PDWBB008

Final Report of the

'94 WIND ENERGY APPLICATIONS AND TRAINING SYMPOSIUM

Amarillo, Texas, Bakersfield, California and Minneapolis, Minnesota

May 1-13, 1994

Presented by

American Wind Energy Association

Prepared by

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Sponsored by

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This year the American Wind Energy Association held its seventh Wind Energy Applications and Training Symposium (WEATS) in conjunction with the association's annual Windpower conference. Energy planners, policy makers, project engineers and business people from targeted developing nations are invited to the U.S. to learn about the U.S. wind energy technologies and companies through presentations and field trips. Nominations are compiled through suggestions from members, recommendations of participants from prior years, contacts with representatives from emerging international markets, and suggestions from U.S. Agency for International Development and the Department of Energy.

ACCOMPLISHMENTS

As happens every year, there was substantially more demand for than supply of fully paid or cost-shared slots. Additional funding from various sources and careful management of expenses allowed AWEA to bring 19 guests from 14 developing nations to WEATS and Windpower and six international guests to just Windpower, bringing the grand total to 25 participants. This record- breaking number of participants is up from 23 last year and thirteen the previous year. Of the six guests who participated only in Windpower, four attendees from India were funded mostly by the U.S. Agency for International Development, the New Zealand representative participated on a cost-shared basis, and the guest from England was sponsored by AWEA and NREL. Other funds utilized included existing AWEA support from the International Fund for Renewable Energy and Efficiency (IFREE) and from the U.S. Department of Energy's Wind Division through the National Renewable Energy Laboratory.

Another significant factor allowing additional invitees was the substantial reductions achieved in airfare costs. As last year, AWEA managed to bring many more people than in the past for approximately the same airfare budget. These savings were mostly due to careful shopping among the airlines. That we brought almost the same number of participants as last year on the same budget is particularly noteworthy because of the extended agenda this year compared to last: In '93 we travelled only to Texas and California, and in '94 we travelled to Texas, California and Minnesota.

THE PROGRAM

The program activities began May 1-4 in Amarillo, Texas, and continued May 5-8 in Bakersfield, California and May 9-13 in Minneapolis, Minnesota. (See attachments for a list of guests and an agenda.) Consistent with previous WEATS events, the format included classroom-style training and field trip experiences to acquaint the participants with the history and progress of wind energy development in the U.S. The speakers were drawn from the U.S. wind industry, federal government agencies and laboratories, non-governmental organizations and the utility sector.

Subjects covered during the program ranged from basic introductions to the technology to detailed discussions of resource assessment techniques and the challenges of integrating wind into the utility grid (see agenda). Field trips included a visit to the testing facilities at USDA/Bushland and the Alternative Energy Institute at West Texas State University, as well as the Southwest Public Service Facility's small grid-connected wind project in Texas and the

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Tehachapi Pass in California for a windfarm tour, where the group visited the sites of Zond Systems, Cannon, SeaWest and FloWind. A highlight of the windfarm tour was seeing two of the new turbines from DOE's Advanced Turbine Program: R. Lynette and Associates' "AWT" and Zond's "Z-40". The WEATS participants were privileged to be the first people outside of select Zond employees to see the Z-40, which was ceremoniously unveiled to the general public at the Windpower Conference the next week.

PROGRAM IMPROVEMENTS

As the WEATS program grows and industry focus evolves, AWEA reviews the structure of the program and makes any changes we think might improve it. Several of the changes we made this year follow.

The wind industry continues to mature in international markets. As a result, the wind activities in target countries/regions increase, and with that, the knowledge level of our WEATS guests. Additionally, as AWEA continues to work in these key countries, we gain a broader base of contacts who are active in wind energy in their countries, and who may be appropriate candidates for training programs such as WEATS. This year's attendees were more knowledgeable about wind energy than participants in past years, and this knowledge was reflected in their questions and country presentations. The agenda will have to change to reflect this increased understanding of the technology, although strong support was still voiced for the "fundamentals" materials covered early in the WEATS program and in the preconference (Windpower) seminar.

In order to keep the agenda of the WEATS program as focused as possible on technology training and not on specific companies or products, we changed the format of the industry presentations. In the past, companies gave brief introductions to their products and services throughout the week of WEATS. This year we had a WEATS group lunch every day of the Windpower program at which companies were offered time to give their presentations and have lunch with the guests. We found that this format offered several benefits: primarily, it gave the WEATS attendees a chance to better understand the technology and related issues before giving them sales pitches for particular products and services. In addition, it gave WEATS guests a chance to digest all the training information before confusing them with company, individual and product names. Lastly, it allowed more time for the company presentations, questions and answers than was allotted during the tightly scheduled WEATS agenda. After hearing the company presentations in this format, the WEATS guests had a better idea of the companies and what they offered and could set up meetings with those companies that interested them. Not only did we find that this daily luncheon was a success in these respects, but it also provided the WEATS guests with a definite place and time every day to discuss individual schedules, group events or any problems or concerns they may have had.

The debriefing sessions with each country were changed a little bit more this year to allow even more thorough interaction between AWEA staff and the guests. Instead of a group one-hour, wrap-up session such as two years ago, or 30 minute one-on-one meetings such as last year, AWEA staff (Kevin Rackstraw, Mary Grady, and Sergio Castedo) met with participants from each country over the course of the WINDPOWER '94 event for at least an hour. This was a

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particularly good method for exploring the next step(s) needed in each country toward development of their wind energy potential. Brief presentations about wind energy development in all each country represented were made by the participants throughout the week of WEATS. The information gleaned from the AWEA debriefing meetings, along with the presentations made for each country, is the basis for the country reports contained within this document.

AWEA also aggressively set up meetings between WEATS participants and industry members expressing interest in meeting with one another. WEATS guests were asked to identify companies with whom they'd like to meet, and companies were instructed to schedule all meetings with WEATS guests through AWEA staff. Although this type of meeting facilitation has been done in the past, it was structured much more formally this year. Each WEATS participant had a daily meeting schedule posted on the bulletin board in the WEATS room which they checked a couple of times a day to see if new meetings had been scheduled. This new arrangement worked out quite well, and it was commented by several Windpower attendees that it was the busiest they'd ever seen the WEATS meeting room.

EVALUATION

The 1994 WEATS program was a highly successful trade development event. Numerous side meetings had to be scheduled to meet the particular needs of all participants, but all expressed interests appear to have been satisfied either on-site or through follow-up that is now underway. Follow-up has always been extremely difficult due to limited staff resources, however, follow-up from last year has led to increased activity in many of the regions, and even led to WEATS nominations for this year as international wind energy programs expand. Based on information gathered during the conference, AWEA will set priorities and schedule additional follow-up activities. Despite the fact that the number of attendees this year at WEATS was one of the largest ever, having three AWEA international staffers instead of only two (due to the recent addition of Sergio Castedo) made providing individual attention to guests a bit easier.

Although the success of the event will be measured by activities that flow out of the conference, AWEA's following-up on all potential opportunities will be difficult and will be pursued on a priorities basis. A number of countries represented at WEATS are marginal to AWEA's strategic focus but still offer opportunities. These will be passed on to members with limited support from AWEA, whose stance will be reactive, rather than proactive in these markets. In key markets, such as Chile, Argentina, Brazil, Central America, Philippines and Indonesia, AWEA will move aggressively to build on existing momentum.

AWEA's market priorities among the countries represented at WEATS vary depending on the size of system involved and the type of application. For a quick summary of how these priorities sort out, countries are categorized below into three groups. "A" countries are those that have good wind resources, a substantial level of current activities that are expected to accelerate the market for wind energy, and show strong promise of very near-term sales of U.S. equipment and services. "B" countries have good potential but are not as far along in the exploration or development of wind energy. "C" countries have very little or no activities in wind energy and tend to hold relatively long-term promise. Countries are also broken down by application/system size.

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Categorization of WEATS Represented Countries for Small Systems

ACTIVITY LEVEL:	PRIORITY: A Countries	B Countries	C Countries
High	Philippines Russia		
Moderate	Guatemala	Indonesia	
Low		Brazil Honduras Argentina Chile Bolivia	China Jamaica Nicaragua Spain Cook Islands

Categorization of WEATS Represented Countries for Wind Farms

ACTIVITY LEVEL:	PRIORITY: A Countries	B Countries	C Countries
High	Argentina Chile		
Moderate	Brazil	Spain	
Low		Guatemala Honduras Nicaragua China Jamaica	Philippines Russia Cook Islands Indonesia Bolivia

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RECOMMENDATIONS

1. One element that could be improved upon is some real hands-on experience. Most of the attendees are engineers and would very much like to see equipment up close. This year in Texas, the participants viewed a large turbine without its nacelle, which offered an excellent opportunity for guests to see the inner workings of the system. In California we spent about a half hour each in SeaWest's and Cannon's windfarm control rooms, but would have liked to have spent more time looking around and asking questions. These are the types of opportunities that should be enhanced.

2. Several subject areas need to be included, expanded or improved:
   batteries: very little good information was provided (or is available) on the performance or cost of batteries; this is an absolutely critical area for small systems in remote locations;
   software/models: numerous questions were asked about this area; software and/or models provide a good way of having an ongoing effect on and connection to future guest activities;

3. As many of the WEATS guests work for the utilities in their countries, they need to have more contact with utility representatives in the U.S. who can share their experience with incorporating wind into the utility mix. We should offer a utility workshop during the program, similar to the resource assessment training we have added.

4. Follow-up communications will be key to successful harvesting of the opportunities presented at WEATS. A continuing link between AWEA and the guests and within the guest group in order to share experiences would be extremely useful. In our new offices, AWEA has electronic mail and fax broadcast capability. We will continue our communication with WEATS guests throughout the year by sending out periodic reports of what we are doing, and news of what wind activities WEATS participants are pursuing. Perhaps a more formal WEATS newsletter is an idea for the future.

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1994 WEATS COUNTRY REPORTS

Prepared by

Mary Grady, International Programs Specialist

and

Sergio Castedo, International Technical Specialist

June 13, 1994

Argentina
Guest: Carlos D'Alesio, IDESA Ingenieria.

Energy Picture

Over the past several years, Argentina has pursued an aggressive restructuring and privatization program in its energy sector. The electric industry in Argentina has been disaggregated by privatization into generation, transport and distribution. By December 1993, Argentina had sold off 7,619 MW of generation, while another 4,780 MW remained to be sold. The privatization of electric utilities and deregulation of electricity generation facilitates the entry of wind energy generation through the decentralization of decision making to the utilities and a movement toward market-oriented pricing. The installed electric capacity is about 15,250 MW. This includes about 6,620 MW of hydroelectric, 1,018 MW of nuclear, 5,070 MW of oil, 2,138 MW of gas and 405 MW of coal or lignite. Over the next 6 years, the total payments to independents will fluctuate between 3.75 cents/kWh and 4.4 cents/kWh, with future adjustments taking into account changes in the prices of goods and services, as well as increased costs outside the control of the licensee.

Wind Resource

Wind energy for water pumping has been utilized in the Argentine pampas for over a century. There are over 10,000 installed turbines with 1.5 kW or less, 20 with up to 10 kW, 5 with 10 to 100 kW and 2 with over 100 kW. Argentine regions that present the largest potential are in Patagonia, the Atlantic coast, the Andean regions, the pampas and the central mountains. It has been estimated that the notably windy conditions of southern province of Santa Cruz would easily permit an installed capacity of 6500 MW in wind farms and that 90% of the surface of the provinces of Santa Cruz and Chubut are able to produce a minimum average power of 500 watts/meter square per year. Patagonia has prevailing winds with a mean speed over 7 m/s available more than 80% of the time. Battelle/Pacific Northwest Laboratory has estimated the wind energy potential of Argentina at up to 500,000 MW, representing one of the best wind resources in the world. Much of this resource is far from load centers, however, making the developable resource much smaller.

Current/Planned Wind Activities

The "Sistema Interconectado Nacional" (SIN) connects the major populated areas in Argentina; in 1990 this system accounted for about 90% of the total generation, with the rest generated by producers not connected to the grid. Because of low electric prices offered to most grid-connected customers, it appears that the major opportunities for wind are in rural electrification. The Secretaria de Energia estimates the number of people outside of the reach of line extension at 3 million, or about 8% of the total population. They are geographically located primarily in the regions not covered by the SIN, that is in the North and in southern Patagonia, and can be a major target of some of the funding available from local and multilateral sources. One Danish wind company has signed a contract for 500 MW with the Province of Buenos Aires. Other wind projects ranging from 5-100 MW are under discussion in several provinces. One small wind system supplier provides turbines for cathodic protection of Argentina's major oil pipelines. The presence of several local manufacturers of wind equipment offers good opportunities for joint ventures. In 1994 the total installed wind capacity in Argentina was around 3.7 MW. It has been estimated that for 1994-1997 the potential installed capacity could be 14.3 to 27.7 MW.

Follow Up Activities

The project opportunities will need to be developed through the provincial electric regulation authorities. By way of examples, the Province of Buenos Aires has funds available for projects having a social impact, and a project to use PV and wind generators to provide electricity to 490 rural schools over a three year period, beginning with about 100 schools the first year, is under consideration by the Ente Provincial Regulador Energetico (EPRE). The estimated requirement is about 1 kWp per school. The Dirección de Energia de Jujuy has provided electricity to 70 schools using primarily PV, and the program will be extended in a second phase to provide larger systems to a number of schools. A number of municipal and electric cooperative organizations (Pico Truncado, Santa Cruz, UCELCA, Cordoba) have expressed interest in similar wind-hybrid projects. Private projects to establish new self-powered communities on arid, low-cost land where water can be pumped are also being considered.

AWEA also discussed with Mr. D'Alesio the utilization of wind in large irrigation processes for a jojoba plantation. This particular project in the province of La Rioja was presented to AWEA in 1993. Since then, the world market price for jojoba has plunged and as a result the local government has been forced to subsidize the price of electricity generated by the provincial utility (EPELAR). The jojoba plantation owners pay around 3 cents per kWh. However, with the privatization of EPELAR the subsidy will have to be removed and this will force the local government to look closely at the possibilities of developing wind in the region. Currently, the plantations are irrigated with pumps of 125 hp in 3 deep wells (70 meters below ground level). The local farmers have also identified the need for two additional wells.

Bolivia
Guest: Danilo Carranza, NRECA-BOLIVIA

Energy Picture

Bolivia is a landlocked country of 1.1 million km2, made up of three different geographical zones: 1) the Altiplano, a highland at an altitude of 3,000 to 4,000 meters; 2) the fertile valleys and; 3) the Llanos, or lowlands in the eastern part of the country. It is also one of the poorest countries in Latin America with a per capita income of US$630, which is reflected in poor social conditions and inadequate development of the country's human resource base. The country entered the 1990s having successfully stabilized its economy and today has a small but stable economy. The economic growth rate has averaged 3.5% since 1987.

The energy production is derived from: oil, natural gas, biomass and hydro. At current production levels, oil reserves are expected to last for another 14 years. Less than 2% of the 18,000 MW hydro potential has been developed. There is also a geothermal potential estimated at 350 MW. Since 1972, Bolivia has exported natural gas to Argentina. In 1992, the Government signed a contract for the export of gas to Brazil's biggest market: Sao Paulo. The country's principal energy objective is to become a distribution center for South America. The installed electric power capacity was 749.6 MW (42% hydroelectric). The thermoelectric units are fueled mainly by natural gas. Sixty percent of the installed capacity belongs to the National Electric Company (ENDE).

Wind Resource

The wind speed records of Bolivia's Servicio Nacional de Meteorologia e Hidrologia and the United States military account for virtually all of Bolivia's available wind speed data. The South American wind energy map published by Pacific Northwest Laboratories (PNL) identified a central region of the country in the 2 to 4 class range. This classification corresponds to an annual average wind speed velocity of 5.1 to 6.0 m/s at a height of 10 m. The city of Santa Cruz, located in this region, exhibits wind energy potential that would favor the economical utilization of wind energy systems today. The region is characterized by a flat, unobstructed nature of the terrain. Except for the area around Santa Cruz, the true wind power potential in Bolivia remains to be determined.

Current/Planned Wind Activities

In April 1994, the Dutch Government expressed interest of financing a windfarm near Santa Cruz. By the end of 1994, NRECA-BOLIVIA will install seven anemometers in different regions of the country and two wind hybrid systems for irrigation. This organization is already working very actively in rural electrification with photovoltaic system and is interested in increasing the utilization of wind power for rural applications. AWEA has agreed to provide support in setting up the seven anemometers so as to help determine Bolivia's wind potential. NRECA is interested in purchasing more anemometers in the future.

Follow Up Activities

Presently, NRECA and AWEA are working very closely in coordinating their efforts in South America. Both organizations have expressed interest in developing a wind map for the country. NRECA's experience will be very useful in developing wind projects for electrification in Bolivia. Zond Systems has also expressed interest in developing wind in Bolivia.

Brazil

Guests: Carlos Alvarenga, CEMIG; Pedro Bezerra, CHESF; Sergio Cardoso, COELCE

Energy Picture

Brazil, the largest country in South America, has an installed energy capacity of 58,140 MW (included is the 12,600 MW Brazil-Paraguay joint venture Itaipu hydro station), 96% of which is produced by hydroelectric plants. The installed capacity of the main utility holding company, Electrobras, is 25,389 MW, and primarily investor-owned utilities account for 20,151 MW. The annual average load growth for the country is expected to be 5%, however, many of the states in the northeast are forecasting a 6-7% annual load growth for the next ten years.

Since privatization is seen as the only way the government can raise enough money to make the investments needed to meet growing demand, the movement toward an open market in power generation in Brazil is taking shape. Much depends on constitutional reforms and legislative initiatives that have yet to be decided by the Senate. At the moment, privatization initiatives are stalled due to senate elections, which will take place in October (2/3 of the senate is up for election). If and when reform measures pass, Brazil could offer private developers a huge market for both new projects and the purchase of existing assets: selloffs, including Electrobras, could total as much as 6,200 MW in the first round (which could be sold either through stock offerings or competitive bids) and new capacity additions available to the private sector could reach 16,315 MW. The legislation now under consideration would also allow both state-owned and privatized electric companies to increase rates without first obtaining federal approval. Currently, all electric tariffs are equal, resulting in huge losses in some states. This gap between generating costs and end-user rates has resulted in a debt of $20 billion. The government is under pressure to increase electricity rates by up to 40%.

As Electrobras has the responsibility for providing financial resources for energy expansion, the state electric companies have the responsibility of providing electricity to residential and industrial consumers. Presently, since most states purchase the majority of their power from an out-of-state generating company such as CHESF (the hydroelectric company of the São Francisco river), a major objective of state planning for new generation sources is to maximize the use of indigenous resources in order to keep money in the state to assist with internal economic growth. The last major hydroelectric source outside the Amazon (Xingo) will soon be tapped, and the northeast region is expected to experience a serious shortage of electricity by 2004 unless other sources are introduced. For this reason, many of the states in the northeast have begun to consider wind energy as an option for indigenous and economic energy generation. That this region boasts 90% of the wind potential in Brazil makes the wind alternative seem ideal. Other states outside of the northeast that are planning large wind projects are Minas Gerais, Parana, and Rio Grande do Sul.

Small wind stand-alone and wind hybrid systems also have very near term market potential for rural electrification, telecommunications and water pumping, especially in the arid northeast, which is facing the driest year of the century. These small wind energy applications represent a sizeable market since water pumping and rural electrification have become priorities in many states around election time. In the state of Minas Gerais alone, there are over 300,000 homes

without electricity, and CEMIG expects to electrify a third of these (100,000) in the next ten years. In addition, there are 310 isolated electricity systems throughout Brazil (primarily diesel) with a total installed capacity of 1,400 MW. They are located in the north, the interior and on islands and present an opportunity to be coupled with wind turbines. The market for wind technology for these smaller applications should begin to see growth as experience is gained with the few turbines installed through the DOE/NREL renewable energy rural electrification program.

Through the World Bank PAPP program (the small producer support program), small-scale renewable energy systems are one option for energy provision to productive end-users. Ten states in the north and northeast are eligible for PAPP funds for projects, which are limited to $40,000 per project after import taxes and shipment. Ten percent (10%) of this cost, or $4,000, must be paid by the community, and the other 90% is paid by the Federal government. Villages in the participating states place a request for electrification and/or water pumping systems to the mayor, who with the assistance of a technical committee, chooses the most efficient way to provide for the villages' request, including consideration of small wind systems.

Wind Resource

Various groups are undertaking wind resource assessment for wind energy projects. These groups include: the Electric Company of Alagoas (CEAL) through the Wind Energy Group (WEG) at the University of Pernambuco, the Electric Company of Bahia (COELBA) through the WEG, the Electric Company of Ceara (COELCE) through GTZ, J.Macedo and CHESF, the Electric Company of Minas Gerais (CEMIG), the state of Pernambuco through WEG, the state of Parana and the state of Rio Grande do Sul through the Secretary of Energy of the State.

The estimated Brazilian wind potential at promising sites is about 21,700 MW, and an estimated 90% of this potential is located in the northeast region. Typically good coastal sites render annual averages between 8 m/s and 10 m/s.

Current/Planned Wind Activities

The Wind Energy Group (WEG) at the Federal University of Pernambuco, under the direction of Everaldo Feitosa, has been working for the past 15 years to develop support for practical applications for the technology in Brazil. The group is involved in wind technology R&D and provides consulting services to wind energy projects throughout Brazil. Currently they are working in five states in such areas as wind resource assessment, wind/diesel hybrid systems, wind systems for irrigation, wind project feasibility studies and wind project evaluation.

Two large wind projects are currently in operation in Brazil:
The Wind Energy Group boasts involvement in the installation of the first large wind (75 kW)/diesel hybrid system in Brazil on the remote island of Fernando de Noronha, a fuel-saving project which was implemented with the cooperation of CELPE, the WEG and Folk Center/Denmark. And CEMIG was recently the first utility in Brazil to install a grid-connected windfarm at Morro do Camelihno. The US$ 1.54 million 1 MW demonstration project, which was just inaugurated in April, was 51% financed by the German *El Dourado* program.
CEMIG is already planning for expansion of this demonstration project as well as future wind projects.

Three wind projects are planned for the near term. (1) A US$ 2.1 million (49% paid by COELCE) 1 MW demonstration project on the "Porto do Mucuripe" (a fingerlike peninsula of the Fortaleza harbor) to be financed 51% by the German *El Dourado* program. Proposals are currently under analysis and once begun, construction is expected to take 17 months. (2) Two 30 MW windfarm projects being discussed with the Overseas Economic Cooperation Fund (OECF) of Japan, since the Japanese government has reserved money for environmental preservation projects in Brazil. The projects will be internationally competitively bid, but the Japanese (i.e. Mitsubishi) have been actively courting the Brazilians in this area.

In April, CEPEL held a "National Meeting for Renewable Energy (wind and PV) Development" to develop a national plan for renewables. Representatives from CEPEL, Electrobras, the Federal Ministry of Mines and Energy, the Ministry of Finance and Technology, the state electric companies, and US and European agencies were present to build this national plan, which is now referred to as the "Declaration of Belo Horizonte." The goal for wind development stated in the Declaration is 1000 MW by the year 2005, and although ambitious, represents the Brazilian government's serious stance on including renewables in the future planning scenario.

Follow-up

1) Since the lack of reliable wind resource information is a major constraint to project development, AWEA has been called upon to assist in determining appropriate sites and amount of detail for windmapping. We intend to ask Dennis Elliott of PNL for his advice regarding the cost to analyze and correlate existing data, such as was done in Mexico. We will coordinate with the WEG, specifically Everaldo Feitosa, on this matter

2) Pedro Bezerra from CHESF was invited to participate in NREL's visiting scholar program to work on the Hybrid systems model and help identify potential projects in Brazil

3) As promised to Sergio Cardoso, ECRE will look into using America's Twenty-first Century (A21) money for the 1 MW wind demonstration project planned for Ceara, which hasn't procured equipment through El Dourado yet, as was planned. The chances of leveraging this project through this year's monies are slim, and AWEA is not too sure it's a good idea to spend scarce financial resources on small demonstration projects

Chile
Guest: Manuel Quevedo, Empresa Electrica de Antofagasta ELECDA.

Energy Picture

Chile has often been hailed as a model developing country, particularly in terms of the market orientation of its economy and its emphasis on privatization in areas such as the energy sector. For the last nine years the average annual growth rate has been over 6%. Today, Chile imports 40 percent of its total energy needs, primarily in the form of oil, liquid fuels and coal. This has moved the government to promote the substitution of petroleum with other types of energy such as hydroelectricity, domestic coal, geothermal power and renewables.

The electric sector has been developed around four independent systems in three main zones: 1) In the North, the Sistema Interconectado del Norte Grande, SING, supplies mines and industries; 2) In the center, where most of the population lives, the Sistema Interconectado Central, SIC represents 80% of the country's total electric installed capacity and; 3) In the South, where there are two isolated systems in Aysen and Magallanes. Three large investor-owned utilities supply 90% of the power in Chile: Empresa Nacional de Electrcidad SA (Endesa), Compañia Chilena de Generacion Electrica SA (Chilgener), and Empresa Electrica Colbum-Machicura SA (Colbum). The total electric installed capacity in Chile is about 5,149 MW. This number includes about 3,099 MW of hydropower and 2,050 MW of thermoelectric power plants, mainly coal-fired. The annual load growth has been estimated to be about 5.5% until the end of the decade.

Wind Resources

Chile's potential for the use of wind power is estimated by Battelle/Pacific Northwest Laboratory at 25,000 MW. The same geographical features and climatological phenomena that drive California's wind farms are present in the northern third of Chile, and southern Chile for other geoclimatic reasons is one of the windiest regions of the world. Today, the greatest potential market for utility-scale wind power is found in the North primarily because of the availability of substantial hydro resources in the South. Remote communities and industries in both the north and south represent good potential markets as well. Recently, PV-Wind hybrid systems for cathodic protection were installed in the pipeline connecting the Argentine province of Neuquen to Chile.

Current/Planned Wind Activities

In Chile there are 2.1 million people who live in the rural areas (or 16% of the total population of 13.2 million). Out of this rural population, 47% (1 million) have no access to electricity. The declaration of Chilean President Frei that all rural populations be electrified within 6 years creates an outstanding opportunity for wind energy.

The Comision Nacional de Energia (CNE) is quite interested in maximizing productive uses in its rural electrification programs, given the country's economic development goals and the need to support economic growth in rural areas. CNE is actively looking for joint ventures for industry in photovoltaics, wind and microhydro technologies.

The Inter-American Development Bank (IDB) has a Fondo Nacional de Desarrollo Regional (FNDR) loan in Chile for approximately $250 million that has been used for grid extension in the past that is now being renegotiated for another 4-year term. Current negotiations are determining how this facility might be opened to wind and renewables.

On the large-scale side, Chile's utilities are looking at wind projects. The most significant to date is the 50 MW windfarm being considered by EDELNOR. The purchase of EDELNOR by a Southern Electric Corporation has slowed down the approvals' process, but the project should begin construction later this year. The electric power company, EDELAYSEN, is also planning to develop a 1 MW wind farm in Southern Chile and the distribution company, ELECDA, is considering the development of wind in Northern Chile.

Follow Up Activities

Mr. Quevedo will present a report to the Board of Directors of ELECDA on the opportunities to develop a wind farm. He expects that the Board will be interested and ask AWEA for support in developing a line of action. ELECDA needs to evaluate whether a joint-venture or a contract for the purchase of electricity is the most appropriate alternative in developing wind. Zond Systems and R. Lynette have expressed interest in following up this project. At the same time, AWEA is following very closely other developments of wind in Chile. Given the high investment rating Chile has attained, and the strong resources Chile has in wind, the country must rate as one of the most attractive places in Latin America to pursue wind projects.

The Chilean Energy Minister is a speaker at the REIA Conference in late June 1994 in Puerto Rico. He will discuss with AWEA and DOE officials the possibility of a U.S./Chilean initiative including wind.

China
Guest: Dai Huizu

Energy Picture

About 85% of China's electricity (181,000 MW) is generated by "electric power administrations," which are actually large electric utility companies with territories generally corresponding to one or more of China's political and administrative subdivisions, provinces or municipalities. The administration's build power stations, generate power, and sell electricity to industrial, agricultural and residential end-users. The four largest administrations account for almost 66% of the generating capacity of the electric utility networks. Two other regional electric power administrations and eight smaller provincial power administrations account for most of the rest. Although the administrations are considered independent accounting units, they are essentially bureaucratic organizations, and important investment, output, and pricing decisions are made in Beijing by the Ministry of Energy.

Based on an annual load growth of 9%, it is calculated that China will need about 125,000 MW by the year 2000, or between 15,000 MW and 18,000 MW annually to reduce the gap between supply and demand. The government and various utilities have issued or are preparing to issue solicitations for as much as 169,840 MW, not including outstanding proposals for about 52,000 MW of private power. At least half of the new power called for by the Chinese government will be built and owned by the private sector. To meet its electric power development goals, China is turning to "unconventional" development, including joint-stock companies and a strong mix of private, foreign investment. China's provincial power bureaus are separating the development of new generation and the operation and planning aspects of its electrical power industry by creating provincial power development companies that are responsible for contracting loans, paying interest and repaying debts. Contrary to reports in the Chinese press, China has not adopted a fixed rate of return on private power projects. Project returns are determined on a case-by-case basis at both the state and central government levels, according to Energy Ministry officials. New regulations have been developed that established 5 levels of authority, from the state down to the county level. These regulations are assigned to also allow the central Chinese government to gradually decontrol prices of electric power and give a greater sense of security to foreign and independent power producers, providing an avenue for IIPs and consumers to fight interference from state and local governments.

Wind Resource

There are two main regions with high wind potential in China: the coast area in southeastern China and the north of Inner Mongolia. In addition, Gansu Province, northern Xinjiang Autocad Region and the downstream of Songhuajiang River are also rich in wind energy resources.

Along the coast and nearby islands in southeastern China, the annual average windspeed reaches 6-9 m/s, making medium and large-scale windfarms feasible. Most of the villages in these areas are connected to the power grid. Mainland, north of Inner Mongolia, annual average windspeed reaches 4-6 m/s. In this area, extension of the grid is not feasible, therefore opportunities exist for stand-alone systems for individuals and villages.

Current/Planned Wind Activities

The Chinese government has taken great interest in the development of wind energy as one of the main sources for remote areas. The wind development strategy is to give priority to utilizations in remote and coastal areas which have good wind resources and a shortage of conventional energy. In the future, small wind turbines for pumping water, lighting and other small household uses will be developed, and in the medium- to long-term, large scale grid connected windfarms will become more important. There are currently 42 companies in China which manufacture 30,000 wind turbines a year, as well as 38 institutions and universities working on turbine design and wind technology research. These turbines are generally low-end, outdated and relatively inefficient. By the end of 1992, about 120,000 small turbines were being used in China, with a total capacity of 13 MW and 67 medium and large turbines totalling 6.2 MW. By 1994, there were 86 medium and large wind turbines (from various foreign companies: Bonus, Nordtank, Vestas, U.S. Windpower, experimental Chinese turbines and others), totalling a capacity of 13 MW. Another 10.2 MW is planned for installation by the end of 1994: 4.5 MW as phase I of the eventual 200 MW Nanao Windfarm, 3 MW at the Zhurehe Windfarm, 1.2 MW at the Zhangbei Windfarm, and 1.5 MW at the Donggang Windfarm.

The U.S. Department of Energy recently opened an energy efficiency center in Beijing and a renewable energy center is under discussion and planning. The Global Environment Facility (GEF) is considering a $7.5 million project focusing on small, efficiency and distributed renewable energy applications. The project is still in the proposal stage, however.

Follow-up Activities

1. A US/DOE trade mission to China led by Hazel O'Leary is scheduled (tentatively) to take place in July, and AWEA has been involved to ensure that a few wind companies have been invited to take part. Because of the interest and participation by Secretary O'Leary, this mission is very high-profile, and companies participating have been asked to sign deals during the trip.

2. As part of a resource assessment proposal to EPA, AWEA is seeking funding for a windmap of China (or provinces therein).

3. AWEA is also seeking to influence the makeup of the proposed $7.5 million Global Environment Facility (GEF) project for renewables in China.

Cook Islands
Guest: Michael Wilson, Cook Islands Electric Company

Energy Picture

The Cook Island group is made up of fifteen islands located in the South Pacific Ocean between Western Samoa in the west and French Polynesia in the east. The territorial waters and economic zone of the Cook Islands cover an area of 2 million square kilometers, while their land area totals approximately 240 square kilometers. The population of the Cook Islands is approximately 18,500, with 11,000 people living on Rarotonaga, the main island and capital of the Cook Islands. The islands in the southern group of nine islands are low-lying atolls, while the six northernmost islands are generally 5-9m above mean sea level. The highest mountain on Rarotonga is 652m above mean sea level. The Cook Islands' location predisposes them to renewable energy use. They have no fossil fuel resources of their own, and their remote location make shipment of fossil fuels costly and unreliable. They do have ample solar and wind resources and have made use of these energy sources in the past. However, after the introduction of diesel-generated grids on most of the islands, their renewable energy infrastructure (particularly wind turbines) fell into disuse. Presently, the Government of the Cook Islands is eager to reestablish the role of renewable energy, primarily wind, solar, and hybrid systems, in meeting the Islands' energy needs. This is due to both the high cost of diesel imports, the unreliability of shipping and supply (particularly outside Rarotonga), and the high cost of maintenance and repair of the generators themselves.

Wind Resource

Wind measuring instruments (velocity and direction) have been installed in Penrhyn in the north, and in Aitutaki and Rarotonga. According to a site selection report on the Cook Islands done for the Energy Division of the South Pacific Forum, the average annual windspeed for Rarotonga was 4.4m/s, with monthly averages exceeding this rate from August to January. Sites on Rarotonga were located that had higher average annual speeds, including the island's east coast (average windspeed 6m/s) and Matavera Coast and Matavera Hill (average windspeeds of 5m/s, and 6m/s, respectively). Reports from Aitutaki, an island located 220km north of Rarotonga, also indicated windspeeds fast enough for energy generation. Average windspeeds on Aitutaki's highest hill were 7.7m/s.

Current/Planned Wind Activities

The South Pacific Forum Secretariat is currently carrying out a Southern Pacific Wind Monitoring Project under the auspices of its Small Energy Projects Programme. The Project aims at providing accurate wind resource data for the participating countries(Vanuatu, Fiji, Tonga, Niue, Cook Islands), to be used in determining the economic feasibility of wind power for electricity generation. One monitoring site has been selected in each country, and wind resource measurements will be taken for two years, beginning in 1994. The project is being funded by the South Pacific Forum Secretariat.

Follow-up

We will maintain contact with Mr. Wilson to identify any necessary role for AWEA. No specific need has yet been identified.

Guatemala

Guest: Hugo Beteta, NRECA/CARES and the Fundacion Solar

Energy Picture

Guatemala has a total electric capacity of 654 MW, 65% of which is hydropower, and most of the remainder imported oil. A predominant 62% of the population is rural and only 40% have electricity, resulting in over 6 million potential customers. Many agencies, including the Guatemalan utility EEGSA, are beginning to take interest in alternative sources of indigenous energy, including wind. Both supply and demand side management are being implemented as EEGSA and NRECA are concentrating on smaller, decentralized solutions on the supply side and productive uses and ability to pay for electricity on the demand side. Regulation exists for private power generation and sale, and although a few years ago only one power purchase agreement was signed, fourteen were signed last year and twenty are expected in '95.

NRECA and the CARES (Central America Rural Electrification Support) program have been instrumental in initiating a new approach to energy reform with the goal of raising the standard of living in the region. AWEA is working closely with NRECA to generally incorporate wind and other renewables into the NRECA program and specifically to help identify potential wind energy projects. Focusing especially on the use of renewable energy sources, NRECA has developed a program which has focused on increasing the productivity of farms and rural industry. This productive uses program fosters rural development through employment creation and enhancement of productivity in small and micro enterprises.

Wind Resource

At least the two areas of Jutiapa and Palin are thought to have windspeeds sufficient for utility scale projects. Winds are currently being measured at these sites. There are also many areas believed to have ample wind resource for village power systems, telecommunications and water pumping. For this reason, Dennis Elliot of PNL is preparing a windmap of Guatemala through a cooperative agreement between AWEA and NRECA. In addition, many organizations including NRECA, EEGSA, GUATEL and private companies, have installed 19 wind measurement stations throughout Guatemala. These stations are measuring windspeeds in Palin Jutiapa, Huehuetenango, Livingston, San Marcos, Peten and Coban.

Current/Planned Wind Activities

With the eminent folding of CARES, the NRECA office will continue its work in renewables through the Renewable Energy Project Support Office (REPSO). REPSO Guatemala is operated by Winrock International, NRECA, and the Fundacion Solar, a Guatemalan non-profit organization. The REPSO office will be offering cost-share funding for renewable energy project pre-feasibility and feasibility studies. Under an open solicitation, developers may apply for funding to cover up to 50% of the costs of such studies. U.S. companies must have a local partner to be considered for support. Funding takes the form of a reimbursable grant that is to be repaid, interest-free, if the project goes forward to financial closure. A total of $200,000 in grant money is being offered under the solicitation. The USAID Office of Energy and Infrastructure, the USAID Regional Office for Central American Programs and the USAID Mission sponsors REPSO Guatemala. It is expected that two wind projects will be presented for the first round of pre-feasibility study funding.

In addition to offering funding for pre-investment studies, Winrock and REPSO Guatemala will work to link interested U.S. developers with identified project opportunities in Guatemala. Winrock will also assist in alerting U.S. companies to joint venture opportunities that we identify through this cost-share program.

Follow-up Activities

1. AWEA is helping to finance the completion of pre-feasibility studies for three projects:
    - a water pumping project at the Anderson finca in Guatemala
    - the wind/diesel hybrid project for the island of Ometepe in Nicaragua
    - the Santa Barbara, Guatemala village electrification project

2. AWEA will visit Guatemala in the short term to ensure that the finca owners and municipal utilities who are interested in doing wind projects are able to match up with U.S. industry in time to apply for pre-feasibility study money offered by the REPSO/Guatemala.

3. AWEA will discuss with NRECA the possibility of sending Edward Morales, the "wind guy" at NRECA, to the U.S. for resource assessment training

4. AWEA and NRECA will work on a contract outlining common areas of work and possible coordination efforts in not only Central America, but also Mexico, the Caribbean, Bolivia, Southern Cone and Brazil

Honduras
Guest: Armando Alvarez, Roatan Electric Company

Energy Picture

Honduras' 561 MW system is supplied primarily by hydropower, which is abundant and inexpensive. Currently, the country is experiencing severe energy shortages, resulting in daily brown and black outs, and the electric company, ENEE, is actively seeking new generation capacity. ENEE has asked for the advice and support of our guest, Armando Alvarez, to help solve mainland Honduras' energy problem. Armando Alvarez is the general manager of the Electric Company of Roatan, which is one of the Bay Islands 40 miles off the coast of Honduras. Roatan has a population of 25,000 and is the largest of the Bay Islands at 35 miles long east to west and 5 miles wide north to south. The island's topography includes beautiful beaches as well as a chain of mountains which run from east to west reaching heights of 1300 feet. RECO's aggressive pursuit of successful, replicable wind energy projects to be installed on the island in the short term are an indirect route to potential wind projects on mainland Honduras.

The Roatan Electric Company, RECO, began in February of 1993 out of a contract with ENEE, and was the first privatized electric cooperative in Central America. As an electric cooperative, RECO operates under the guidelines that the customers are the owners: each customer is a shareholder owning no more than five percent of the cooperative's shares.

In its first year of operation RECO has greatly increased the quantity and quality of service on the island. Four to five years ago, Roatan had no electric service other than small portable generators, and when RECO began it served 900 metered customers with a peak load of 900 kW. Fourteen months later, RECO serves 3000 customers (15,000 people) at a peak load of 3 MW. The total generation capacity is 6.6 MW of diesel engines, and RECO has plans to double the total generation in the next two years. An increase of this size will double RECO's initial investment in less than four years, leading to higher energy costs on the island. Armando Alvarez has begun looking at renewable energy alternatives, especially wind, to offset the high cost and detrimental environmental impact of diesel. RECO intends to incorporate renewables into its system for both on and off grid applications.

Wind Resource

There is not much wind data for mainland Honduras. Existing data is primarily from airports and meteorological stations, and as typical of this type of information, not accurately representative. We have a windmap for Honduras from a '92 WEATS guest, but we are not sure how accurate it is either. AWEA has loaned an anemometer to the Ministry of Natural Resources for a water pumping irrigation project, and it has been installed since April.

Mr. Alvarez is interested in getting anemometry equipment installed on Roatan as soon as possible, and AWEA is looking into transferring anemometers from another Central America location. There are also private companies interested in doing projects on the island who may perform a resource assessment themselves. Roatan has good winds which are stable throughout the year, as most islands in the Caribbean do.

Current/Planned Wind Activities
Mr. Alvarez has listed five projects planned for Roatan in the second half of '94 (dependent upon availability of funds and time), all of which he wishes to do with wind:

1. A 1 MW grid-connect project
2. A 150 kW wind/diesel plant in the village of Helene (population 900)
3. A 50 kW wind/diesel plant in the village of Curacua (population 250)
4. A 50 kW wind/diesel plant in the village of Crawfish Rock (population 150)
5. A 100 kW wind/diesel plant in the village of Diamond Rock (population 200)

Also planned for the first half of '95 are wind projects for the other Bay Islands:

1. A 500 kW wind/diesel plant for the island of Utila (population 3-5000)
2. A 500 kW wind/diesel plant for the island of Guanaha (population 2500)
3 A 200 kW wind/diesel plant for the island of Cochinos (population 1500)

RECO would want joint ownership of any installed projects; RECO won't buy electricity from a private producer.

Follow-up
1. AWEA will ensure that Mr. Alvarez is invited, paid, to the REIA Conference in Puerto Rico

2. AWEA will help arrange training for RECO personnel and technical assistance to projects as needed through consultants and NREL

3. AWEA will make a decision about anemometers for the island based on private company actions (if no companies come forward to offer resource assessment, AWEA will assist)

Indonesia
Guest: Abubakar Lubis, BPPT

Energy Picture

Indonesia, a Southeast Asian country made up of 13,677 islands, has a variety of energy resources at its disposal. Among the country's main energy assets are oil and natural gas, which provide a large percentage of Indonesia's foreign exchange through export earnings. Because of their importance to Indonesia's national income, as well as their role in ensuring an affordable supply of energy to the country, oil and natural gas have remained the dominant energy sources in Indonesia, followed by coal, hydro and geothermal. However, the current government development plan, (begun in 1994) aims at decreasing the role of oil in domestic power generation from 41.2% to 30.8%, in favor of gas, coal, and renewable energies.

By the end of the first quarter of 1994, the total installed energy generating capacity in Indonesia was 21,596 MW, with 13,510 MW being supplied by PLN, the state electric utility. In the past 17 years, electricity demand has grown at a rate of 15.9% a year: Due to rapid industrialization, Indonesia currently has a backlog of unconnected industries with a total estimated load of 4,000MW. Only about 60% of Indonesia's residential population has electricity, with outlying and sparsely populated areas such as Sumatra and Kalimantan having little access to power. As a result, the Indonesian government has embarked on an ambitious drive to increase the country's energy generation capacity by 27,500 MW over the next 10 years. This goal has been laid out in two consecutive 5 year plans, the first of which began on April 1, 1994 and called for an increased generation capacity of 12,250 MW.

It is likely that renewable energy will have a large part to play in Indonesia's energy future, particularly in the area of rural electrification. Because of the country's geography and population distribution it is particularly predisposed to decentralized power. The development of renewable energy is directed towards meeting the basic energy needs of the people, as well as towards supporting local economic activities. Although Indonesia has enormous renewable resources, they have not been developed to their full potential. The main constraints at present remain those related to economic aspects: a lack of financial incentives for market development and a lack of funding mechanisms to catalyze the development of renewable energy projects. Recent initiatives by the Indonesian government, however, indicate that these obstacles may well be in the past.

In early June 1994, the government announced that previous restrictions on joint ventures between Indonesian and foreign firms would no longer require a majority Indonesian stake in the venture, Foreign firms will now be allowed to invest in formerly restricted sectors such as electricity generation. It is the hope of the Indonesian government that private power firms will supply an additional 7,475 MW of power after 10 years. However, since PLN remains the sole distributor and transmitter of power in Indonesia, it is up to the Ministry of Energy and Mines to raise user rates to meet the generation cost and provide incentive for private actors to generate power for those already served by PLN. Based on these observations, it is probable that foreign firms will enter into the drive for increased power generation in Indonesia in areas outside of

PLN's reach[1], given adequate funding mechanisms and government initiative. Such support has been forthcoming in the recent past as the government has embarked on a number of initiatives to develop and introduce renewable energy projects:

1. Small Scale Irrigation Management Project (SSIMP) - supported by AID and bilateral donor aid from Japan (OECF); aims to make use of abundant groundwater resources to support irrigation-based agricultural practices, including year-round cultivation and more profitable crops; Bergey Windpower has turbines east of Kupang on Timor Island.

2. Eastern Islands Remote Power Project - IPC/Westinghouse's $20 million program for electrifying 50 rural villages with 20 kW stand-alone hybrid systems (wind/PV/diesel).

3. AID Renewable Energy pilot program - $2.9 million; Wind Energy for Islands and NGO development; GEF; small scale village projects.

4. World Bank Rural Electrification II project (REII) - $280 million; supports government rural electrification initiative; support for government's role in encouraging private power cooperation in rural electrification.

5. The Asian Development Bank (ADB)(from which Indonesia is the single largest borrower) has developed a plan in place through 1996 for Indonesia which focuses on diversification within the energy sector.

Wind Resource

Indonesia does not yet have a complete map of its wind energy potential. Although a continuous measurement of wind is carried out in meteorological stations in several big cities with airports, only limited areas of Indonesia conduct special measurements for wind potential. Dennis Elliot of PNL has performed a very preliminary analysis for the World Bank and has concluded that the southeastern islands have sufficient wind for small wind systems; in addition, there are some areas that have average wind speeds of 5.6-6 m/s, sufficient for use of larger systems. Measurements in East Java conclude that the average wind speed is 3-4 m/s.

Current/Planned Wind Activities

Wind energy is presently being used for small-scale electricity generation (500 watts - 1kW) to fulfill the basic energy needs of the rural population, including electrification of homes, water pumping, and powering boats. Some of the wind energy pilot projects are designed to support the growing electricity demand in rural areas and are being done in cooperation with rural community cooperative projects. The World Bank is considering a major component for wind (up to $10 million) as part of its $100 million REII loan package. Winrock and DOE/NREL

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[1]Again, rural electrification projects will constitute the majority of projects outside PLN's agenda. Although rural electrification is an important component of Indonesia's overall energy policy, PLN's coverage of this segment of the market is much smaller than that of the industrial sector, in which it plans to provide 80-90% of all need power by 2004.

will support a preliminary windmapping project that will help the Bank recognize the viability of wind for its REII loan.

A Renewable Energy Project Support Office (REPSO) has been established in Indonesia to assist companies and organizations design and build renewable energy products as well as to serve as a window for Indonesian developers to U.S. technologies, services and government assistance. REPSO Indonesia is prepared to provide technical and financial assistance to project developers, gather and disseminate useful renewable energy knowledge, and match U.S. renewable energy project developers with project opportunities.

In the current five year development plan (1994-1999) the Indonesian Agency for National Planning and Development (BAPENAS) aims at increasing Indonesia's energy generation by wind to 500 kW. The emphasis will be on small scale projects in rural areas, especially villages and small-scale home industries.

Follow-Up Activities

AWEA is providing ongoing support for resource assessment (through the anemometer loan program) and evaluation of existing wind projects. No new initiatives are currently planned.

Jamaica
Guest: Robert Patrick, Jamaica Public Service Co (JPSCo)

Energy Picture

Jamaica, the third largest country in the Caribbean, has not yet met the energy needs of its 2.5 million people. While 60% of the island's 4,400 square miles are electrified, the current system serves only some 330,000 customers. Given this lag in supply and potential demand, there is large room for growth in the energy sector.

Presently Jamaica has a total installed capacity of 793.4 MW, over 71% of which is supplied by the state-owned Jamaica Public Service Company, Ltd.(JPSCo). JSPCo is the only electric utility in the country and has the sole franchise to produce electricity commercially. Other power producers are the bauxite and sugar industries, and the Caribbean Cement Company; these generate power for their own use and sell surplus to JPSCo.

JPSCo estimates that demand for electricity in Jamaica will grow at an average annual compounded rate of 5% (or 250 MW/yr) over the next ten years. In response to both this increase in demand and the need for replacements for 300 MW of capacity to be retired, the state-owned utility has plans to install some 650 MW of generating capacity (valued at US$600 million) within this time frame.

The Government has also acted to encourage private participation in Jamaica's energy sector in an effort to meet demand. Consequently, all future generation expansion will be developed by private concerns on a "Build, Own and Operate" (BOO) basis. Since the instigation of this approach, two thermal power generation projects have been undertaken; these projects together generate 100 MW of electricity. Yet, there remain 7 pending private power generation proposals, totalling 440 MW, on which the Government has been slow to act.

The electricity demand over the next ten years is forecasted to grow at an average annual rate of 5% (or by 250 MW). To meet this demand growth and to replace some 300 MW of capacity to be retired, JPSCo plans to install 650 MW of generating capacity over the next 10 years.

Moreover,the Government has plans to privatize JPSCo's existing assets over a 3-5 year period. In anticipation of such a move, JPSCo has been split into two branches, one for generation (Gendiv), and one for transmission and distribution (Transdiv). JPSCo expects that Gendiv will be sold to a private company or consortium within two years following an international solicitation. The Government has said that the sale of Transdiv will follow, although no timetable has been outlined. There are plans to hand over the regulatory powers of the Ministry of Public Utilities, Mining and Energy to an independent regulatory body.

Jamaica currently imports large quantities of fossil fuels with which it produces the majority (89.6%) of its electricity. Use of renewable energy is low. Jamaica currently produces 21-23 MW of electricity through use of hydropower, with approximately 110 MW of hydro capacity untapped. There are currently no wind power facilities in operation in Jamaica. However, because of Jamaica's dependence on fuel imports, the Government is committed to exploring the possibility of renewable energy use on the island.

Wind Resource
The three characteristic wind patterns on Jamaica are tradewinds, coastal winds, and hurricanes. Several windmapping studies carried out in Jamaica have identified areas on the island that would be favorable windpower generation sites. These included Munroe, the Palisadoes strip, Yallas, and Rose Hill. A study done for the US Department of Energy by Pacific Northwest Laboratories identified numerous areas in Jamaica with "useful" (class 3 or greater) wind potential.

Current/Planned Wind Activities
To date there have been no coordinated efforts on the part of JFS or the government to pursue wind projects, however, the shift in future focus to private generation and any change in utility policy due to privatization will probably be favorable to wind. There are currently two wind project proposals being considered and one wind water pumping project is in the feasibility stage.

Mr. Patrick would like to see wind included as an option in the expansion plan, citing wind resource information for the island as well as basic project economics. He would also like to develop a cost shared windmapping plan with AWEA, and would like information to pre-qualify companies for project competitive bid process. He would like to see the first project be a replicable technology transfer project, leading to other project on Jamaica and in the Caribbean.

Follow-up

1. Send power curves for various turbines including: RLA's Advanced Turbine, Zond's Z-40, Cannon's new turbine and USW's 33 MVS and 56-100

2. Send sample RFPs for wind projects and sample contracts document

Nicaragua
Guest: Homero Villavicencio, Instituto Nacional de Energia (INE), Alternative Energy Resources Dept.

Energy Picture

Nicaragua's major energy resources are biomass and hydro. The country has a substantial endowment of renewable energy. Its hydropower potential has been estimated at 5,050 MW, of which only 2% is being utilized. Its geothermal potential is estimated at 2,000 MW, of which only 0.035% has been utilized. In 1992, 57% of primary energy came from biomass, 35% from oil, and 8% from hydro and geothermal power. Energy consumption declined by 3% in 1991 and regained 1990 levels in 1992. In the 1982-1992 period, the final energy consumption grew at an average annual rate of 0.8%, and per capita consumption dropped from 3.4 to 2.7 BOE. The country has an installed power capacity of 427 MW of which 56.7% are thermoelectric plants, 17.5% in a geothermal station, and the remaining 25.8% in hydropower plants. By 1999, Nicaragua plans to expand its capacity by 90 MW. In 1989 the electrification index was 38%.

Wind Resource

In 1987, a study conducted by Pacific Northwest Laboratories (PNL) classified the eastern coast and the central part of the country in the 2 to 3 class range. This classification corresponds to an annual average wind speed velocity of 5.1 to 5.6 m/s at a height of 10 m. In the same study, some parts of the western coast as well as the Ometepe Island are classified in the 3-5 class range, which corresponds to a wind speed of 5.6 to 6.4 m/s.

Current/Planned Wind Activities

The Nicaraguan Institute of Energy (INE), the government utility responsible for electricity generation, transmission and distribution, in cooperation with the National Rural Electric Association (NRECA) has been recollecting wind data for over a year. Mr. Villavicencio, Chief of the Alternative Energy Resources Department at INE, believes that in the future wind will be one important way of generating energy in Nicaragua. Today, INE is operating four measuring stations that have recorded average winds of 7.4 m/s at a height of 30 m and 6.18 m/s at a height of 15 m. There are three measuring stations located in the Nicaraguan Lake. One of these stations is located at San Jorge Harbor and two at Ometepe Island. The fourth station is located in Capulin. As a result of Mr. Villavicencio's increasing interest in wind power, INE is planning to expand the work it has carried so far with NRECA for another year. According to Mr. Villavicencio, INE and NRECA are interested in a 30 MW windfarm around the western coast of Lake Nicaragua. This windfarm could easily be connected to the national grid or Sistema Interconectado Nacional (SIN). The possibility also exists for a 250 kW hybrid system in Ometepe Island.

Follow Up Opportunities

INE is very interested in getting AWEA's collaboration and technical assistance in developing the wind potential in Nicaragua. Mr. Villavicencio will prepare a report to study the feasibility of the wind in the coast and main island of Lake Nicaragua. This report will be submitted to AWEA to start the application process for an IFREE pre-feasibility study. INE is also hoping to become a member of AWEA.

Philippines
Guests: Eloida Balamiento, Philippines DOE; Bert Dalusung, REPSO; Rodrigo Paras, NPC; Jesus Francisco, Meralco

Energy Picture

The Philippines is made up of 7,100 islands (2,000 of which are inhabited) and has a population of 61 million. The energy mix in the country is dominated by imported oil. which supplies 66%, followed by geothermal, hydro, bagasse and agri-waste. The power crisis situation, which was characterized last year by 4-8 hours daily of brown/black outs, has improved to only half an hour to an hour of daily brown outs, nevertheless the government is forced to seriously consider options for future expansion strategy of the energy generation and distribution system. Baseload capacity additions of 20,680 MW are planned by 2005. Legislation exists which allows for private generation, however, power purchase agreements are apparently tedious to negotiate.

The Non-Conventional Energy Department of the Philippines DOE has been involved in more than a decade of research, development and promotion of non-conventional energy systems and has now been tasked to formulate and direct a comprehensive national non-conventional energy program. Based on pilot and demonstration projects, technologies were classified according to their prospects of being readily commercialized. Wind energy was among the priority technologies classified for immediate development, therefore in promotion of a favorable market environment for both buyers and sellers of alternative technologies, financing and development incentives are being structured. These include: Removal of import taxes and duties on non-conventional technologies; Provision of financial assistance to users and manufacturers; Mandate for the NEA and other GFIs to provide loans for energy projects; Encouragement of electric cooperatives to undertake non conventional energy projects; and Ensuring the enactment of the noncon (non-conventional energy) bill. This bill will provide local manufacturers, suppliers, dealers, and users with the following privileges: Exemption from payment of custom tariff and duties and/or VAT of all imported non-con energy systems and components as well as local manufacture or repair of non-con energy systems; Depreciation of fixed assets to the extent of not more than twice as fast as normal depreciation rate; Exemption from all taxes, except income tax, for the local manufacturers if his only product(s) are non-conventional energy products and services.

Wind Resource

According to existing windmaps, the wind speeds in the Philippines range from 1-6 m/s, and it is estimated that there are numerous sites available with windspeeds of 5-6 m/s. Although these wind speeds are not especially high, they are adequate for economic small-scale projects as well as larger projects utilizing new technology. The country's wind resources are primarily a product of the Northeast and Southwest monsoons, of which the former stars in late September until April and the latter from May until early September. In addition, an average of 20 cyclonic storms lash the east coast of Luzon and the Visayas from June to December, reaching its peak in August. These typhoons originate in the Western Pacific, moving in a north-westerly direction over the Philippines.

In October of 1986, the Philippines Atmospheric Geographical and Astronomical Service Administration (PAGASA) completed a project entitled "Solar Radiation and Wind Mapping of the Philippines" which concluded the following:

1. The western sections of the country and extreme northern Luzon may have good potentials win wind energy utilization. However, proper precautions must be observed during occurrences of strong typhoon winds most especially in extreme Northern Luzon

2. The eastern portions of the country and the Mindanao region were observed to have relatively low wind speeds and low wind energy potentials.

3. The wind speeds were observed to be consistent and relatively high during the northeast monsoon season. Since less typhoon occurrences are observed during this period, this season may very well be a good time to fully utilize the wind energy resource.

4. The areas near the vicinity of Cuyo (5.58 m/s), Basco (5.39 m/s), Catanduanes (4.15 m/s), and inTagaytay City (5.0 m/s) showed a very high potential for wind energy utilization. This may be attributed to their geographical locations and the consistent high winds during the northeast monsoon season.

Aside from the above, potential sites include Lubang and Cabra islands off the Northwestern coast of Mindoro, the western portions of Batangas, Guimaras in Western Visayas, Subic in Zambales and the entire coastline along Western Luzon. The NPC has plans for a 10 kW pilot wind project on Romblon Island, which could be replicated on other islands. They are monitoring the wind resource at five other sites for wind project development: Burgos, Guimaras, Romblon, Catanduanes, Cuyo and Basco.

Current/Planned Wind Activities

The Philippines DOE Non-conventional Energy Division, the National Power Corporation (NPC) and the Renewable Energy Project Support Office (REPSO) are currently involved in activities targeted for windpower development. To provide for a conducive market environment for renewable technologies, the government is implementing a Renewable Energy Power Program (REPP), which has annual seed money of $27 million to provide financing for large and small-scale renewable energy projects. The fund, to be used as loans to cover up to 50% of project costs, was sourced by government financial institutions and can be augmented by any of the participating government financial institutions and/or funds from private, bilateral and multilateral sources. PDOE is negotiating with USAID for the infusion of a grant to the program. The fast-track projects initially targeted for this fund are hydro and biomass, but the program will be expanded to include wind and solar. Projects must be between 200 kW and 25 MW, although project bundling is possible. NPC and the National Electrification Administration (NEA) will provide technical and marketing support to the project developers and guarantee the purchase of the power generated from the plants. The goal of REPP is to have installed at least 50 MW of renewable power by the end of 1996. Another source of financing which will soon be available is the REFTA fund. The $3.75 million includes $3 million for renewable energy project support and $750,000 for feasibility studies and technical analysis of projects. The bid for management of this fund will close in July.

Based on an assessment of potential applications for wind energy in the Philippines by PDOE and UNIDO, PDOE has submitted a proposal to the UNDP for a Wind Energy Feasibility Support Program to establish the institutional can technical capacity at the national level to develop wind projects. If funded, the program will undertake a wind measuring program at 4-8 pre-selected sites over a 12 month period; provide on the job training for engineers and technicians in wind monitoring and data analysis based on the [illegible]ific wind data; develop guidelines and appraisal criteria for small and large scale wind [illegible]ogram; and support the formation of joint-ventures between overseas wind turbine manufact[illegible]s and Philippine partners. The REPSO office which was established in October of 1993 in the [illegible]ippines will sponsor a wind energy workshop late in 1994 and plans to support a "Nationwide Wind Resource Assessment Study."

In summary, the present and future wind energy projects and their implementing agencies are:

10 kW Wind Demonstration Project on Romblon	1994	NPC/PCIERD
Feasibility Study on Wind Energy in the Philippines	1994	DOE/UNDP
Nationwide Wind Resource Assessment Study	1994	REPSO
Workshop on Wind Energy Development	1994	REPSO
Conference/workshop on Small Wind Systems	Nov 1994	PDOE/CPU-ANEC
Resource Assessment/Economic & Financial Analysis of Wind Energy Technology	1995-96	PDOE
Development of Guidelines for Private Utility Participation in Wind Projects	1995-96	PDOE
Demonstration of Wind/Diesel Hybrid Project	1996-98	DOE-NPC
Technical wind Training	1996-98	PDOE
Installation of Medium-Large Wind Projects	1997-98	NPC

Follow-Up Activities

1. Dennis Elliot of PNL/NREL is preparing an estimate for a windmapping project. REPSO and PDOE will assist with data gathering and analysis

2. Coordinate PDOE's wind training with NREL and RETI

3. Participate in PDOE's small wind energy conference in November

Eastern Russia
Guest: Lev Ovis, LMW Windenergy Company.

Energy Picture

The Russian installed capacity is about 212,000 MW, including 148,000 MW from fossil-fuel plants, 44,000 MW from hydro units, and 20,000 MW from nuclear plants. In 1989, there were 50 power stations with capacities in excess of 1,000 MW, all but 12 located in the European regions of Russia. But up to 70% of all thermal generating units have passed their rated lives, and up to 100,000 MW may have to be replaced in the near future. The International Private Power Quarterly reported that as much as 50,000 MW are in need of immediate replacement. In addition the Russian power sector is very inefficient, as low as 25%, in some cases. Mr. Ovis compares the current energy crisis in Russia to the "Oil Embargo" that Western countries experienced in the 1970s. In the eastern part of Russia, energy is simply not available. In most cases, the wind systems Mr. Ovis has installed have shown to be the only reliable source of energy. For example, the emergency room in a hospital in Khabarovsk uses wind power to generate its electricity.

Wind Resource

The Eastern Asia wind energy map published by Pacific Northwest Laboratories (PNL) identified regions around the Kamchatka district in the 3 to 7 class range. This classification corresponds to an annual average wind speed velocity of 5.6 to 8.8 m/s at a height of 10 m. This represents an enormous wind potential, specially in the coastal areas of the pacific.

Current/Planned Wind Activities

As of today, Mr. Ovis has installed 46 wind turbines in the region around Khabarovsk. All of these systems, with a capacity under 10 kW, have been utilized for residential and commercial electrification. In one case, the emergency room of a hospital in the city Khabarovsk is supplied by two Bergey turbines of 10 kW. Mr. Ovis mentioned that the surgery room of another hospital in the region was considering wind as an alternative generation.

Currently, Mr. Ovis is working in developing a 100 kW wind demonstration project in the region of Kamchatka. His company will be in charge of all the local expenses, including installation. This demonstration project is the first step of a larger project to supply different villages in the northern and eastern parts of Russia. Mr. Ovis is seeking US support in helping finance the demonstration project.

Follow Up Activities

AWEA is following Mr. Ovis' projects in Eastern Russia very closely. Mr. Ovis has offered AWEA to take a leading role in the development of this demonstration project. EXIM Bank has already been approached to finance this project. US/ECRE is another institution that has expressed interest in supporting wind projects in the region.

Spain
Guest: Manuel Lara Coira, Gestion Energetica de Galicia (Gestenga)

Energy Picture

Spain is one of the more active countries in European Community for private power development. The country is in the midst of an industry-wide reorganization of its electric power sector. Spain's 17 main utilities supply 98% of the electricity and operate under the auspices of a coordinating company, Unidad Electrica SA (Unesa). The installed capacity is about 46,590 MW, including 40% fired by coal, 35% nuclear, 17% hydro, 5% oil and 3% gas or an alternative energy.

Wind Resource

Spain has an important wind potential distributed in four main zones: the north-west, north-east, south and the Canary Islands. In these zones, there exists a theoretical capacity to generate electricity of well over $12*10^6$ MWh. Considering today's technology, it would be possible to install around 2,400 MW in these zones of high potential, which would correspond to a generation of 4,000,000 MWh/year. The distribution of this capacity would be as follows: 1,000 MW in Galicia, 600 MW in Andalucia, 400 MW in Valle del Ebro, 200 MW in Cataluña and 200 MW in the Canary Islands. Between 1991 and 1992, 40 MW of capacity were installed in Spain (30 MW in Tarifa, Cadiz) for a total of 45.7 MW.

Current/Planned Wind Activities

At the end of 1990, the total installed capacity was 7.2 MW. This corresponded mainly to small wind farms and dispersed individual systems. However, 1992 was definitely the year in the wind market for Spain with the installation of the largest windfarm in Europe. In 1992 fourteen projects were installed (1 in Galicia, 4 in Andalucia, 7 in the Canary Islands and 2 in Comunidad Valenciana). The fivefold increase in the installed capacity since the end of 1990 can be explained by vast technology improvements in the Spanish wind manufacturers. In 1993, 21.4 MW were installed with the addition of 4 wind farms (Barranco de Tirajana, Valles-Lanzarote and Cañada del Rio in the Canaries and Bajo Ebro in Cataluña).

In Spain there are two wind turbine manufacturers with Spanish technology and two others international companies (Nortank and Carter Sr. "Wind Eagle"). Spain has an annual wind turbine production capability well over 50 MW. The country has also developed the necessary tools and experience related to the wind market (resource assessment, development, production, installation, operation and control). Spain is currently developing the country's first 500 kW turbine.

In 1982, Mr. Lara helped the Spanish Government to establish Gestenga to study alternative energy in Galicia. Since then, he has been involved and supported most wind developments in Spain. Gestenga is a state-owned consulting and support group working in various areas of the energy sector including mini-hydro, efficiency, biomass, natural gas, wind and others. Gestenga and Sea West are currently monitoring 9 wind measuring stations and developing land-lease agreements for 30 MW project tender. Overall Gestenga operates 17 wind measuring stations.

Follow up Activities

Mr. Lara is interested in working with AWEA in Spain. He mentioned that Kenetech has serious plans to develop a wind farm in Spain. He also suggested the possibility of working with AWEA in Latin America. The Banco de Cooperacion Hispano-Americana (state-owned) has funds that could be accessed for the development of wind projects in that region. He also intends to help AWEA determine the constraints that exist in the Spanish market for US companies. Mr. Lara mentioned that there are other areas with interesting projects for Spanish-AWEA cooperation, including Northern Ireland (where there exists a number of small islands with no access to electricity) and Britannia.

1994 WIND ENERGY APPLICATIONS AND TRAINING SYMPOSIUM
(WEATS)

FINAL AGENDA

Sunday, May 1 - Amarillo, Texas

WELCOME RECEPTION AND DINNER (Informal) — 6:30 PM

Monday, May 2 - Amarillo, Texas

WELCOME AND OVERVIEW OF WEATS PROGRAM — 8:30 AM
Kevin Rackstraw, American Wind Energy Association (AWEA)
Mary Grady, American Wind Energy Association

INTRODUCTION TO WIND ENERGY — 8:50 AM
Nolan Clark, Ken Starcher

---Coffee/Tea Break---10:00 AM

RESOURCE ASSESSMENT FOR SMALL SYSTEMS — 10:15 AM
Sergio Castedo, AWEA

WATER PUMPING APPLICATIONS — 10:45 PM
MECHANICAL WATER-PUMPING - Nolan Clark/USDA
ELECTRIC WATER-PUMPING - Mike Bergey/Bergey Windpower

---Lunch--- 12:00

Guest Presentations — 10 PM

U.S. DEPARTMENT OF AGRICULTURE/BUSHLAND SITE TOUR — 2:00 PM
Water-Pumping Demonstration

----Dinner----

Creekwood Range and chuckwagon dinner

Tuesday, May 3 - Amarillo, TX

VILLAGE ELECTRIFICATION — 8:30 AM
HYBRID SYSTEMS - Mike Bergey, Bergey Windpower
HYBRID SYSTEMS - Project Design, Art Lilley, IPC

SMALL RESIDENTIAL POWER SYSTEMS — 9:30 AM
Mike Bergey - BWC

---Coffee Break--- — 10:00 AM

LARGE WIND/DIESEL SYSTEMS — 10:30 AM
Dave Corbus, NREL

TELECOMMUNICATIONS APPLICATIONS Woody Stevens, Northern Power Systems	11:00 AM
SMALL SYSTEM PROJECT DEVELOPMENT & COMMERCIALIZATION Mike Bergey, Bergey Windpower	11:30 AM
----Lunch----	12:00 PM
NATIONAL LABORATORY RESEARCH & DEVELOPMENT **TECHNICAL ASSISTANCE** Larry Flowers, National Renewable Energy Lab Max Harcourt, Sandia National Lab Design Assistance Center	1:15 PM 1:45 PM
TOUR OF ALTERNATIVE ENERGY INSTITUTE RESEARCH FACILITY	2:30 PM

----Dinner----

Big Texan Steak House and Opry program

Wednesday, May 4 - Amarillo

TOUR OF SOUTHWEST PUBLIC SERVICE POWER FACILITY	8:00 AM

Group Travels to Bakersfield, California. Evening free.

Thursday, May 5 - Bakersfield, California

HISTORY OF WINDFARM DEVELOPMENT IN THE U.S. Kevin Rackstraw, AWEA	8:30 AM
RESOURCE ASSESSMENT/SITING CONSIDERATIONS Karen Conover, R. Lynette & Associates	9:00 AM
Guest Presentations	10:00 AM
----Coffee Break----	10:30 AM
ELEMENTS OF A WIND FARM Bob Gates,Zond Systems	11:00 AM
Guest Presentations	11:30 AM
---Lunch---	12:15 PM
OPERATIONS & MAINTENANCE, TRAINING, AND SAFETY Dean Landen and Graham Goad, SeaWest	1:15 PM
DEVELOPERS' PERSPECTIVE ON WIND FARMS Bob Paul, New World Power Corporation	1:45 PM

UTILITY PERSPECTIVE - INTERCONNECTION ISSUES 2:15 AM
Paul Olmstead, Sacramento Municipal Utility District (SMUD)

---Soft Drink Break--- 2:45 PM

INTEGRATED RESOURCE PLANNING AND LEAST COST PLANNING 3:15 PM
Jim Spires, Consultant and former Executive Director of the Colorado Electric Co.

DISTRIBUTED GENERATION 3:45 PM
Joe Iannuci, Distributed Utility Associates

PROJECT FEASIBILITY/ECONOMIC ANALYSIS 4:15 PM
Large and Small Systems: Karen Conover/R. Lynette and Associates

Guest Presentations 4:45 PM

Dinner at "Wool Growers" Basque Restaurant

Friday, May 6 - Bakersfield, California

PROJECT SUPPORT AND FINANCING 9:00 AM
US Government Program Overview: Kevin Rackstraw, AWEA
AWEA Programs: Mary Grady, AWEA
Winrock International Programs: Marc Ancraca
Renewable Energy Training Institute: Jeff Ross, US/ECRE

---Coffee/Tea Break--- 10:30 AM

SYMPOSIUM WRAP-UP: FEEDBACK SESSION 11:00 AM

CLOSING REMARKS - Kevin Rackstraw, AWEA 11:30 AM

---Luncheon--- 11:45

WINDFARM TOUR of Tehachapi Pass Load bus at 12:45 PM
Return late afternoon

BBQ Dinner at the Dehlsen home

Saturday, May 7 - Bakersfield, California

Day free for exciting activities in Bakersfield. Alternatives include whitewater rafting on the Kern River, Bakersfield Jazz Festival, Stampede Days Street Faire and Rodeo and Bussell's Peach Tree Ranch tour.

Sunday, May 8 - Minneapolis, Minnesota

Group travels to Minneapolis, Minnesota for WINDPOWER '94

Monday, May 9 - Minneapolis, Minn.

WINDPOWER Events begin *[See the "Windpower '94" Conference Brochure for rest of week's events]*

WINDPOWER Pre-Conference Seminars: 8:30 AM to 5:30 PM

I. Fundamentals of Wind Energy
II. Wind Characteristics and Advanced Siting Workshop

WEATS RECEPTION - 5:30 PM to 6:30 PM
Sponsored by Export Committee

WINDPOWER WELCOME RECEPTION - 6:30 PM to 8:30 PM

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