

WIND ENERGY DEVELOPMENT IN CALIFORNIA

STATUS REPORT



APRIL 1985

*State of California
George Deukmejian, Governor*

**CALIFORNIA
ENERGY
COMMISSION**

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WIND ENERGY DEVELOPMENT IN CALIFORNIA:

STATUS REPORT

CALIFORNIA ENERGY COMMISSION

STAFF REPORT

APRIL 1985

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PREFACE

Much of the information provided in this report, including the manufacturers and developers, and numbers, types and sizes of wind turbine generators in California, was provided by the California Energy Commission, Office of Small Power Producers.

The information contained in this report was collected late in 1984. Due to the rapid rate of development in the wind turbine generator industry, numbers contained in this report should be considered accurate only for the time period in which they were developed.

WIND ENERGY DEVELOPMENT IN CALIFORNIA

INTRODUCTION

The use of wind, to produce electricity, is occurring statewide in California. The purpose of this report is to provide an overview of the status of wind energy development, particularly regarding permitting activities, for use by California Energy Commission (CEC) staff and policy makers, developers, and county and local agencies involved in either siting or reviewing wind projects.

The report discusses the status of the technology, current and proposed development, regulatory processes, issues hindering development, and recommended actions needed to resolve identified issues.

STATUS OF TECHNOLOGY

A wide variety of wind turbine generators (WTGs) are available or are being tested. These machines range between 25 and 4000 kW (4.0 MW), have a horizontal or vertical axis, and have from one to five blades (see Appendix A). Currently, independent wind farm developers are using WTGs ranging between 25 and 400 kW to generate electricity for sale to utilities. Larger machines, 1-4 MW, are still being tested; utilities are interested in developing these larger machines to produce electricity for existing grid systems.

There are over 150 small companies in the U.S., Canada, and Europe in the business of manufacturing wind machines (see Appendix B for sample list of manufacturers).

Boeing is the primary company in the United States building and testing MW scale WTGs. Canada and several European countries, such as Denmark and Sweden, are also involved in producing large WTGs. The Federal Wind Energy Program, managed by the Department of Energy (DOE) is currently testing three, 2.5 MW, Boeing Mod-2 turbines in Washington state while the Department of Interior is testing a 4 MW, Hamilton Standard WTS-4 turbine and a 2.5 MW, Boeing MOD-2 in Medicine Bow, Wyoming. The 2.5 MW Washington turbines started testing in late 1981. These three units are operating in a cluster to test wind flow interference in a wind farm configuration.

In 1980, Southern California Edison (SCE) installed a Bendix/Schachle wind electric generator in the San Geronio Pass near Palm Springs. This unit, which had a 165 foot blade span and a generation capacity rated at 1.3 MW in a 40 mph wind, has been dismantled. In 1982, SCE began operation of a 120 foot, vertical axis, 50 kW Darrieus unit and added a 500 kW vertical axis turbine and a 100 kW horizontal axis turbine for a total of four machines at their Devers substation. Pacific Gas and Electric (PGandE) installed a large, horizontal axis Boeing MOD-2 (2.5 MW) machine in late 1982 near Cordelia in Solano County. Boeing is proposing to begin testing a 3.2 MW MOD-5 machine in Hawaii in 1986.

Prototype demonstrations of large WTGs can verify performance designs and help resolve any mechanical, structural, or control problems. Demonstration of multiple units (e.g., DOE's test of three MOD-2 units in Washington) will provide data on acceptable electrical stability of parallel units, performance and spacing limits for grouped units, on-line availability, and operating and maintenance costs of multiple-unit installations. (See 1984 CEC Commercial Status Report for additional information on WTG manufacturing costs and deployment issues.)

STATUS OF DEVELOPMENT

Wind farm development is occurring primarily in Kern, Riverside, Alameda, Contra Costa, Monterey, Merced, San Diego, and Solano Counties (Table 1). At the end of 1983, there were nearly 4,000 wind turbine generators (243 MW) operating in California's wind farms. By the end of 1984, the CEC estimates that there will be 8,500 operating turbines or 609 MW of installed capacity, and by the year 2,000, there could be as much as 4,000 MW on line. Map 1 identifies current wind farm locations. Appendix C, Table C-1 identifies (by wind farm developers, types of wind machines, and sizes of various developments) large wind projects on line in 1981 and 1982; Table C-2 identifies large wind projects on line in 1983, and Table C-3 identifies large wind projects planned for 1984. Private use of individual wind turbine generators is occurring statewide; however, there is virtually no readily available information on the sizes and exact locations of these individual wind turbines.

The wind development industry is beginning to face several problems. A number of prime wind resource areas in Southern California may be precluded from development due to the existence of the endangered California condor. As more and more wind turbines are constructed and operated, cumulative impacts from noise, communications interference, erosion, and aesthetic disturbances are being observed by several counties. Some counties are now considering revising their general plans to include more stringent requirements for WTG, development while other counties are considering declaring a moratorium on development until they can determine the extent of the impacts. The "avoided cost" that utilities are willing to pay for electricity has decreased. For example, in 1982 Southern California Edison (SCE) was offering approximately 7.5 cents/kWh; in April 1984 the price was down to approximately 4.8 cents/kWh. The Energy Commission staff estimates that avoided costs will increase annually --0.2 percent (PG&E), 2.09 percent (SDGandE), and 1.56 percent (SCE) --from 1984 to 2004. In addition, federal and state tax credits are due to expire in 1985 and 1986 respectively.

The industry has recently had problems as a result of a few developers who have not met contractual obligations to investors by not constructing or operating proposed wind farms. There have been a number of wind turbines that have been partially or completely installed but have never operated. The Internal Revenue Service has recently been conducting investigations of several wind farm developers.

TABLE 1
SUMMARY OF LARGE SCALE CALIFORNIA WIND PROJECTS
1981 - 1984

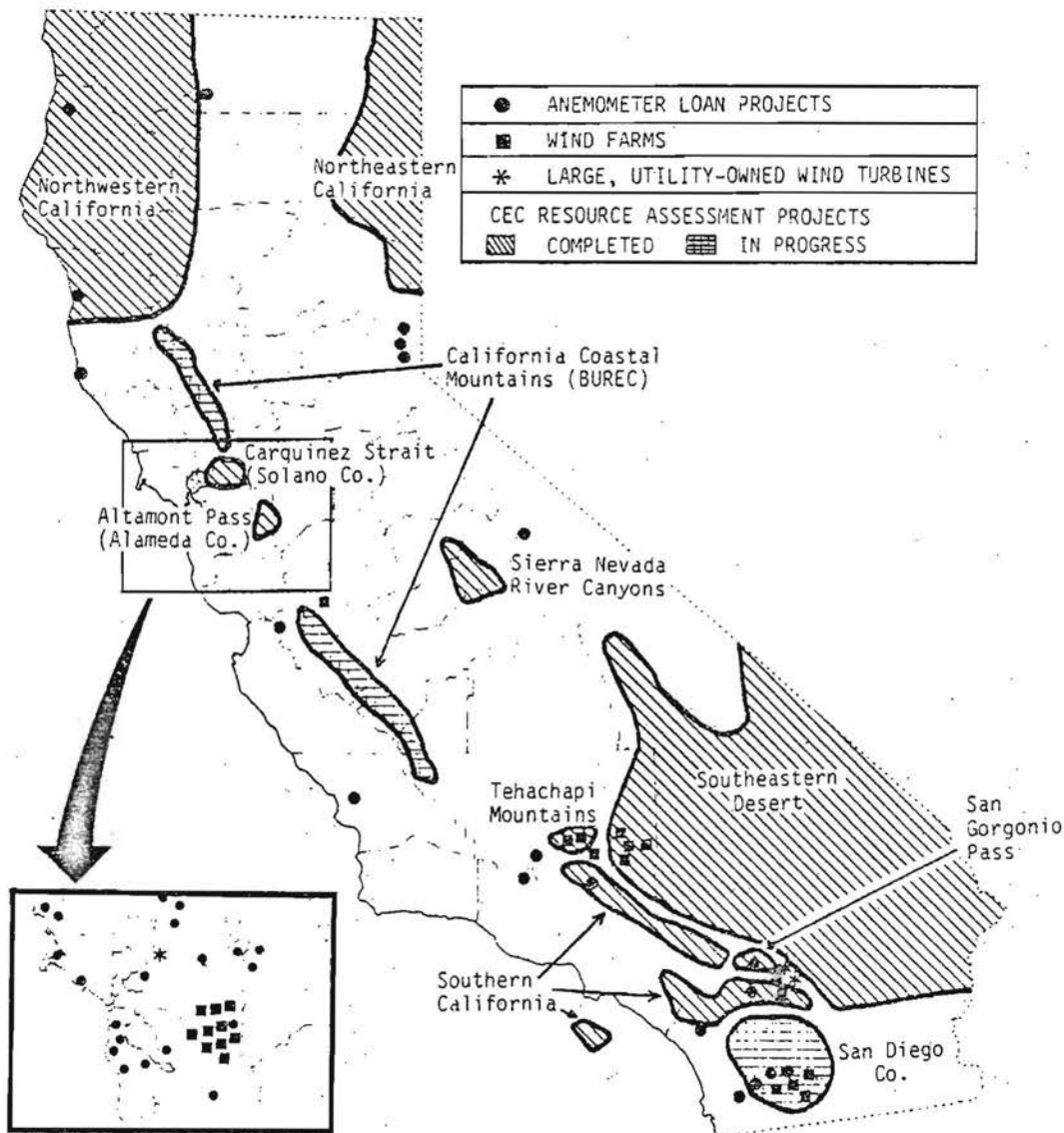
<u>Resource Area/County</u>	<u>Cumulative</u>	<u>1984</u>	<u>1983</u>	<u>1981 - 1982</u>
Altamont Pass (Alameda, Contra Costa)	3893 WTG* 317.5 MW**	1910 WTG 181.4 MW	1179 WTG 90.1 MW	804 WTG 46 MW
Boulevard (San Diego)	16 WTG .4 MW	6 WTG .2 MW	-- --	10 WTG .2 MW
Carquinez Strait (Solano)	10 WTG 3 MW	2 WTG .2 MW	7 WTG .3 MW	1 WTG 2.5 MW
Mojave Desert (Kern)	153 WTG 6.5 MW	153 WTG 6.5 MW	-- --	-- --
Salinas Valley (Monterey)	4 WTG .2 MW	-- --	4 WTG .2 MW	-- --
San Geronio Pass (Riverside)	2447 WTG 150.2 MW	1786 WTG 111.8 MW	651 WTG 36.8 MW	10 WTG 1.6 MW
Tehachapi Pass (Kern)	1946 WTG <u>131.6 MW</u>	830 WTG <u>5.9 MW</u>	652 WTG <u>44.7 MW</u>	464 WTG <u>21 MW</u>
CUMULATIVE TOTALS	8469 WTG 609 MW	4687 WTG 366 MW	2493 WTG 172 MW	1289 WTG 71.3 MW

*WTG stands for wind turbine generators, installed or proposed for installation.

**MW stands for megawatts of installed capacity.

MAP 1

CEC RESOURCE ASSESSMENT PROJECTS,
WIND FARMS, AND LARGE WIND TURBINES
IN CALIFORNIA



(Source: Wind Resource Assessment of California: A Summary of CEC-Sponsored Studies, California Energy Commission Staff Report, 1983 (P500-83-019))

PERMITTING PROCESSES

Wind farms usually fall under the jurisdiction of individual counties which issue use permits and act as lead agencies in the preparation of any California Environmental Quality Act (CEQA) required documentation [e.g., Negative Declarations or Environmental Impact Reports (EIR)]. However, permitting is not limited to local agencies. In addition to providing permits for projects under their jurisdiction, federal and state agencies may review county documents to assist local agencies in their permitting process. (See Figure 1 for generalized review process and time limits.)

Federal Agency Involvement

If a proposed project requires a federal permit (such as a lease or right of way on public land) or involves federal funding, the project will trigger a National Environmental Policy Act (NEPA) review to determine what type of environmental analysis is required. If both a federal and county permit are required, the federal agency and the county may choose to prepare a joint document to satisfy NEPA and CEQA and avoid duplication of effort.

Individually, federal and county agencies are required to make a decision on a project within one year. However, the timing involved in preparing a joint document, circulating the document for public review, and making a decision on a project may take as much as 18 months.

Counties can request that federal agencies, who do not have jurisdiction but have a specific expertise or interest, review and provide comments on a project prior to determining what kind of environmental analysis is required.

State Agency Involvement

State agencies may also become involved as consulting and reviewing agencies for county or federal environmental documents. A state agency, as a responsible agency, may also be in a position to grant a permit and will use the county's environmental document as a part of its own process. County documents may be sent to the State Clearinghouse for distribution to various state agencies for review. Counties have not, however, always circulated environmental documents through the clearinghouse; consequently, there is some inconsistency in the environmental review process.

County Use Permit Process

There is no single, standardized county use permit process for wind development. Each county establishes its own parameters for siting wind farms. Occasionally a county will transfer siting authority to a city. Some counties have extensive requirements, while others have virtually no requirements and may not even issue a use permit. Individual WTGs for private use require only building permits in most counties. The permitting requirements of counties where wind development is occurring are discussed below.

o Kern County

Kern County has a specific zone designation for wind development. A zone "overlay" classification was instituted to create a standardized use permit process and to allow for more orderly growth of wind generated electrical power. Kern County requires a use permit for any private wind

GENERALIZED REVIEW PROCESS
 (showing maximum time limits)

First, the applicant submits permit application to lead agency.

- | | | | |
|---------|---|----|--|
| Day 1 | In writing, lead agency accepts application as complete. | or | If lead agency fails to respond in writing, application is "deemed" accepted within 30 days after submittal. |
| Day 45 | After consulting with responsible agencies, lead agency determines that an EIR is necessary and immediately issues a <u>Notice of Preparation</u> . | or | After consulting with responsible agencies, lead agency elects to write a Negative Declaration and begins work on this document. |
| Day 90 | Lead agency receives comments on the <u>Notice</u> and begins writing the EIR. | | |
| Day 105 | Lead agency completes the Negative Declaration. | | |
| | Lead agency issues draft EIR and distributes it for public and agency review, holds public hearing (optional), and completes final EIR. | | |
| Day 365 | Lead agency adopts final EIR and reaches permit decision. | or | Lead agency adopts the Negative Declaration and reaches permit decision. |

Then, the applicant submits permit application to responsible agencies.

- | | | | |
|---------|--|----|---|
| Day 1 | In writing, responsible agencies accept applications as complete. | or | If responsible agencies fail to respond in writing, applications are "deemed" accepted 30 days after submittal. |
| | Responsible agencies evaluate the project and consider the lead agency's environmental document. | | |
| Day 180 | Responsible agencies reach permit decisions. | | |

Source: California Permit Handbook, Office of Planning and Research, 1980.

machine over 80 feet in height or for two or more machines that will generate electricity for sale to a utility. Anything else requires only a building permit. Kern County's zoning classification for wind energy systems (W-E) established conditions which an applicant must meet to obtain a use permit. The zoning classification can only be used in combination with three other zone classifications: 1) agriculture (A), 2) natural resources 20 acres (NR-20), and 3) 20-acre estate (E-8). The conditions specified by the zoning ordinance are:

1. The applicant must obtain building and grading permits;
2. Towers and blades must be painted a nonreflective, unobtrusive color;
3. Facilities must be enclosed by a minimum 5 foot high security fence with warning signs;
4. Electrical wires must be undergrounded except for the utility tie-in location;
5. Set-back limitations to project boundaries and structures must be met;
6. The developer must submit a detailed project description and plot plan which includes the existing topography and drainage channels and the location and extent of known archeological resources; and
7. The applicant must submit an environmental assessment which includes a soils survey, vegetation survey, wildlife survey, archeology survey, acoustical evaluation, and access improvement plans.

o Riverside County

Riverside County held off on approving use permits for wind farms until after they completed a Master EIR on the major wind resource area, the San Geronio Pass. Riverside County now requires site-specific environmental assessments for each new application. The County has also created a specific zone (W-E) for wind development. The conditions established as part of the special wind zone are comparable to those adopted by Kern County. In one location, residents have complained about noise levels, although monitored levels have not exceeded the maximum allowable levels identified in the county's noise ordinance. (McCall, 1984)

o Alameda and Contra Costa Counties

Alameda and Contra Costa Counties have permitted a substantial amount of wind development in the Altamont Pass as evidenced by the 136.1 MW of electrical capacity on-line in that area at the end of 1983.

Alameda County allows wind development only on land zoned for agriculture and requires a conditional use permit. As a part of the use permit process, the county prepares a "Conditional Negative Declaration." The county has also developed a set of standards which they provide to developers prior to filing for use permits.

The Alameda County Board of Supervisors has received several complaints about noise levels from operating wind turbines. In March of 1984, the Board approved a new requirement that all wind projects be phased or brought on-line slowly and that noise levels be monitored to assure compliance with the noise ordinance. Visual effects are also beginning to be an issue. (Richards, 1984)

Wind development in Contra Costa County is also allowed only on land zoned for agriculture. In early 1984, Contra Costa amended their general plan to include a requirement that wind developers obtain a use permit. (Bragden, 1984)

o Solano County

Solano County has a wind ordinance, and development is allowed only on land zoned as "agricultural" and "rural residential." Noncommercial wind turbines, less than 100 feet in height, are exempted from CEQA and require only a building permit. Wind farms and individual wind machines over 100 feet must obtain conditional use permits and, depending upon the size of the proposal and its potential impacts, the county will prepare a Negative Declaration or an EIR.

Development in an unincorporated area normally falls under the jurisdiction of the county. However, in one instance, the City of Fairfield assumed lead agency status for a proposed 150 MW wind farm proposal (approximately 60 machines) at Cordelia Hills.

A major environmental concern in Solano County is that wind development be controlled where it might affect bird populations in the Suisun Marsh. (Monsky, 1984)

o Merced County

Merced County created a new agricultural zone (A1-A2) in February, 1983, which allows wind development on property larger than 20 acres and at least 1/2 mile from developed areas. With the new zoning, wind farm development requires a conditional use permit which includes an environmental assessment to be approved by the Planning Commission.

Merced has granted a use permit for a 1,000 machine wind farm; however, construction has not begun. According to the county planning department (Balestrery, 1984) approximately 102 machines were approved under another use permit and have been constructed.

Because Pacheco Pass, the prime wind resource area in Merced, is in a remote area, there have not been any complaints about noise or aesthetics. (Peterson, 1984)

o Los Angeles County

Los Angeles County requires a conditional use permit which includes an initial study to determine if, and what kind of, an environmental document is necessary.

Los Angeles County has designated certain areas as "Sensitive Ecological Areas" (SEA). If a wind farm is proposed in or near an SEA, a technical committee provides an analysis as part of the use permit process. The county is currently revising its general plan to include an energy element which will include siting criteria for wind development. (Trumbo, 1984)

Los Angeles County is primarily concerned about environmental impacts to the California condor. The County is also concerned about noise, aesthetics, and erosion. Los Angeles County has denied one application for a use permit for a wind farm that was proposed in the condor range. Another application was approved, but with a condition that a proposed monitoring plan be approved by the Condor Research Center. The County anticipates that the Westinghouse Corporation will be submitting an application for a wind farm in the condor habitat. (Ristick, 1984)

o San Diego County

A number of wind projects have been developed in San Diego County. In 1981, the County removed all restrictions to wind development. During the time the WTGs have been operating, there have been a number of unforeseen problems; consequently, the San Diego Board of Supervisors has adopted a wind ordinance which requires a land use permit for all new WTGs over 25 kW (Sloop, 1984). Wind development will also be precluded adjacent to special receptors or land uses such as schools or hospitals. San Diego views wind development as being exempt from the CEQA process. (Sloop, 1984)

ENVIRONMENTAL ISSUES

Noise

Both audible and low frequency impulse noise can be produced by operating WTGs. The noises produced and their impacts will differ according to machine design and size, and site specific characteristics such as topography. Noise has not been a primary issue where wind farms are in isolated locations. However, some counties are beginning to receive complaints about noise where wind development is occurring near populated areas. Alameda County has received a substantial number of complaints about the noise levels from residents near the Altamont Pass. If new wind farms are to be located near existing residences or businesses, mitigation measures for noise may be necessary. Such mitigation measures can include testing of the wind turbines(s) prior to installation to determine the level of audible and impulse noise generated by operation, monitoring of noise levels as individual WTG's come on-line, and requiring compliance with local noise standards or ordinances.

Aesthetics

The aesthetic impact of wind farm development is very difficult to evaluate and resolve. As more wind farms are constructed, counties are beginning to receive complaints from some residents. Some of the best winds are along or just below ridge tops and placing wind machines in these locations makes them extremely visible. In addition, construction on hillside locations results in vegetation loss and visible scarring of the landscape by roads and turbine pads.

Whether aesthetics becomes a major issue will depend upon the extent of actual damage, the viability of mitigation measures, the local political climate, and how vocal local residents are to changes in existing views resulting from WTG installations.

In the San Geronimo Wind Resource Study, Riverside County and the U.S. Bureau of Land Management have established a number of guidelines or mitigation measures, based on topography and the types and number of wind turbines being proposed, which can be implemented to reduce visual impacts in siting wind farms. These guidelines require that developers avoid slopes over 25 percent to prevent disturbance and degradation of landforms, and to limit visual scarring by cut and fill, retaining walls, trenching, and vegetation removal. The document also discusses appropriate set-backs from scenic highways and key viewpoints, spacing and clustering of various sized turbines, placement of turbines with unusual designs such as the Darrieus "eggbeater" turbines, and using colors that blend with the particular environment.

California Condor

A major conflict with wind development (primarily in Los Angeles, Ventura, Kern, Tulare, Kings, Santa Barbara, San Luis Obispo, and Monterey counties) is the California Condor (Gymnogyps californianus). The California Condor is nearly extinct and has been designated as a federal and state endangered species.

Because condors tend to soar along ridgelines, are large, and not very maneuverable, the primary concern is collisions with wind machines and transmission lines. Condors, as well as other birds, are known to fly into tall objects.

The Condor Research Center (CRC), funded by the U.S. Fish and Wildlife Service, the State Department of Fish and Game, and the Audubon Society, has proposed that wind development be curtailed in condor roosting and foraging habitat (See Map 2) until more data is available about the bird and until the condor population is increased to a level where it may be possible for it to sustain itself.

The CRC estimates that it will probably be three to five years before adequate information is available to determine, with any accuracy, if and where developers will be able to construct wind turbines without creating a hazard to the condors. There is currently insufficient information to determine exactly

here the condors' range extends. During this time period, young condors--hatched and raised in captivity--will be fitted with radio transmitters and returned to the wild to begin the process of re-establishing the species and also providing continuing information on the status and range of the birds. The CRC also estimates that the condor population could begin to stabilize in the mid 1990s. (March 26, 1984. Condor/Wind Developer Meeting, Ventura CA.)

The problem developers face is that several prime wind development locations are within the known and potential condor range and developers want to be able to take advantage of federal and state tax credits that will expire in 1985 and 1986 respectively (there is a pending proposal to extend the federal tax credits). For some of the prime wind areas, with an estimated capacity of 500 MW, development may never be acceptable because of its extensive use by condors.

Los Angeles County has already denied one wind farm use permit application based on recommendations from the CRC. A second use permit application was approved with a condition that the CRC approve the developer's proposed condor mitigation plan. That approval was unlikely because of the location of the proposed facility, so the developer withdrew the application.

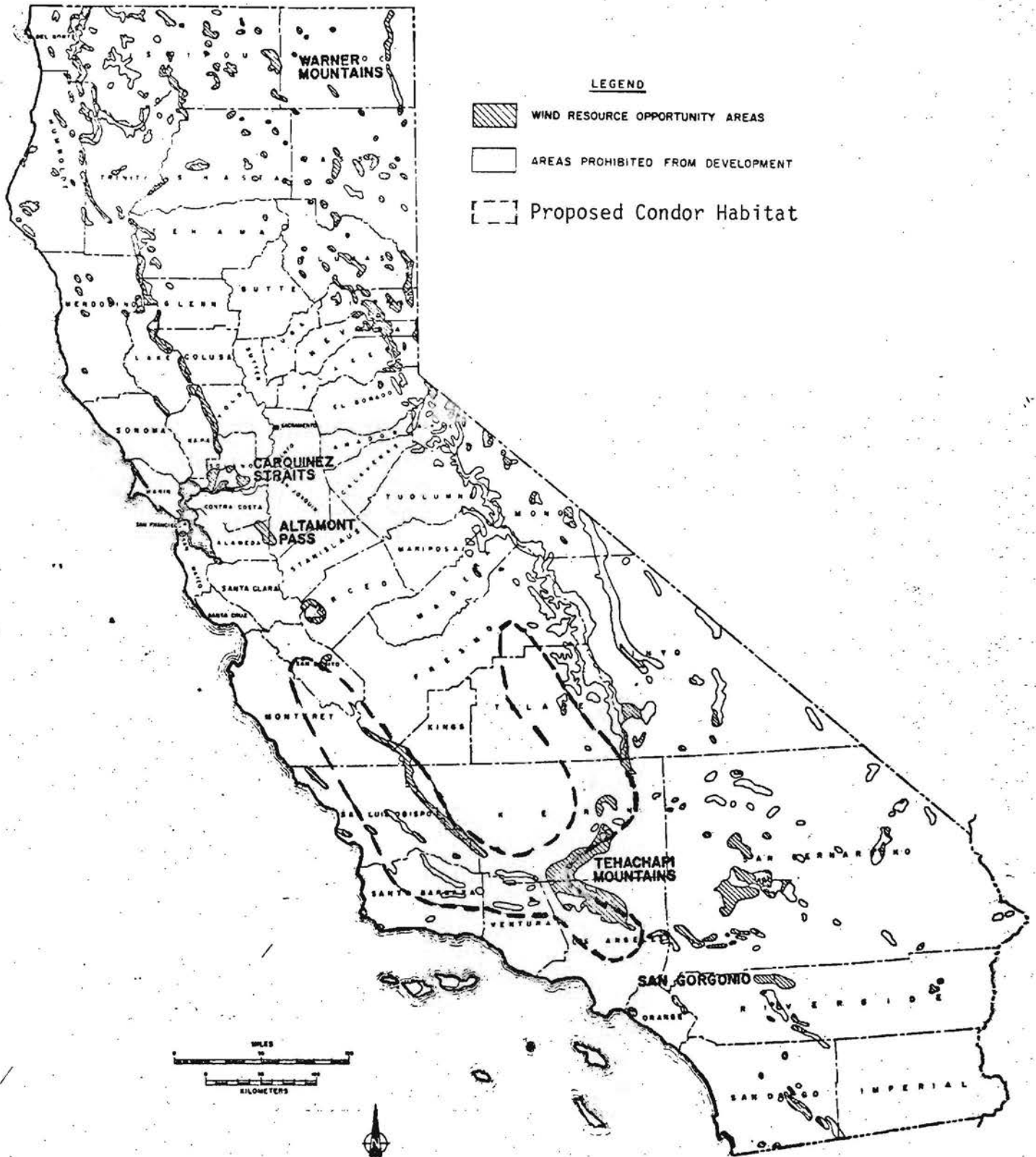
The CRC recommends that developers consult with Dave Harlow, (916) 484-4935 of the U.S. Fish and Wildlife Service or Linda Blum at CRC, (805), 644-1766, prior to investing time and money in the use permit process (which could include the cost of preparing an EIR) when development may be prohibited. Fish and Game and the CRC are willing to review proposals for wind development within the currently proposed essential condor habitat on a case by case basis.

Interference with Broadcast Signals

At specific sites, WTGs may reflect radio and television signals. The major potential for electromagnetic interference (EMI) is in the reception of UHF TV picture signals. Metallic blade materials cause greater interference than composite, fiberglass, or wood designs. EMI can be alleviated by using a highly directional (fringe) antenna, using a local TV receptor, having transmissions circularly polarized, or employing cable reception. Currently, only Kern County has reported complaints regarding television interference.

VORTAC stations provide directional and/or range information for air navigation. The Federal Aviation Administration has guidelines for the siting of large objects near VORTAC stations. These guidelines provide that no structure should be located within 1,200 feet, 1.5 vertical degrees of the ground level of a VORTAC antenna or 0.5 vertical degrees from the antenna. WTGs are subject to these restrictions.

WIND RESOURCE AREAS



CALIFORNIA ENERGY COMMISSION

1981

Erosion

If the wind resource is sufficient to warrant wind farm development, it is also sufficient to erode soils disturbed during WTG, transmission line, and road construction. As is the case with other construction activities, eroded soils may also result in changes in the natural drainage patterns of an area and cause flooding and mud slides.

In Kern County's Tehachapi area, several residents have complained to the County Board of Supervisors about increasing problems with wind and water eroded soils. In Kern County, erosion has become a problem because a few developers have not complied with county use permit grading requirements. Compliance monitoring could become a condition of future use permits.

SUMMARY AND RECOMMENDATIONS

Wind farm development is continuing in California, primarily in Kern, Riverside, Alameda, Contra Costa, and Solano Counties and to a lesser extent in Los Angeles, Monterey, Merced, San Diego, and San Bernardino. As time passes, more data on wind farm operation is becoming available; consequently, the successes and problems with the wind industry are becoming more apparent.

Individual counties are discovering that increased wind development may be creating cumulative environmental impacts that were not present with the operation of a limited number of wind turbines. The primary environmental problems resulting from wind development are noise, aesthetics, communication interference, and erosion.

Several counties are finding it necessary to revise their general plans, place additional conditions on use permits for wind projects, and consider more stringent monitoring programs to insure that wind developers comply with conditions of use permits. Some counties may even declare a moratorium on wind development until cumulative impact studies can be completed.

Problems currently faced by developers are the end of state and federal tax credits in 1985 and 1986; reduced utility payments; inadequate regional transmission line capacity in several prime wind resource areas; restricted development in several prime wind resource areas because of the presence of the California Condor; and recent problems caused by a few developers who have misrepresented their projects to investors or have not complied with use permit conditions.

There are several courses of action which can be taken by the Energy Commission, local agencies, and developers to resolve issues which may hinder further development of the wind industry in California:

1. The Energy Commission's Siting and Permit Assistance Program can provide technical assistance and grants-in-aid to counties for cumulative environmental impact studies and/or monitoring studies and general plan related documents such as wind zoning ordinances, siting criteria, and general plan amendments. For more information on this program, contact Chuck Najarian at (916) 324-3225.

2. The Energy Commission's Wind Office can also provide technical assistance to developers and local governments. The Wind Office is currently beginning a computerized wind performance reporting system which will establish a data base of wind farm performance for developers, industry observers, and potential investors. For information on this program, contact Mike Batham at (916) 324-3472.
3. Counties and developers may also contact the State Office of Permit Assistance (OPA) in the Governor's Office of Planning and Research for assistance in identifying necessary permits for wind development or for resolving any conflicts that may arise between themselves and other governmental agencies. For information on OPA's programs, contact Randy Pestor at (916) 322-4245.
4. The Energy Research Technologies Research, Development and Demonstration Act, being implemented by the Commission starting in fiscal year 85/86, will provide loans and grants for the purpose of making energy technologies more efficient and cost effective. For more information on this program, contact Mike Batham at (916) 324-3472.

INFORMATION SOURCES

CEC, Wind Resource Assessment of California: A Summary of CEC-Sponsored Studies, 1983. (P500-83-019).

CEC, Commercial Status Report, 11/84.

U.S. Dept. of the Interior, Bureau of Land Management, San Geronio Pass Wind Energy Project - Draft Environmental Impact Statement, 1982.

Personal Communications:

1. Mr. Balestrery, Merced County Planning Department, 5/31/83 and 5/3/84.
2. Glen Barnhill, Kern County Planning Department, 4/17/84.
3. Harvey Bragden, Contra Costa County Planning Department, 4/17/84.
4. Tim Calkins, Solano County Planning Department, 5/31/84.
5. Michael McCall, Riverside County Planning Department, 4/17/84.
6. Chris Monsky, Solano County Planning Department, 4/16/84.
7. Robert Peterson, Merced County Planning Department, 4/16/84.
8. Steve Richards, Alameda County Planning Department, 5/3/83 and 4/12/84.
9. Ray Ristick, Los Angeles County Planning Department, 4/12/84.
10. Michael Sloop, San Diego County Planning Department, 6/3/83 and 4/17/84.
11. Judy Trumbo, Los Angeles County Planning Department, 5/16/83 and 4/12/84.

APPENDIX A Wind Turbine Specifications

Feature	Hamilton Standard WTS-4	Boeing MOD-2	DAF Indal	Westinghouse WVG-0500
Power Output	4000 kw	2500 & 3200 kw	500 kw	600 kw
Rated Wind Speed	36 mph	28 mph	43 mph	27 mph
Rotation Speed	30 rpm	18 rpm	45 rpm	42 rpm
Blade Tip Speed	404 ft/sec	275 ft/sec	188 ft/sec	275 ft/sec
Cut-in Speed	16 mph	14 mph	16 mph	14 mph
Cut-out Speed	60 mph	60 mph	80 mph	50 mph
Rotor Orientation	Downwind	Upwind	Vertical	Downwind
Generator RPM	1800 rpm	1800 rpm	1200 rpm	1800 rpm
Generator Type	Synchronous	Synchronous	Induction	Synchronous
Gearbox Step-Up Ratio	60:1	103:1	27:1	43:1
Gearbox Type	Epicyclic	Planetary	Parallel Shaft	Planetary
Total Height	391 ft	350 ft	120 ft	163 ft
Tower Height	252 ft	193 ft	120 ft	100 ft
Rotor Diameter	256 ft	300 ft	80 ft	125 ft
Rotor Weight	110,000 lbs	189,000 lbs	4,400 lbs	5,200 lbs
Rotor Blade Material	Fiberglass	Steel	Aluminum	Wood/Fiber-glass
Foundation	Footing: 60 ft sq, 5 ft deep. Ped- estal tap- ered: 32 ft top, 5 ft deep	Footing: 66 ft diam. octa- gon, 6 ft deep Pedestal 32 ft diam. octagon, 4.7 ft deep	Single Caisson 4 ft deep	Multiple Cais- son 26 ft sq, Guy wire foot- ing 3'x10'x8'
Foundation Weight	3.1 mil lbs	3.2 mil lbs	Unknown	390,000 lbs

(Continued)

Feature	Carter CWG-125	WECS Tech WT-605-HAWT	Weecs Tech Mark 1605	Windpower USW-56-50	Carter CWG-25
	(Most in California are inoperable)				
Power Output	250 kw	100 kw	100 kw	50 & 100 kw	25 kw
Rated Wind Speed	31 mph	28 mph	28 mph	22 mph	26 mph
Rotation Speed	75 rpm	60 rpm	60 rpm	72 rpm	120 rpm
Blade Tip Speed	255 ft/sec	206 ft/sec	188 ft/sec	210 ft/sec	200 ft/sec
Cut-in Speed	9 mph	12 mph	Unknown	10 mph	7.5 mph
Cut-out Speed	None	Unknown	Unknown	44 mph	None
Rotor Orientation	Downwind	Downwind	Downwind	Downwind	Downwind
Generator RPM	1838 rpm	1800 rpm	1800 rpm	1800 rpm	1800 rpm
Generator Type	Induction	Induction	Induction	Induction	Induction
Gearbox Step-Up Ratio	24:1	125:1	125:1	25:1	15:1
Gearbox Type	Planetary	Conventional	Conventional	Conventional	Double Reductio
Total Height	155 ft	110 ft	110 ft	90 ft	96 ft
Tower Height	120 ft	75 ft	75 ft	60 ft	80 ft
Rotor Diameter	65 ft	58 ft	58 ft	56 ft	32 ft
Rotor Weight	800 lbs	750 lbs	350 lbs	N/A	200 lbs
Rotor Blade Material	Fiberglass	Aluminum/Dacron	Aluminum/Dacron	Fiberglass	Fiberglass
Foundation	Spread-Anchor 4'x 6'x5' footing 5 ft sq, 2.5 ft deep	8 ft sq, 2 ft deep Guywire footing 5 ft sq, 2.5 ft deep	8 ft sq, 2 ft deep, Guy wire footing 5 ft sq 2.5 ft deep	Piers, 2.5 ft diam, 7 ft deep	Spread Anchor 2'x6'x5' Guy wire foot ing 3'x6'x5'
Foundation Weight	Wt of 45 cu, yds concrete	56,400 lbs All Foundations	56,400 lbs (All Foundations)	Unknown	Weight of 10 cu. yds conor

(Source: San Geronimo Pass Wind Energy Project Draft EIR 1982 U.S. Dept. of Interior (RIM) Appendix B)

APPENDIX B

MEDIUM AND LARGE SCALE
WIND TURBINE MANUFACTURERS

The following companies manufacture wind-to-electric turbines. The names on this list were gathered by the staff of the Wind Program of the California Energy Commission and may not contain all manufacturers in the field. Inclusion on this list does not constitute an endorsement by the State of California or the Energy Commission.

Aeroman Turbines
Automatic Power Inc.
P.O. Box 18738
Houston, TX 77223

Phone: (713) 228-5208
Turbines: 40 kW (M.A.N. turbine)

Carter Wind Systems, Inc.
Rt. Box 405 A
Burkburnett, TX 76354

Phone: (817) 569-2238
Contact: Jay W. Carter, Jr.
Turbines: 25 kW, 225 kW

Boeing Aerospace Company
P. O. Box 3999 - MS-9A-67
Seattle, WA 98124

Phone: (206) 575-5985
Contact: Bill Engle
Turbines: 2.5 MW

DAF Indal Ltd.
3570 Kawkestone Rd.
Mississauga, Ontario
Canada L5C 2V8

Phone: (416) 275-5300
Contact: V. Lacey
Turbines: 50 kW, 500 kW
vertical axis

Bonus
Ole Fisker Hansen
1300 Dover Drive - Suite 200
Newport Beach, CA 92660

Phone: (714) 476-8651
Turbines: 65 kW

Dan-Regn Vindpower
Fabriksvej 4 A/S
DK 7330 Brande
Denmark

Turbines: 65kW

Bouma Wind Turbines
P.O. Box 79483
Houston, TX 77024

Phone: (713) 222-0742
Turbines: 100 kW, 200kW

Danish Wind Technology
Stal-Laval, Inc.
525 Executive Blvd.
Elmsford, NY 10523

Phone: (814) 592-4710
Turbines: 340 kW

Enertech Corporation
379 Earhart Way
Livermore, CA 94550

Phone: (415) 449-7227
Contact: Patricia Weis
Turbines: 25 kW, 40 kW

ESI (Energy Sciences Inc.)
500 Valley Way
Milpitas, CA 95035

Phone: (408) 945-9922
Contact: Sharon Alexander
Turbines: 50 kW, 80 kW

Fayette Manufacturing Corp.
P.O. Box 1149
Tracy, CA 95376

Phone: (415) 443-2929
Contact: Jerry Helms
Turbines: 56 kW, 75 kW,
95 kW, 400 kW

Micon Energy Systems
1660 Hotel Circle, Suite 400
San Diego, CA 92108

Phone: (619) 297-8066
Turbines: 65 kW

FloWind Corporation
21414 68th Avenue, South
Ken, WA 98032

Phone: (206) 872-8500
Contact: Dr. Irwin E. Vas
Turbines: 170 kW, 300 kW

Hamilton Standard
Bradley Field Road
Windsor Locks, CT 06096

Phone: (203) 623-1621
Contact: Phillip Young
Turbines: 3 MW, 4 MW

Holec Power Systems, Inc.
Airtricity
11145 Tampa - Suite 1913
Northridge, CA 91326

Phone: (818) 368-1951
Contact: Niel Herkman
Turbines: 65 kW

Micon Energy Systems
14740 Altamont Pass Road
Tracy, CA 95376

Phone: (415) 443-8184
Contact: Neils Rydder
Turbines: 65 kW, 100 kW

Nordtank
P.O. Box 6057
Tehachapi, CA 94561

Phone: (805) 822-7723
Contact: Sven Holst
Turbines: 65 kW

North American Power
240 W. Shaw, Suite D
Clovis, CA 93612

Phone: (209) 227-3296
Contact: Robert N. Wagner
Turbines: 400 kW

Riisager
Scandia Wind, Inc.
42625 N. Sierra Hwy.
Lancaster, CA 93534

Phone: (805) 945-0611
Contact: Jorgen Petersen
Turbines: 65 kW, 90 kW, 130 kW

Windtech, Inc.
P.O. Box 837
Glastonberry, CT 06033

Phone: (203) 659-3786
Contact: Kip Cheney
Turbines: 75 kW

Vawtpower, Inc.
134 Rio Rancho Drive
Rio Rancho, NM 97124

Phone: (505) 892-9463
Contact: Paul Vosburgh
Turbines: 185 kW vertical axis

Vestas North American Ltd.
P.O. Box 276
Tehachapi, CA 93561

Phone: (805) 822-6839
Turbines: 65 kW

Wind Harvest
80 Lincoln Drive
Ventura, CA 93001

Phone: (805) 643-6689
Contact: Bob Thomas
Turbines: 30 kW

Wind Technologies, Inc.
1190 Brooks Avenue
Rochester, NY 14624

Phone: (716) 235-8500
Turbines: 80 kW

APPENDIX C
LARGE-SCALE CALIFORNIA WIND PROJECTS
1981 and 1982 Installations*

<u>1983 SUMMARY</u>				
<u>No. of Turbines Installed</u>			<u>Turbine Size Range (kW)</u>	<u>Total Installed Capacity (MW)</u>
1,289*			20-2,500	72
<u>Resource/Area Developer</u>	<u>Number of Turbines</u>	<u>Manufacturer of Turbine</u>	<u>Size per Turbine (kW)</u>	<u>Installed Capacity (MW)</u>
<u>ALTAMONT PASS -- 46.4 MW</u> (Alameda, Contra Costa)				
American Energy Projects 2570 El Camino Real Suite 610 Mountain View, CA 94040 (415) 941-2929	108	Fayette	75	8.1
CWES 1660 Hotel Circle North Suite 317 San Diego, CA 92108 (619) 299-6089	30	ESI	50	1.5
Executive Productions 2235 E. Flamingo Road Las Vegas, NV 89109 (702) 731-0066	30	Fayette	75	2.3

* The data listed in this summary are for 1981 and 1982 only.

<u>Resource/Area Developer</u>	<u>Number of Turbines</u>	<u>Manufacturer of Turbine</u>	<u>Size per Turbine (kW)</u>	<u>Installed Capacity (MW)</u>
<u>ALTAMONT PASS (cont.)</u> (Alameda, Contra Costa)				
Farrell O'Keefe 1330 Lincoln Ave., Suite 201 San Rafael, CA 94901 (415) 459-4420	50 40 26 2	Fayette Fayette ESI Vestas	75 56 65 65	7.8
Fayette P.O. Box 1149 Tracy, CA 95376 (415) 443-2929	28 18	Fayette Fayette	56 75	2.9
TERA Corporation 2150 Shattuck Avenue Berkeley, CA 94704 (415) 845-5200	60	ESI	50	3
U.S. Windpower 6421-B South Front Rd. Livermore, CA 94550 (415) 455-6012	407	U.S. Windpower	50	20.4
WindMaster 106 K Street Sacramento, CA 95814 (916) 443-0511	5	HMZ	75	.4
<u>BOULEVARD -- .2 MW</u> (San Diego)				
Aeolus Wind Farms 430 Westbourne La Jolla, CA 92037 (619) 454-1494	10	Enertech	20	.2

<u>Resource/Area Developer</u>	<u>Number of Turbines</u>	<u>Manufacturer of Turbine</u>	<u>Size per Turbine (kW)</u>	<u>Installed Capacity (MW)</u>
<u>CARQUINEZ STRAIT -- .3 MW</u> (Solano, Contra Costa)				
PG&E Wind Demo 215 Market Street San Francisco, CA 90051 (415) 541-5907	1	Boeing	2,500	2.5
<u>SAN GORGONIO PASS -- 1.6 MW</u> (Riverside)				
San Gorgonio Farms, Inc. 2120 Wilshire Blvd. Suite 400 Santa Monica, CA 90403 (213) 832-0231	8	Carter	25	.2
Southern California Edison Company Demonstration Site P.O. Box 800 Rosemead, CA 91770 (213) 572-2914	1 1	DAF Indal Wenco	500 100	.6
<u>TEHACHAPI PASS -- 21.3 MW</u> (Kern)				
American Wind Energy Systems P.O. Box 6257 Tehachapi, CA 93561 (805) 822-7533	65	Hall-Mach	50	3.3
Ardgee, Remco, and International Science and Technology 1505 Mahalo Drive Compton, CA 90220 (213) 604-1518	25	WECS-TECH	70	1.8

<u>Resource/Area Developer</u>	<u>Number of Turbines</u>	<u>Manufacturer of Turbine</u>	<u>Size per Turbine (kW)</u>	<u>Installed Capacity (MW)</u>
<u>TEHACHAPI PASS -- 21 MW (cont.) (Kern)</u>				
Cannon Financial Group 6920 Miramar Road Suite 304 San Diego, CA 92121 (619) 271-0881	85	Wind Power Systems	40	3.4
Oak Creek Energy Systems 188 S. Robinson Tehachapi, CA 93561 (805) 822-6853	61 50 6 2	Carter Hall-Mach Bonus Vestas	25 50 65 65	4.6
Pacific Wind & Solar 1448-15th Street Suite 102 Santa Monica, CA 90404 (213) 394-4026	10	ESI	50	.5
Pacific Wind Systems 1335 Hotel Circle South Suite 201 San Diego, CA 92108 (619) 296-9441	20	Wind Power Systems	40	.8
Windland, Inc. 6994 El Camino Real Suite 211 Carlsbad, CA 92008 (619) 438-5361	10	Wind Power Systems	40	.4
Zond Energy Systems 112 So. Curry Street Tehachapi, CA 93561 (805) 822-6835	78 10 30 2 10	Wind Power Systems Carter Windmatic Vestas Polenko	40 25 65 65 100	6.5

LARGE-SCALE CALIFORNIA WIND PROJECTS

1983 Installations*

1983 SUMMARY

<u>No. of Turbines Installed</u>	<u>Turbine Size Range (kW)</u>	<u>Total Installed Capacity (MW)</u>
2,493*	10 - 500	172.1*

<u>Resource/Area Developer</u>	<u>Number of Turbines</u>	<u>Manufacturer of Turbine</u>	<u>Size per Turbine (kW)</u>	<u>Installed Capacity (MW)</u>
<u>ALTAMONT PASS -- 90.1 MW</u> (Alameda, Contra Costa)				
Altamont Energy Corp. 1330 Lincoln Ave. Suite 201 San Rafael, CA 94901 (415) 459-4420	55	ESI	80	4.4
American Diversified Corporation 3200 Park Center Dr. Suite 1300 Costa Mesa, CA 92626 (714) 641-6660	26 12	Windmatic Polenko	65 100	2.9

* This data does not include installations completed in 1981 and 1982.

<u>Resource/Area Developer</u>	<u>Number of Turbines</u>	<u>Manufacturer of Turbine</u>	<u>Size per Turbine (kW)</u>	<u>Installed Capacity (MW)</u>
<u>ALTAMONT PASS -- (cont.)</u>				
American Energy Projects 3150 Almaden Expressway Suite 145 San Jose, CA 95118 (408) 269-7002	72	Fayette	75	5.4
CWES 1660 Hotel Circle North Suite 400 San Diego, CA 92108 (619) 299-6089	144 27	Enertech Micon	40 65	7.5
Executive Productions 2235 E. Flamingo Road Las Vegas, NV 89109 (702) 731-0066	17	Fayette	95	1.6
Fayette P.O. Box 1149 Tracy, CA 95376 (415) 443-2929	150 10	Fayette Fayette	95 400	18.3
FloWind 1183 Quarry Lane Pleasanton, CA 94566 (415) 484-3300	40	FloWind	150	6
TERA Corporation 2150 Shattuck Avenue Berkeley, CA 94704 (415) 845-5200	145	ESI	50	7.3
U.S. Windpower 500 Sansome Street Suite 600 San Francisco, CA 94111 (415) 455-6012	99 331	U.S. Windpower U.S. Windpower	100 50	26.5

<u>Resource/Area Developer</u>	<u>Number of Turbines</u>	<u>Manufacturer of Turbine</u>	<u>Size per Turbine (kW)</u>	<u>Installed Capacity (MW)</u>
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ALTAMONT PASS -- (cont.)

WindMaster 660 J Street Suite 350 Sacramento, CA 95814 (916) 443-1704	51	HMZ	200	10.2
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CARQUINEZ STRAIT -- .3 MW
(Solano, Contra Costa)

Wind Generator Distributing 1700 Broadway Vallejo, CA 94589 (707) 644-6685	3	Windtech	75	.2
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Wind Harvest Company 80 Lincoln Dr. Ventura, CA 93001 (805) 643-6689	3	Wind Harvest	30	.1
	1	Wind Harvest	10	

SALINAS VALLEY -- .2 MW
(Monterey)

Casas Del Sol P.O. Box 89 Pacific Grove, CA 93950 (408) 649-0717	4	Enertech	40	.2
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SAN GORGONIO PASS -- 36.8 MW
(Riverside)

Aztec Energy Corporation 777 Tahquitz-McCallum Suite 311 Palm Springs, CA 92262 (619) 323-4088	43	Wind Power Systems	65	6.5
	4	Wenco	100	
	41	Dynergy	80	

<u>Resource/Area Developer</u>	<u>Number of Turbines</u>	<u>Manufacturer of Turbine</u>	<u>Size per Turbine (kW)</u>	<u>Installed Capacity (MW)</u>
<u>SAN GORGONIO PASS -- (cont.)</u>				
CWES 1660 Hotel Circle North Suite 400 San Diego, CA 92108 (619) 299-6089	130 175	Micon Enertech	65 40	15.5
Maeva Wind Farm P.O. Box 1415 San Marcos, CA 92069 (619) 741-5593	41	Dynergy	80	3.3
San Gorgonio Farms 21515 Hawthorne Blvd. Suite 1059 Torrance, CA 90503 (213) 316-7337	144	Carter	25	3.6
Sandberg Wind Corporation 31324 Via Colinas Westlake Village, CA 91362 (818) 991-7137	14 10 7	Vawtpower Wind Power Systems WECS-TECH	185 45 150	4.1
Southern California Edison Company Demonstration Site P.O. Box 800 Rosemead, CA 91770 (818) 302-2914	1 1	DAF Indal Wenco	500 100	.6
Triad American Energy 170 Newport Center Drive Suite 240 Newport Beach, CA 92660 (714)720-9424	40	ESI	80	3.2

<u>Resource/Area Developer</u>	<u>Number of Turbines</u>	<u>Manufacturer of Turbine</u>	<u>Size per Turbine (kW)</u>	<u>Installed Capacity (MW)</u>
<u>TEHACHAPI PASS -- 44.7 MW (Kern)</u>				
Arbutus 4041 MacArther Blvd. Suite 230 Newport, CA 92660 (714) 476-8600	114	Windtech	75	8.6
Cannon Financial Group 6920 Miramar Road Suite 304 San Diego, CA 92121 (619) 271-0881	213 5	Century Design Windtech	75 75	16.4
Oak Creek Energy Systems P.O. Box 469 Tehachapi, CA 93561 (805) 822-6853	9 66 5 30 2	Carter Nordtank Vestas Bonus Micon	25 65 65 65 65	6.9
Windland, Inc. 6994 El Camino Real Suite 211 Carlsbad, CA 92008 (619) 438-5361	15 2	Carter Carter	25 250	.9
Zond 112 So. Curry Street Tehachapi, CA 93561 (805) 822-6835	155 20 1 15	Vestas Windmatic Polenko Carter	65 65 100 25	11.9

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LARGE-SCALE CALIFORNIA WIND PROJECTS

1984 Installations*

1984 SUMMARY

<u>No. of Turbines Installed</u>	<u>Turbine Size Range (kW)</u>	<u>Total Installed Capacity (MW)</u>
4,687*	16-400	366*

<u>Resource/Area Developer</u>	<u>Number of Turbines</u>	<u>Manufacturer of Turbine</u>	<u>Size per Turbine (kW)</u>	<u>Installed Capacity (MW)</u>
<u>ALTAMONT PASS -- 181.4 MW</u> (Alameda, Contra Costa)				
Altamont Energy Corp. 1330 Lincoln Ave. Suite 201 San Rafael, CA 94901 (415) 459-4420	100 50 10 50	Nordtank ESI Howden Enertech	65 50 330 40	14.3
American Diversified Corporation 3200 Park Center Dr. Suite 1300 Costa Mesa, CA 92626 (714) 641-6660	125 105	Nordtank Bonus	65 65	14.9

* This summary shows 1984 data which was gathered in late 1984. This data does not include installations completed in 1981, 1982, and 1983.

<u>Resource/Area Developer</u>	<u>Number of Turbines</u>	<u>Manufacturer of Turbine</u>	<u>Size per Turbine (kW)</u>	<u>Installed Capacity (MW)</u>
<u>ALTAMONT PASS -- (cont.)</u>				
CWES 1660 Hotel Circle North Suite 400 San Diego, CA 92108 (619) 299-6089	200	Micon	65	13
Executive Productions 2235 E. Flamingo Road Las Vegas, NV 89109 (702) 731-0066	75	Aeroman	40	3
Fayette P.O. Box 1149 Tracy, CA 95376 (415) 443-2929	200 26	Fayette Fayette	95 400	29.4
Flowind 1183 Quarry Lane Pleasanton, CA 94566 (415) 484-3300	212	Flowind	150	31.8
TaxVest Windfarms, Inc. 5950 Canoga Avenue Suite 600 Woodland Hills, CA 91367 (818) 887-4850	150	Micon	65	9.8
TERA Corporation 2150 Shattuck Avenue Berkeley, CA 94704 (415) 845-5200	55	ESI	65	3.6
U.S. Windpower 500 Sansome Street Suite 600 San Francisco, CA 94111 (415) 455-6012	491	U.S. Windpower	100	49

<u>Resource/Area Developer</u>	<u>Number of Turbines</u>	<u>Manufacturer of Turbine</u>	<u>Size per Turbine (kW)</u>	<u>Installed Capacity (MW)</u>
<u>ALTAMONT PASS -- (cont.)</u>				
Wind Developers, Inc. 1029 J Street Sacramento, CA 95814 (916) 447-6137	3	Danish Wind Technology	340	1
WindMaster 660 J Street Sacramento, CA 95814 (916) 447-6137	58	HMZ	200	11.6
<u>BOULEVARD -- .2 MW (San Diego)</u>				
Aeolus Wind Farms 430 Westbourne La Jolla, CA 92037 (619) 766-4346	4	Enertech	20	.1
CWES 1660 Hotel Circle No. Suite 400 San Diego, CA 92108 (619) 299-6089	6	Micon	22	.1
<u>CARQUINEZ STRAIT -- .2 MW (Solano, Contra Costa)</u>				
Wind Generator Distributing 1700 Broadway Vallejo, CA 94589 (707) 644-6685	2	Windtech	75	.2

<u>Resource/Area Developer</u>	<u>Number of Turbines</u>	<u>Manufacturer of Turbine</u>	<u>Size per Turbine (kW)</u>	<u>Installed Capacity (MW)</u>
<u>MOJAVE -- 6.5 MW</u> (Kern)				
Solar World Energy 28059 Avenue Stanford Valencia, CA 91355 (805) 257-4797	70	Solar World Energy	16	1.1
Wind Source 24007 Ventura Blvd. Suite 140 Calabasas, CA (805) 522-4494	6 11 66	Bauma Bauma Aeroman	100 200 40	5.4
<u>SAN GORGONIO PASS -- 111.8 MW</u> (Riverside)				
Cathay Wind 4540 Kearny Villa Road Suite 110 San Diego, CA 92123 (619) 569-1875	100	Riisager	90	9
Maeva Wind Farm P.O. Box 1415 San Marcos, CA 92069 (619) 755-6240	59	Dynergy	80	4.7
Renewable Energy Ventures 5955 DeSoto Avenue Suite 249 Woodland Hills, CA 91367 (818) 887-7125	168 358 54	ESI Jacobs Jacobs	80 17.5 20	20.8
San Gorgonio Farms 21515 Hawthorne Blvd. Suite 1059 Torrance, CA 90503 (213) 316-7337	50 30 58	Carter Micon Bonus	25 65 65	7

<u>Resource/Area Developer</u>	<u>Number of Turbines</u>	<u>Manufacturer of Turbine</u>	<u>Size per Turbine (kW)</u>	<u>Installed Capacity (MW)</u>
<u>SAN GORGONIO PASS -- (cont.)</u>				
Sandberg Wind Corporation 31324 Via Colinas Suite 114 Westlake Village, CA 91362 (818) 991-7137	10 30 3	Vawtpower Windmatic WECS-TECH	185 65 150	4.3
Southern California Edison Company Demonstration Site P.O. Box 800 Rosemead, CA 91770 (818) 302-2914	1 1	Howden Magnus	330 Unknown*	.3
Transworld Wind Corp. 777 E. Tahquitz-McCallum Suite 333 Palm Springs, CA 92262 (619) 322-0400	470 4	Dynergy DWT	80 340	39
Triad American Energy 170 Newport Center Drive Suite 240 Newport Beach, CA 92660 (714) 720-9424	90	ESI	80	7.2
Zond 112 So. Curry Street Tehachapi, CA 93561 (805) 822-6835	300	Vestas	65	19.5
<u>TEHACHAPI PASS -- 65.9 MW (Kern)</u>				
Airtricity 11145 Tampa Avenue, Suite 19B Northridge, CA 91326 (818) 368-1951	50 100	Windmatic Windmatic	65 100	13.3

* Edison is testing the aerodynamic aspects of the Magnus turbine without generating electricity.

<u>Resource/Area Developer</u>	<u>Number of Turbines</u>	<u>Manufacturer of Turbine</u>	<u>Size per Turbine (kW)</u>	<u>Installed Capacity (MW)</u>
<u>TEHACHAPI PASS -- (cont.)</u>				
American Wind Energy P.O. Box 6257 Tehachapi, CA 93561 (805) 822-7533	6	Blue Max	150	.9
Arbutus 4041 MacArther Blvd. Suite 230 Newport, CA 92660 (714) 476-8600	85	Ronus	65	5.5
Cannon Financial Group 6920 Miramar Road Suite 304 San Diego, CA 92121 (619) 271-0881	50 190	Century Design Century Design	75 100	22.8
Coram Energy Corp. 401 E. Ocean Blvd. Suite 204 Long Beach, CA 90802 (213) 436-4121	20	Aeroman	40	.8
Oak Creek Energy Systems P.O. Box 469 Tehachapi, CA 93561 (805) 822-6853	15 20 21	Ronus Micon Lolland	65 65 75	3.9
Westwind Energy Development P.O. Box 509 Tehachapi, CA 93561 (805) 822-3004	35	Carter	25	.9
Windland, Inc. 6994 El Camino Real Suite 211 Carlsbad, CA 92008 (619) 438-5361	24 10	Carter Carter	25 250	3.1
Zond 112 So. Curry Street Tehachapi, CA 93561 (805) 822-6835	220 4	Vestas Polenko	65 100	14.7