pacific islands are excellent targets in all three market segments. All of these countries have known geothermal resources, U.S. oil companies (and geothermal companies in the case of the Philippines and Indonesia) have a strong presence providing a marketing entree, most of these countries are good credit risks, and this market will be lost to Japan, New Zealand, and France if the U.S. does not aggressively pursue it. In particular, the opportunities for small mini- and off- grid power plants are the best in the smaller and secondary islands of Indonesia, the Philippines, and Pacific islands and in the more remote regions of Thailand. Many of the U.S. export assistance programs have placed an emphasis on the "Pacific rim" countries. Penetration in this region opens up potential projects in Korea and China.

- Work collectively with CORECT member and state agencies (such as CEC) to aggressively track project opportunities and develop project-specific initiatives.
- Concentrate efforts on mini- and off- grid projects.

- Focus attention on the smaller islands and more remote areas. In particular, focus on potential opportunities on Mindanao and the Visayas in the Philippines; the hundreds of secondary and small islands in Indonesia where fossil fuel is currently being used; and mini-grid opportunities in the northern parts of Thailand.
- Develop strong relationship with local consultants and firms who can help uncover opportunities and broker the projects.
- Invest funds to allow potential buyers to visit and observe U.S. technology in the field.
- Work with CORECT and CEC to educate U.S. agencies and commercial financiers on the geothermal investment opportunities in this region.
- Work with CORECT and CEC to develop more bilateral grants for surveys and feasibility studies.
- Develop and implement an industry-wide initiative to market the Asian Development Bank, the World Bank, and relevant agencies of the United Nations.

C. THIRD PRIORITY - KENYA

The opportunities in Kenya are well defined and immediate. The Kenyan National Power Development Plan (NPDP) has an explicit target of

325 MWe by 2005; currently 45 MWe are on-line and another 60 MWe are under development, leaving 220 MWe still to be developed and built. The NPDP estimates an expenditure of over \$500 million over the next 20 years. In addition, promising opportunities exist for the commercially financed development of off-grid power plants.

- Assemble one strong team to bid on and conduct the "Prioritization" study under the TDP feasibility grant. The selected team should be one that can share information equally with all industry members without bias.
- Work with CORECT to actively promote U.S. industry capabilities with the World Bank and Kenya.
- Work with CORECT member agencies to develop and conduct training highlighting U.S. technology for the Kenyans.
- Maintain a sustained effort to win contracts for future field development and power plant construction.
- Work with CORECT to secure bilateral grants to do more feasibility and engineering studies.
- Work with CORECT to secure bilateral mixed-credit financing for the off-grid projects.

POINT FOUR - Mount a concerted and sustained effort to effect the expansion of existing or creation of new U.S. government bilateral-aid loans, grants, and mixed-credits for capital projects, loan guaranty programs, and risk insurance programs.

- Work with CORECT to develop more TDP grants for public sector feasibility studies in targeted countries. Tap the TDP investor "reimbursable grant" program in developing small power projects in the private sector.
- Work with CORECT to expand the use of the Eximbank mixed-credit "warchest" for geothermal projects facing foreign competition.
- Work the CORECT and commercial banks to increase use of the Eximbank Small Business Credit, Intermediary Loan and programs Eximbank/PEFCO financing for small geothermal projects.
- Work with CORECT to expand use of the OPIC Loan Guaranty and Direct Investment Fund program for geothermal projects.
- Work through CORECT to get Congressional approval to tap the over \$267 million still available in the DOE administered Geothermal Resources Development Fund for guarantying commercial loans for overseas geothermal projects.

- Work with CORECT to expand AID funding of geothermal feasibility studies and projects through its Economic Support Fund.
- Utilize the Loans and Grants Program of the Bureau for Private Enterprise to finance joint venture initiatives for small power plants.

POINT FIVE - Develop and implement a coherent, cohesive, and sustained industry-wide marketing effort directed at target regions/countries, target market segments, public and private financing communities, and selected federal and state agencies.

- Work through NGA and CORECT to develop a suite of focused geothermal industry promotional material for use with LDC buyers, public and private financing organizations, and federal and state export related agencies.
- Establish and fund an explicit mechanism for the early identification of project opportunities and disseminate the information to the industry.
- Engage a consultant in the Washington, D.C. area to maintain a continuous geothermal presence with federal agencies, World Bank, Interamerican Development Bank, and the United Nations.

- Work with federal and state export agencies to conduct focused Trade Missions and Reverse Trade Missions with targeted LDC decision-makers. Work with CORECT member agencies to conduct seminars and prepare material to apprise the geothermal industry of international project development and implementation.
- Work with CORECT to conduct a series of briefings to commercial lenders on geothermal technology and international investment opportunities.
- Consider engaging active marketing agents in selected countries/regions to promote U.S. geothermal industry interests.
- Work with CORECT to provide technical assistance LDCs and donor organizations in defining and selecting geothermal projects.
- Work with CORECT to develop and conduct a "Geothermal Project Opportunities" Workshop that brings together potential LDC off-grid customers, commercial financiers, government financial backers (eg. Eximbank, OPIC, SBA, etc.), and U.S. geothermal developers, manufacturers, and A&E firms to provide a "deal-making" forum.
- Work with CORECT to establish a "Geothermal Export Center" which:
 - is setup to market visiting LDC decision-makers and public and private financing decision-makers on the technology, U.S.

industry capabilities, and advantages of geothermal projects in LDCs.

- contains technology-oriented exhibits emphasizing U.S. industry capabilities.
- displays selected products and literature from individual firms.
- contains information on U.S. export assistance programs.
- is located next to working drill rigs, wells, small power plants, etc. so that first hand observations of U.S. technology and know-how can be observed.
- can be used in part as a training facility for LDC technicians.
- contains power generation as well as direct-use displays and informa

1. INTRODUCTION

The United States is the leader in the development and utilization of technology to exploit geothermal energy resources. Approximately 2500 MWe (megawatts electric) are generated in the U.S. today from geothermal resources; an additional 1,700 MW_T (megawatts thermal) of direct use capacity provides heat for a variety of industrial, agricultural, residential, and commercial applications. This impressive development has been supported by an emerging but strong U.S. geothermal industry and government sponsored research and development (R&D).

Over the last few years, a number of key factors have converged to drastically reduce the U.S. market for geothermal good and services. At the same time, opportunities in the international marketplace have rapidly increased, particularly in the geothermally-rich lesser developed countries (LDC) of Asia, Africa, and Latin America. Spurred by ambitious economic growth objectives and foreign debt issues, and encouraged by international funding institutions, LDCs are becoming keenly interested in exploiting their indigenous geothermal resources. Competition by other developed nations to penetrate and secure this growing market is intense. The U.S. industry and the U.S. government have both recognized the need and opportunity to participate in this international marketplace and to increase U.S. exports of geothermal goods and services. In response, a number of initiatives are being undertaken in both the public and private sectors to enhance the competitive U.S. position. Much of this effort, however, has been uncoordinated and spotty.

This document presents a proposal for an explicit U.S. strategy to focus this still diffuse interest into a coordinated effort by the public and private sectors to increase exports of U.S. geothermal goods and services over the next five to ten years. This document summarizes the background and need for an explicit U.S. strategy, the factors influencing the development of this strategy, strategy options, and a recommended strategy.

2. BACKGROUND

A. INDUSTRY STATUS

The U.S. geothermal industry is a relatively young, heterogeneous industry with a strong, but emerging infrastructure.

- The U.S. geothermal industry grew out of the oil and gas industry. The exploration and field development arm of the industry has been historically dominated by a few large oil giants (eg. Union Oil, Chevron, Aminoil, Diamond Shamrock, etc.).
- Many of the geothermal equipment and parts suppliers also have the oil and gas industry as their primary clients (eg. Halliburton, Loffland Brothers, Barringer Geoservices, Bauder Drilling, etc.). The geothermal market comprises an extremely small portion of their overall revenues.

- The "geothermal industry" is comprised of a heterogeneous group of over 200 companies ranging from small geothermally-specialized firms to large architectural and engineering (A&E) companies and transnational firms (eg. Bechtel, Stone & Webster, Schlumberger, UNOCAL, etc.). A clear geothermal industry infrastructure is still solidifying.
- The U.S. geothermal industry is responsible for approximately 2500 MWe of power-on-line. Another 1,700 MW_T are being exploited in over 250 direct-use applications.
- With a few notable exceptions, the U.S. geothermal industry experience has been limited to the domestic market. Aside from the transnational equipment and parts vendors and the large A&E firms, most of the geothermal industry is inexperienced in international exports and services.
- Although there are a handful of geothermally focused industry organizations (eg. Geothermal Resources Council [GRC], National Geothermal Association [NGA], Geothermal Resources Association [GRA], International Geothermal Association [IGA], Geothermal Energy Institute [GEI]), only recently has there been a collective focus on export related concerns.

The U.S. geothermal industry occupies the world leadership role in power development, technology and know-how.

[The only area where this leadership position has been lost is in the manufacture of large geothermal turbines.]

- Approximately half of the total worldwide installed capacity of geothermal power generation is in the U.S.. In addition, the U.S. geothermal industry has directly participated in a major portion of the non-U.S. installed geothermal capacity.
- The U.S. geothermal industry enjoys an acknowledged reputation in exploration and field development technology and know-how.
- U.S. technology for geophysical measurement and interpretation and drilling tends to be the world standard.

The growth and success of the U.S. geothermal industry has been supported by a strong and sustained federal government commitment to geothermal R&D.

- The federal government has invested well over \$1 billion in geothermal technology R&D. This investment has funded both basic research in geology, materials, chemistry, and physics as well as applied R&D in technology development.
- Results of government sponsored R&D have been a major contributor to industry success.

- the crystallizer clarifier has opened up over 2,000 MWe of power potential for the Salton Sea resource;
 - survivability of elastomeric seals has increased from 200°C to approximately 300°C;
 - survivability of wellbore cements has increased from 200°C to 600°C;
 - downhole electronics can now survive temperatures of over 300°C;
 - drilling efficiency has increased by 30%;
 - the commercial viability of large scale binary cycle power generation has been demonstrated.
 - government sponsored resource assessments have been the basis for private sector site specific exploration and field development.
- The federal government has a stated policy of working in concert with the private sector to develop the technology and utilize the resource. This policy extends to industry interests in pursuing the international marketplace.

B. MOTIVATIONS TO EXPORT

Current and projected power capacity surplus in regions with geothermal resources and the recent drop in oil prices have resulted in a drastically reduced domestic market over the next 5-7 years.

- Energy Report No. 7 of the California Energy Commission concludes that the power surplus will last well into the mid-1990's.
- Industry consensus is that, in general, no new power sales contracts will be signed by utilities in the near future.
- Lack of easily accessible transmission and distribution lines is constraining development of the more remote resources.
- The sudden and drastic downturn in world oil prices has encouraged utilities to utilize marginally economic self-generation capacity.
- Geothermal resources that were expected to be competitive at \$30/boe (barrels of oil equivalent) cannot compete at \$18/boe. World oil prices are not expected to rise significantly in the near term.

There is a strong desire by the geothermal industry to maintain its expertise, manpower and technological leadership edge until the domestic market returns.

- With the downturn in domestic geothermal development, it will be difficult to retain technical staff; trained manpower may not be available when the domestic market improves.
- Foreign competitors are challenging the U.S. leadership position.
- If new business in the international market is not developed, many geothermal companies may not survive until the domestic market returns.

Spurred by ambitious economic growth objectives and foreign debt issues, many less developed countries are keenly interested in developing their indigenous geothermal resources.

- Strong economic growth is critical to LDCs to meet social, economic, military, and foreign debt issues. This growth requires power to fuel the factories, farms, and businesses. Expenditures on imported oil increase precisely at a time when national resources are needed for infrastructure development.
- For many LDCs oil import payments are a significant percentage of their gross export revenues.
- Exploitation of indigenous energy resources has a magnified benefit

to LDCs -- increased power demands by a growing economy are met while fuel import expenses are cut.

- Even for oil producing LDCs, meeting domestic energy needs through geothermal energy permits them to export their petroleum and earn precious foreign exchange currency.
- Many international banks and development organizations (such as the World Bank, United Nations Development Fund, Inter-American Development Bank, Asian Development Bank, etc.) are strongly encouraging their clients to sharply decrease imported oil consumption and develop indigenous energy resources.
- A number of initiatives by international funding organizations as well as bilateral assistance organizations are underway or are planned to promote the development of geothermal resources.

The U.S. federal government agencies and some state agencies have developed an array of programs and services to encourage and assist the export of U.S. goods and services.

- In 1985, Congress passed the "Renewable Energy Industry Development Act of 1984" (P.L. 98-370) which mandated federal assistance to [among others] the geothermal industry. P.L. 98-370 resulted in the

formation of the interagency Committee On Renewable Energy Commerce and Trade (CORECT). This committee provides focus for the geothermal industry to obtain export assistance by federal agencies.

- CORECT is designed to coordinate the export assistance programs of 13 member agencies (DOE, DOC, SBA, TDP, AID, U.S. Trade Representative, OPIC, Ex-Im Bank, DoD, DOI, DOS, DOT, USIA). CORECT focuses on the generic areas of buyer education, technical competitiveness, financing, market development, and trade policy.
- Some states (such as California, Texas, Washington, etc.) have strong export assistance services of direct value to the geothermal industry.

C. NEED FOR EXPLICIT, COORDINATED U.S. EXPORT STRATEGY

The non-homogeneous character of the geothermal industry has not yet coalesced to a structure capable of concerted international marketing and project development.

- The geothermal industry is comprised of both manufacturers and suppliers of goods, as well as providers of services. Its members range widely in size and have differing interests and experience in the international marketplace.

- Most overseas projects call for turnkey contracts that require a team of firms. Active marketing and project development requires a coordinated approach.

- There is no single industry voice when competing with parastatal firms from competitor nations; most international decision-makers are unaware of the comprehensive strength, capabilities, and interests of the U.S. geothermal industry.

Although a wide variety of government export assistance programs are available there is no coordination or focus particular to the geothermal sector.

- Almost 100 export assistance "programs" are available through approximately 15 agencies.

- Most of the involved agencies know little about geothermal technology or the capabilities of the U.S. industry.

- Although CORECT has initiated some geothermal-specific activities, other renewable energy technology industry groups are capturing the Committee's attention and funding.

- Most of the international funding and development organizations are not fully aware of the strength and capabilities of the U.S.

geothermal industry. Commercial banks need to be convinced of international geothermal investment opportunities.

- To date there has not been a serious, coordinated effort by the geothermal industry to educate U.S. and international agencies about the technology and U.S. industry capabilities.

Non-U.S. companies, many parastatal and/or with tied-aid and subsidized financing are aggressively penetrating the international geothermal marketplace.

- Foreign governments of developed nations are offering large amounts of tied-aid and/or mixed credits to secure international projects. Firms from these countries generally present a unified marketing front to the buyer.
- While LDC decision-makers may favor U.S. technology, attractive financing offers by competitor nations and less than aggressive pursuit by U.S. companies results in loss of valuable opportunities for the U.S. geothermal industry.

There is an undisputed and critical need to develop and implement a "U.S. Geothermal Export Strategy".

- The geothermal industry needs to collectively assess its interests and capabilities and to pursue the international market aggressively.

Uncoordinated efforts by individual companies will ensure foreign domination of the international geothermal market.

- Government agencies and financial decision-makers need to be enlisted in competing for overseas project opportunities. This effort needs to be coordinated to minimize resource expenditures.
- Since international marketing and project development is generally new and expensive for individual firms, a coordinated industry-wide strategy will increase efficiency.
- Export assistance programs by federal and state agencies need to be coordinated and focused to support industry initiatives.
- Individual U.S. firms must recognize the realities of the international market, and learn to compete and succeed collectively.

3. FACTORS INFLUENCING U.S. EXPORT STRATEGY

A. NEAR-TERM MARKET OPPORTUNITIES

A number of near-term market opportunities exist in Southeast Asia, Africa, and Latin America.

- Immediate project opportunities exist in the lesser developed countries of Kenya, El Salvador, Indonesia, Djibouti, Costa Rica,

Guatemala, Philippines. Additional near-term opportunities exist in Turkey, Greece, China, Thailand, Yugoslavia, Nicaragua, and the Caribbean.

- Studies by U.S. DOE and the California Energy Commission identified over 70 countries with geothermal potential that may require assistance and technology from foreign sources. (Some of these opportunities may be only for direct use applications.)
- From a near-term market perspective, Central America appears to be the prime target. The five countries of Nicaragua, El Salvador, Honduras, Costa Rica, and Guatemala all have excellent resource potential, projected capacity shortfalls, and demonstrated interest in developing geothermal power. The Central American market for geothermal goods and services is estimated to be about \$500 million over the next 10 years. Some estimates put the total Latin American geothermal market potential near \$2 billion over the next 15 years. Regional Banks (eg. IDB) and competitor nations have expressed interest in financing certain projects.
- All the above countries have completed some degree of resource exploration; two countries are generating power.
 - Costa Rica: Miravalles field has been fully explored, and field development and a 55 MWe power plant construction are planned in the immediate future; Ricon de la Vieja and Santa Maria have had site-specific surveys. There has been Italian, U.S., and New

Zealand participation in field development and feasibility studies.

- **El Salvador:** a 95 MWe power plant is in operation at the **Ahuachapán** field; **Berlin** and **San Vicente** have had exploratory drilling; **Chinameca**, and **Chipilapa** have had thermal gradient holes. The UN has helped to varying degrees at these fields; **Italy**, **U.S.**, **France**, **Britain**, and **New Zealand** have participated in project design, field exploration, and drilling.

- **Guatemala:** **Zunil**, **Mayuta**, and **Amatitlan** have had the most exploratory and development work to date. A 15 MWe power plant is scheduled for **Zunil** as well as some direct use applications; plans are in place to explore in more detail the areas of **Las Majades** - **Cerro Quemado**, **Atitlan**, **Palencia**, **Tecuamburro**, **Las Achiotés**, **Laguna de Ayarza**, and **Laguna de Retina**. The **Japanese**, **Italians**, and **OLADE** have been involved.

- **Honduras:** geological studies have identified six areas of promise, namely **San Ignacio**, **Platanares**, **Azacualpa**, **El Olingo**, **Sambo Greek**, and **Pavana**; five additional areas are considered of secondary promise. The **United Nations**, **World Bank**, and **OLADE** have been involved in funding; the **Italians** have performed a substantial portion of the exploration with some **U.S.** participation.

- Nicaragua: a 35 MWe geothermal plant has been operating since 1983 in the Momotombo area; a second 35 MWe plant is planned. Other areas of geothermal interest include thermal gradient holes at El Hoyo, San Jacinto Tisate, and Masaya - Nandame. USAID was involved in the early field exploration at Momotombo and San Jacinto - Tisate; the Italians, French, IDB, and OLADE have all been involved to varying degrees.

- Kenya has the most immediate opportunity in Africa for feasibility studies, field development, and subsequent power plant construction. National energy goals call for 325 MWe of geothermal power by 2005; the Olkaria field is currently producing 45 MWe. The National Power Development Plan calls for over \$500 million investment over the next 20 years for the development of 280 MWe of geothermal power.
- The World Bank has approved funding of \$46 million for field development and engineering studies for two 30 MWe power plants at Northeast Olkaria, Kenya. The World Bank project also calls for a "Prioritization" study to determine an exploration and development strategy to meet the national goals.
- In addition to the above described grid connected power generation, good opportunities exist in Kenya for small power production units for industrial applications, including a 3-5 MWe plant at Lake Bogoria to service 3 resort hotels, and a 5 MWe plant at Lake Magadi to replace diesel generators for the Magadi Soda Company. Each of

these projects would entail a potential export of \$10 million, not including drilling.

- Plans have already been made by the Government of Philippines to develop between 220-400 MWe at four sites on Luzon (i.e. Bacon Manito II, Del Gallego, Bulusan, and Mt. Pinatubo). At approximately \$2000/kw, an export market of \$440-\$800 million exists for U.S. goods and services over the next 10 years.
- The U.S. Trade and Development Program has recently approved a \$400,000 grant to the Philippines to conduct feasibility studies at the above sites. U.S. companies are now being short-listed.
- In addition to the larger projects on Luzon, the Philippines National Power Corporation has requested bids on twenty units of 20 MWe each for installation on Visayan and Mindanao Island. More off-grid applications are anticipated.
- Indonesia currently has approximately 140 MWe on-line at Kamojang. An additional 855 MWe are planned in the near-term for utility grids on Java. This represents an export market of over \$1.7 billion for goods and services.
- In addition to projects on Java, tremendous interest exists for mini- and off-grid power on hundreds of smaller islands in the archipelago.

A large portion of the near-term market for U.S. geothermal exports is for technology and services for exploration and field development (including production drilling). U.S. opportunities are best in this area.

Market opportunities for large (> 25 MWe) power plant design and construction are fewer in number, spread over time, and very aggressively contested by competitor nations. U.S. industry weakness in competing for large power plant projects include difficulties in meeting the competition's financing packages and the lack of turbine-generator manufacturers with significant geothermal experience.

Market opportunities for U.S. exports of small power plants (3-25 MWe) are much more promising. U.S. technological superiority, the need for smaller financing, and the interests in off-grid and industrial applications may make this the strongest suit for the export of U.S. geothermal hardware.

B. FOREIGN COMPETITION

The U.S. geothermal industry faces strong competition in penetrating the international market.

- *U.S. industry faces strong competition in the exploration and field development phase by firms from Italy, New Zealand, France, and Japan. U.S. firms, however, have competed well in the past in situations of open competition.*

- Firms from Italy and New Zealand have conducted more project design and consulting studies due primarily to tied-aid. France has been the most involved in direct-use project studies.
- Japanese companies are most successful in supplying the turbo-generators for large power plants. U.S. and Italian firms have had some limited success.
- Israel and China appear to be the major potential competitors in the small flash and binary unit area. U.S. geothermal industry is well suited to compete successfully in this market sector.

Offers of mixed credit and tied-aid to LDCs by competitor nations is the major barrier to the expanded exports of U.S. geothermal goods and services.

- Unlike the U.S. government, Italy, France, and Japan work with their firms to offer project financing that combine export commercial credits with soft loans having lower interest rates or more favorable payment schedules, or grants. For example:
 - The Overseas Economic Cooperation Fund (OECF) of Japan has offered Costa Rica lending terms of 4.75% interest over 25 years with a 7-year grace period for the Miravalles project.
 - The Italians are offering Costa Rica a 1.75% to 2.25% interest rate over 20 years with an 8-year grace period for the same Miravalles project.

- The French are offering a loan to El Salvador for the construction of a geothermal project with interest rates of 1.25% over 30 years with a 4-year grace period.
- A bid by UNOCAL to finance and build a 55 MWe plant at Mount Salak in West Java, Indonesia was rejected in favor of an Italian offer of a \$71 million soft loan/tied-aid package with 1.5% interest over 20 years and a 10-year grace period. Ansaldo is constructing the power plant on a field that was developed by UNOCAL.

Competitor nations earmark a larger percentage of their bilateral aid for capital projects that promote exports. Mixed credits to finance these capital projects result in a less than competitive position for the U.S. geothermal industry.

- U.S. funding of capital projects as a percentage of total bilateral aid, over the 2-year period of 1985-1986 is one of the lowest (at 2.3%) of the OECD members. Japan had the highest concentration at 45.8%; other countries included Denmark at 33%, Norway at 22.5%, West Germany at 20.8%, Italy at 17%, U.K. at 15.4%, Canada at 14%, Sweden at 13.3%, and France at 13%.
- While Japan provided less than half the amount of U.S. bilateral aid, it provided over 10 times the U.S. allocation for mixed credit financing of capital projects.

C. U.S. INDUSTRY CAPABILITIES

The U.S. geothermal industry is the leader in technology, know-how, and experience in the exploration and field development phase.

- In addition to domestic projects, U.S. industry has participated in a major portion of overseas geothermal exploration and field development.
- With government R&D support, U.S. industry has access to the some of the best geophysical measurement and interpretation instrumentation.
- U.S. industry has drilled more geothermal well footage than any of its competition.

U.S. geothermal industry capabilities to design and construct large (> 25 MWe) power plants are competitive with geothermal industries from other nations.

- Much of the technology is conventional power plant technology hardened to withstand the geothermal brine and steam.
- U.S. industry has built more large power plants than any other national group.
- Italy, New Zealand, and Japan can generally U.S. industry skills.

The U.S. does not compete well with Japan in the manufacture of large geothermal turbo-generators.

- The majority (by far) of all geothermal turbo-generators worldwide are Japanese.
- The two major U.S. turbine manufacturers, General Electric and Westinghouse, discontinued making geothermal turbines many years ago. A few other U.S. companies claim the capability to manufacture large geothermal turbines, but have a limited track record in this size range.
- U.S. manufacturers can potentially compete well in the small (< 25 MWe) turbo-generator market. This is particularly true for wellhead turbo-generators in the 3-10 MWe range.

In general, most U.S. geothermal firms are inexperienced in overseas marketing and project development.

- With the exception of geothermal subsidiaries of the larger oil companies and the large A&E firms, most smaller developers and power plant constructors cannot demonstrate substantial overseas experience. The smaller and second tier companies are interested but unsure and cautious.

- U.S. geothermal companies generally conduct intelligence gathering and marketing with little outside input or coordination; little information is shared. This puts U.S. bids for turnkey projects at a disadvantage with the concerted, coordinated bids by firms from competitor nations.
- Since the selection is generally made by the LDC, awareness of U.S. industry capabilities by the decision-makers is limited.

D. AVAILABLE FINANCING OPTIONS

There are two basic modes of financing geothermal projects -- public sector (either loans or grants) from bilateral or multilateral donors, and private sector in the form of loans or equity financing.

- All financing by multilateral lending organizations (e.g., World Bank, Inter-American Development Bank, etc.) are negotiated with the host country government; most (if not all) bilateral assistance, either in the form of loans or grants, are also government-to-government.
- Decisions on projects and contractors, therefore, are made by or on behalf of the host government.

- Financing from multilateral funding sources is generally open to bids from any member nation company, subject to host country shortlisting.
- Financing from bilateral funding sources generally (but not always) is limited to bidders from either the donor or recipient countries. Sometimes it is sufficient that only the majority of the goods or services be from these two countries. In AID funded projects, for example, at least 51 percent (in dollars) of the goods or services must be from the U.S..
- Rules on bidding for multilaterally funded projects are generally clear cut.
- Private sector financing from commercial banks or investor groups are given for projects not in the LDC public sector.
- Because the primary criteria for private sector financing is assured return on investment, the terms are tougher and the project risks lower.
- Public sector financing is generally most used for large sectoral or capital projects; by their nature, large loans are planned, assessed, and earmarked well in advance.
- Private sector loans can be, and are used for smaller capital projects, and decisions can be quickly made. Private sector financing is generally not available for feasibility studies,

exploration surveys, or field development (unless it results in a contract for energy sales).

- Private investor groups (including the geothermal company involved) may take equity positions in return for their financial support.

Commercial financing is best suited for power development projects in the \$20-\$40 million range.

- Projects of this size are generally too little for the multilateral funding agencies, unless it is part of a larger package with co-financing.
- Commercial banks with the need for short payback times (1-3 years) generally feel comfortable in this range.
- This funding range is ideally suited for small power plants (<25 MWe).
- Private investment groups and self-financing is a good option for projects in the \$10-\$30 million range.
- Local financing can often be secured for a portion of small projects; however, interest rates tend to be very high.

- In financing U.S. geothermal projects overseas, most commercial lenders will require U.S. government guarantees (such as from the Eximbank).
- U.S. government co-financing and loan guarantees would be important parts of commercial financing of small projects.

E. GOVERNMENT ASSISTANCE PROGRAMS

By Congressional mandate and agency missions, the U.S. government offers a wide range of export assistance programs applicable to the U.S. geothermal industry.

- Over 15 federal agencies offer approximately 100 export assistance programs. These programs range from counselling to publications and data bases to financial assistance and risk insurance.
- Identifying and using these assistance programs is generally considered (by the industry) to be time-consuming and frustrating.
- Most of these assistance programs are focused on the exports of goods rather than services. In addition, since most geothermal opportunities are "projects," involving feasibility studies, hardware, service, financing, and training, using many of these programs becomes of questionable value.

- Assistance in project financing (e.g., feasibility studies, loan guarantees, risk insurance, etc.) is usually most available for larger projects.
- CORECT is the best match as a government umbrella group for the U.S. geothermal industry to work with.
- CORECT has a modest budget and has already assisted the U.S. geothermal industry (e.g., Reverse Trade Mission in 1987); however, constant industry involvement and input is necessary to attract Committee attention from competing U.S. technology groups.
- U.S. export assistance programs, focused through CORECT, can play a major role in implementing the U.S. Geothermal Export Strategy.

A number of states have instituted export assistance programs applicable to the U.S. geothermal industry.

- California Energy Commission's (CEC) "Alternative Energy Export Program" has sponsored a number of initiatives specific to the geothermal industry.
- CEC-sponsored trade missions and seminars of particular interest are upcoming.

- A few of the California geothermal companies are already enrolled in the CEC program.

4. LEGAL ASPECTS OF SELECTED STRATEGY

There are a number of legal, political, and trade policy issues that influence the viability and ultimate success of the U.S. Geothermal Export Strategy. Some of these issues are readily visible now; others will only be uncovered in implementing the strategy. Political and policy issues are generally broad and of limited susceptibility to influence by the geothermal industry. In addition to the legal issues of doing business overseas, a number of issues may need to be examined in the formulation of the Strategy itself. They need addressed before adoption and implementation of the U.S. Geothermal Export Strategy. Salient legal issues include:

- Can groups of firms jointly agree not to market or compete on certain projects on a selective basis?
- What latitude would NGA have in promoting individual firms or groups of firms (consortia) to financial and buyer organizations?
- What are the limits of joint industry-governmental promotional initiatives?
- What are the limits of joint industry-government efforts to influence U.S. trade policy?

- Are foreign firms with U.S. offices qualified to participate in the Strategy?
- To what degree can information developed under U.S. government-funded efforts (e.g., feasibility studies, trade missions, etc.) be withheld from the rest of the industry?