

PERMITTING SMALL WIND TURBINES: A HANDBOOK

Learning from the California Experience



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www.consumerenergycenter.org/erprebate/forms

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American Wind Energy Association

www.awea.org

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INTRODUCTION

Small Turbines – Large Benefits

Americans today generally associate wind energy with dense arrays of commercial-scale turbines that rise on 200 ft or taller towers, so they are often less familiar with wind turbines scaled for personal use on small acreages. Small (or “residential”) wind energy systems typically generate just enough power to meet the demands of a home, farm, or small business. They range from 400 watts to 100 kilowatts or more, and typically consist of a single turbine, while commercial wind farms consist of dozens or even hundreds of megawatt-scale turbines.

But small wind systems are not mere playthings for backyard hobbyists. They can be significant power resources that have proven records of performance, even in locations with modest winds. The success of the commercial wind industry has propelled significant advances in small turbine design, making these systems more reliable, quieter, and safer than those introduced in past decades. And though most of the electricity they produce is used on-site, excess generation from small wind turbines can be fed into distribution lines, strengthening the electric grid.

Small wind systems can be an important component of a power system that’s more affordable, secure, and sustainable.



Photo courtesy Kevin Schiebel

Small wind turbines were commonplace on farms and ranches across the Midwestern United States before the advent of rural electrification programs. Wind generators powered lights, radios, and kitchen appliances in far-flung reaches of the country, offering rural families most of the conveniences of modern urban life.

In this new century, small wind turbines are an attractive investment for residents in rural areas looking for relief from high energy costs. Small turbines also contribute a larger public benefit by reducing demand on utility systems now supplied primarily by centralized fossil-fuel plants. In recent years this system has left electricity customers vulnerable to power shortages and sharp price increases. The development of large-scale power plants has become riskier in the turbulent energy market, creating the need for new forms of distributed generation sources to make the system more secure

and sustainable. Small wind systems can be an important component of such energy independence.

In 2001, the California Legislature passed landmark legislation, Assembly Bill 1207, to promote small wind turbine installations by standardizing permitting requirements. Other state incentives include a rebate program administered by the California Energy Commission and a state income tax credit for purchasers of small wind systems. The following excerpt from AB 1207 articulates the benefits the state hopes to derive from small wind development:

Distributed small wind energy systems ...enhance the reliability and power quality of the power grid, reduce peak power demands, increase in-state electricity generation, diversify the state's energy supply portfolio, and make the electricity supply market more competitive by promoting consumer choice.¹



Photo courtesy Southwest Windpower

1. California Government Code, Section 65892.13 (a) (2)
www.leginfo.ca.gov/cgi-bin/displaycode?section=gov&group=65001-66000&file=65892.13

Using This Handbook

Public officials and property owners alike will find the information in this handbook useful in determining best practices for siting wind turbines and in understanding the permitting implications of California's new law. The handbook cites key provisions of Assembly Bill 1207 and describes how California counties are complying with the new law. It notes the steps counties have taken (and could take) to streamline the permitting of small wind turbines, using existing installations as examples. Public officials will gain a better understanding of small wind systems, and property owners will learn what to expect in the permitting process.

- I. The first section covers site considerations. It lists the factors that determine whether the site is right, where to position the turbine, and what impacts the turbine could have on neighboring properties, wildlife, and safety.
- II. The next section describes key provisions of AB 1207, explaining both the letter and the spirit of the law, and illustrates how the law has been applied in specific counties throughout California.
- III. The third section provides a model zoning ordinance recommended by the American Wind Energy Association and a list of best practices for permitting small wind turbines both in California and nationwide.
- IV. The final section lists a variety of information resources, including publications and web resources offered by the American Wind Energy Association, the California Energy Commission, utilities, and other government agencies and organizations. Small wind turbine manufacturers are also listed.

I. INSTALLING SMALL WIND ENERGY SYSTEMS

Permitting reviews can absorb a significant amount of time and energy from property owners and public officials. Before beginning the process, property owners should be reasonably certain that their site is windy enough to justify the effort. After that, there's more to consider: How difficult will it be to obtain the necessary permit? How do you arrange for a utility line connection? What about safety and impacts on wildlife?

Much of the land mass of the United States gets enough wind to power small wind turbines.

Evaluating the Site

Small wind turbines require lesser wind resources than large commercial turbines, so they are feasible in many more places. Much of the land mass of the United States gets enough wind to power small turbines. Simply put, if a site "feels" windy enough, it is probably worth investigating and determining the estimated pay back. Does the wind blow steadily for sustained periods on a regular basis? Are there large seasonal variations? What are the expected electricity bill savings? Turbine dealers can often help assess a potential site through visual inspection of surrounding terrain.

Property owners in many parts of the country can analyze their hunches with recently updated wind maps that predict wind patterns. County officials also can use wind maps to familiarize themselves with local wind



Photo courtesy of Tom Rhamy

Hybrid Solar and Wind Installation Pays Off

Ridgecrest (Kern County) — Tom and Angela Rhamy decided that electricity had become too expensive during the power crisis of 2001, so they bought a combination wind/solar energy system and started generating their own. When conditions are good their meter spins backward, cutting their power bills to half what they used to be.

The Rhamys, who own a 2,000-square foot home and keep an office in the barn behind the house, have joined the ranks of homeowners discovering that small-scale wind systems are a viable alternative to high power bills. They took advantage of state

For more info on the economics of small wind, see:
www.awea.org/smallwind/toolbox/INSTALL/financing.asp

incentives designed to encourage the installation of home generating systems, receiving a state tax credit and a rebate from the California Energy Commission that covered half the cost of their machine. Their system went online in May 2002 and should pay for itself within five to seven years.

The Rhamys found plenty of information available from the American Wind Energy Association, *Home Power Magazine*, and state resources such as California's "Green Team" video conferences and the California Energy Commission. Their turbine dealer gave them the information they needed to approach the county building inspector, who approved a permit for the system that same day.

Kern County allows towers up to 80 feet high in most zoning districts, so no special permitting was required. "It was very simple," says Tom Rhamy.

Connecting their generator to the utility's system was also a straightforward process. Southern California Edison sent the Rhamys a blank contract that included a net metering agreement and other interconnection requirements. The Rhamys filled in specific information about their system, and the utility sent a completed contract for them to sign.

Small wind turbine installations are not this easy in all California counties, but the Rhamys' experience shows the widespread acceptance that residential renewable power systems have earned in recent years.

resources and answer inquiries from prospective permit applicants.

The primary map used by the small wind industry in California to predict the performance and economics of a small wind system for potential customers is produced by the California Energy Commission and available online² or by calling (916) 654-3902. Also available online is *The Renewable Energy Atlas of The West: A Guide to the Region's Resource Potential*, which allows users to find average wind speeds at specific locations in 11 western states using ZIP codes or geographic coordinates.³

The Department of Energy ranks wind strength according to seven classifications. Class 1 winds are the weakest. Small wind turbines are generally cost-effective when installed in at least Class 2 or Class 3 winds (taller towers, 100 ft or higher, may be necessary in Class 2 winds), or where winds average at least 10 to 12.5 miles per hour (4.4 to 5.6 meters per second) at a height of 33 ft (10 meters) above ground. However, the wind power on a particular site is greatly affected by terrain. The wind may be obstructed by a hill or accelerated by a trough or valley. In complex terrain, small turbine dealers can help determine whether the wind is sheltered or concentrated. In a few cases, the installation of a wind data logging system may be necessary. (See inset next page.)

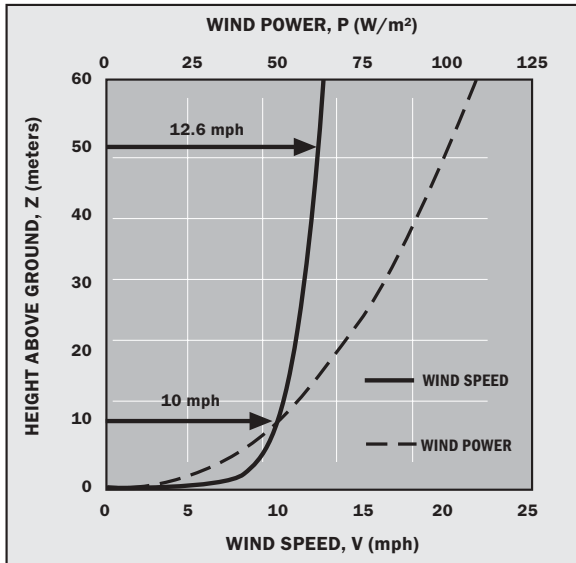
Positioning the Turbine

Ideally, property owners will place their turbines where wind is least obstructed, which is often the highest point on the site. Wind speed increases with height, and gaining even a small increase in velocity boosts

2. www.energy.ca.gov/maps/wind.html
3. www.EnergyAtlas.org

a turbine’s generating potential significantly (see graph below). County officials may have aesthetic concerns about allowing turbines proposed on hills or ridges. However, planners and permitting officials should be aware that restricting the placement of a wind turbine within a site for aesthetic reasons may

Graphic: Texas State Energy Conservation Office



Typical Wind Shear Profile — Speed and power available in the wind increases with increasing elevation. The relationship is commonly referred to as the one seventh power law ($a=1/7$).

adversely affect project economics.

Wind turbines should be elevated so that the bottom tips of their blades pass three times above the tallest upwind barrier, or at least 25-30 feet above any physical wind barriers (trees, buildings, bluffs) within 300-500 feet of the tower or the local treeline, whichever is higher. This is advisable to minimize air turbulence that places stress on mechanical components and reduces turbine performance. (See diagram next page.) Elevating the turbine higher above adjacent obstacles is always better, although one manufacturer suggests that clearance of at least 20 feet may be adequate for “micro” turbines (under 1 kW). However, optimum tower height is always determined by the terrain and wind resource, not the turbine size.

In cases where it is impossible to elevate a turbine sufficiently because of local permitting restrictions, planning officials can review their rules to see

Your Best Guess May Not Be Good Enough

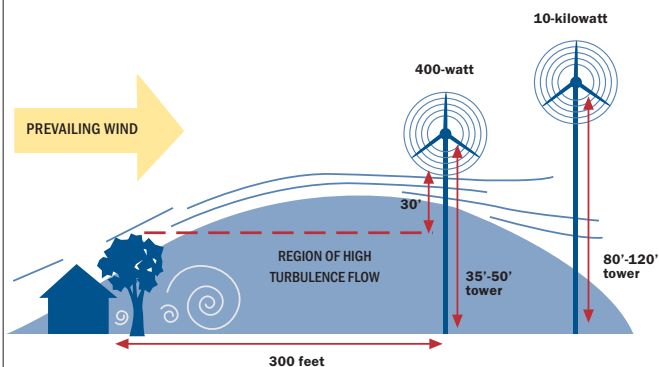
Scotts Valley (Santa Cruz County) — Larry Gilliam found out that wind maps are no substitute for on-site wind measurements. A map may show healthy winds over a general area, but topological features significantly affect the strength of the wind blowing across a particular site. “I looked at the maps and thought I was in a Class 2 wind regime,” says Gilliam, whose 10-kilowatt turbine hasn’t been as productive as he’d hoped. “If I had to do it over again, I would have erected an anemometer.”

Still, Gilliam’s enthusiasm for wind turbines — inspired by a visit to a wind farm in San Geronio Pass — is not diminished. His turbine cut his monthly electric bill from \$120 to about \$80, and he’s confident that the turbine will prove an even better investment over time as energy prices continue to rise.



Photo courtesy Bergrey Windpower

if they are more restrictive than necessary or allowed by AB 1207 and grant waivers as appropriate. (See “County Staff Make Way for Small Wind,” page 27.)



Utility Line Interconnection

Wind turbine owners serviced by distribution lines can derive significant economic advantages by connecting their generators with the utility’s system. Federal law (PURPA, 1978) requires that all utilities permit customer-owned generators to interconnect with their systems and compensate them for energy production.

In California and many other states, utilities are also required to provide **net metering** service, which allows turbine owners’ electric meters to spin backward when the turbines generate more power than the owners

need.⁴ *This does not mean that the turbine owner is selling electricity.* Rather, net metering is a trade between the turbine owner and utility. When the turbine owner does not need the power the generator is producing, the energy is essentially banked with the utility. When the customer’s demand exceeds the turbine’s output, electricity is drawn back from the utility.



Photo courtesy of Chuck Koch

4. California State Public Utilities Code 1995 § 2827, as amended 1998, 2000 & 2201); www.dsireusa.org

Do it Yourself, but be Prepared to Wait

Tracy (San Joaquin County) — Steve and Kathy Nelson, who live five miles from one of the world’s largest wind developments at the Altamont Pass, didn’t have to worry about tower height restrictions when they put up a small turbine on their rural property. But they learned that it can still take some time and patience to install a turbine, especially if you do it yourself rather than contract with a turbine supplier.

Local permitting officials required two sets of plans for the Nelsons’ installation — one from a civil engineer, and another from a structural engineer. Local inspectors were sometimes too busy to sign off on plans right away and asked for revisions. The Nelsons waited three months just for utility staff to approve the interconnection. (Other utility customers, however, have not encountered such lengthy delays.)

Fortunately for the Nelsons, the California Energy Commission had not yet changed the rules of its Emerging Renewables Program to discount the rebate awarded to owner-installed systems. The new rules, which took effect in 2003, now reduce the rebate by 15% for systems not installed professionally. So a prospective turbine owner should carefully consider whether self-installation will save money once the reduced rebate is calculated in.

For the Nelsons, the do-it-yourself ethic did pay off. Their wind turbine has been performing well, reducing monthly bills on their 3,000 square-foot home from nearly \$300 to under \$100. The Nelsons expect their turbine to pay for itself in six to seven years.

Net metering shortens the payoff period for a wind turbine because it gives retail credit for power generated during low-use periods. Under net metering laws in California and several other states, however, utilities have the right to claim excess generation left over at the end of an annual billing cycle. If a turbine produces more electricity than the customer uses over a 12-month period, the utility does not have to reimburse the customer for that extra power.

For more information on net metering, see www.awea.org/smallwind/

Wind turbines must be connected to the utility system to be eligible for rebates through the California Energy Commission's **Emerging Renewables Program**.⁵

Customers of Pacific Gas and Electric Company (PG&E), Southern California Edison (SCE), San Diego Gas & Electric Company (SDG&E), and Bear Valley Electric are eligible for rebates that can currently cover up to \$2.30/watt toward a wind turbine's installed cost. Rebates apply only to equipment that has been certified by the Energy Commission. Applicants must document and may be asked to justify specific installation expenditures when applying for rebates.

Utilities generally define requirements for connecting to the grid through interconnection agreements. California's three private utilities (PG&E, SCE, and SDG&E) offer simplified interconnection agreements that are consumer friendly. These contracts define turbine specifications, permitting and design requirements, technical

5. Emerging Renewables Program requirements are at: www.consumerenergycenter.org/erprebate

6. For more information see: www.energy.ca.gov/distgen/interconnection/guide_book.html

requirements for interconnection, conditions under which the turbine is to be disconnected, and legal liability. They also set the rate at which the utility will credit the customer for excess electricity, the billing arrangement, and any administrative fees the customer must pay. The Energy Commission is preparing a document for customer-generators interested in interconnecting to their utility.⁶

Communicating with Neighbors

County planners advise and sometimes require that permit applicants notify their neighbors before proceeding with a project as visible as a wind turbine. Small wind turbine manufacturers also recommend early notification of neighbors. That courtesy will in many cases correct misperceptions and head off full-blown opposition. A letter like the one below can answer most questions people have about small wind turbines.

Dear Neighbor,

You may be interested to learn that I plan to install a small wind energy system on my property at [address]. This modern, non-polluting system will generate electricity solely for my own use, reducing my dependence on the local utility. Any excess generation will be supplied to the utility system, but I will not receive any income from this exchange.

I plan to install a [turbine make and model] that will be mounted on a ___-foot tower, set back ___ feet from the street and ___ feet from the [south/north/east/west] property line. This wind turbine uses a [two/three]-bladed propeller ___ feet in diameter and has only ___ moving parts. It does not turn until the wind speed reaches at least ___ mph. On calm, quiet days the wind turbine will not likely be audible. When the rotor is turning, the sound of the wind passing over the blades will register about ___ decibels (dB(A)), at a distance of ___ feet, which will barely be audible over other noises caused by the wind.

[Manufacturer] has installed ___ [number] of [turbine make and model] in the United States [and overseas]. They have a proven track record of producing energy quietly, cleanly, and safely. If you have any questions about the proposed installation, please feel free to contact me.

Sincerely,

It also lets the neighbors know that an applicant has properly researched the project. California law limits locally imposed notification requirements to neighbors living within 300 feet of the proposed installation.

Concerns that may arise about small wind turbines are typically about noise and other perceived nuisances, safety, and impacts on views and property values. Often these worries are fueled by neighbors' lack of familiarity with wind systems. Below are some facts that address common issues.

1. Acoustics

Wind turbines produce two types of noise: one from the equipment inside the nacelle, such as the generator, and the second from the aerodynamic noise of the rotating blades. Most small wind turbines do not have gearboxes or other noisy mechanical systems, and manufacturers have made them quieter through better sound insulation, lower rotor speeds and adjustments to blade geometry.

Although turbine noise increases with wind speed, so does the background noise produced by nearby trees, cars, animals and airplanes. Research has found that the background can be almost as noisy as the wind turbine, and at low wind speeds, will usually mask the wind turbine noise.

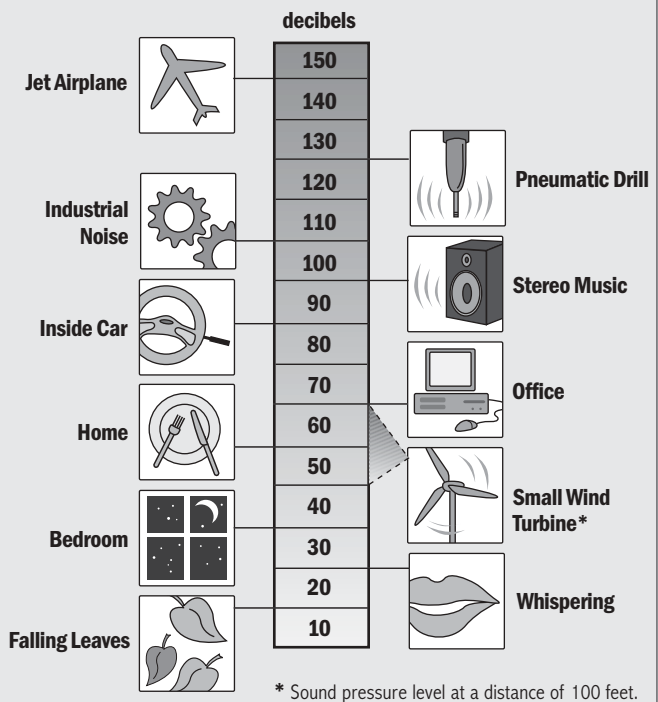
In a test conducted by the Clinton (Iowa) Detective Bureau, the noise from a 10-kW Jacobs wind system was measured in winds between 16 and 36 miles per hour. At 50 feet, the decibels measured between 55 dB(A) and 59 dB(A). But the detective, noting that the turbine noise was partially masked by rustling leaves, also took readings from trees that were 300 feet away. The trees registered 60 dB(A) to 62 dB(A).

7. Mick Sagrillo, Windletter Feb/Mar 1997.

The report concluded that the wind generator produced "inconsequential" noise emissions.⁷

Wind turbine noise is measured in two ways: sound power level is a measure of the acoustic strength of the source – the wind turbine itself, and sound pressure level is a measure of the noise perceived at a particular location. Therefore, a distance from the wind turbine rotor hub must be specified for the sound pressure level to be meaningful. The noise perceived at a receptor location also depends upon the wind speed and the local surroundings. Mathematical models allow estimates of the sound pressure level at any location around the wind turbines.

The acoustic source strength of a wind turbine is measured in dB (decibels) on a logarithmic scale.



<http://www.awea.org/faq/noisefaq.html>

www.awea.org/smallwind.html

Because humans hear higher frequencies better than lower frequencies, an adjusted dB(A) scale is used to replicate this human response. Tests at the National Wind Technology Center⁸ show that the sound power level of small wind turbines varies from about 75-100 dB(A). At a distance of 100 feet from the rotor hub, this range corresponds to sound pressure levels (perceived noise) of 40-65 dB(A). A level of 40 dB(A) – about the same as inside an average living room – is generally considered acceptable for neighboring structures. A level of 65 dB(A) – noisier than a loud conversation – may cause an annoyance.

problem for the many people who find wind turbines aesthetically pleasing. But in response to neighbors who do not, planning officials should consider the relative visual impacts of wind turbines. Communities already accept water towers, billboards, relay towers, and utility lines as part of the landscape. Does a wind turbine constitute a greater intrusion on a neighbor's view than would the addition of a second story to a home or other property improvements that are legally permitted? The right of applicants to generate their own local, clean energy, along with the public benefits spelled out by AB 1207, must be weighed against those who object to turbines on aesthetic grounds. County planners should weigh the potential cost impacts and lost revenue resulting from preventing turbines from being sited in optimal locations, and follow the guidance of Assembly Bill 1207:

In light of the state's electricity supply shortage and its existing program to encourage the adoption of small wind energy systems...local agencies [should]...not unreasonably restrict the ability of homeowners, farms, and small business to install small wind energy systems ...It is the policy of the state to promote and encourage the use of small wind energy systems and to limit obstacles to their use.⁹

Small turbines are not as visibly noticeable as many people imagine. Even in flat, treeless areas it is difficult to pick them out from a quarter of a mile away. Among hills or trees they are even less noticeable. Guyed lattice towers are the least visible from a distance. Turbines and towers can be painted light gray to further minimize visual impacts.

- 8. Migliore, P., van Dam, J. and Huskey, A, Acoustic Tests of Small Wind Turbines, NREL SR-500-34601, Golden, CO, 2003.
- 9. California Government Code, Section 65892.13 (a) (2)



Photo courtesy Southwest Windpower

Noise complaints are rarely lodged against installed small wind turbines. The noise from their blades tends to blend in with the background acoustic vibrations produced in windy conditions.

When responding to neighbors' questions about noise, remember that sound levels

decrease at a rate approximately equivalent to the square of the distance from the source. So a noise reading taken 25 feet away from a turbine will fall by a factor of four at 50 feet, by a factor of 16 at 1000 feet, and so on.

2. Aesthetics

Turbines must be mounted on tall towers to achieve their best performance and avoid damaging turbulence, so visibility is unavoidable. This isn't a



3. Property Values

There is no documented evidence that wind turbines — including commercial wind farms — have ever lowered the values of surrounding properties. In fact, the opposite effect has been recorded. A recent study

that examined 25,000 property transactions within five miles of wind farms found that values almost always rose faster in those areas than in similar communities without turbines. The report, commissioned by the U.S. Department of Energy, included data from 10 wind installations in seven states.¹⁰

Vermont turbine owner David Blittersdorf reports that the home next to his sold within one day for the full asking price. His new neighbors later told him that his 10-kW wind turbine was a major factor in the quick sale. “They said they wanted to live in a place where the community cared about the environment. They told me that they too wanted to install a small wind turbine someday,” says Blittersdorf.

Wind turbine manufacturer Mike Bergey says that in 20 years of business he’s never heard of a customer’s wind turbine adversely affecting the value of neighboring real estate. “Our customers have sold their homes and adjacent lots, and they have had direct and nearby neighbors sell their homes. In all but one case the wind turbine was not an issue. In that case, the turbine had been partially installed on the abutting property due to a faulty survey. This situation was resolved amicably,” notes Bergey.

Some homebuyers will pay more for a home equipped with a renewable energy system. A California Energy Commission market survey of 300 California homeowners found that half were willing to pay extra for homes with solar panels or wind turbines. The study also found that more than 60% of homeowners preferred to buy a home already equipped with a renewable energy system rather than install it themselves.¹¹

4. Electronic Interference

Experimental wind turbines with metal blades put up in the 1970s reportedly “chopped up” television signals, resulting in ghost images on TV screens.

But the rotors on small-scale turbines are not large enough to interfere with TV or telecommunications signals, and their blades are made from wood, fiberglass, and plastic — materials that signals easily pass through.

Small wind turbine generators have never been shown to disrupt telecommunications or radio waves through electromagnetic interference. Jim Green of the U.S. Department of Energy’s National Renewable Energy Laboratory reports that in 10 years researching small wind turbines, he has never encountered a problem with electromagnetic interference, nor have other researchers found cause to study them.

In fact, one of the major niche markets for small wind systems is powering remote telecommunications sites. Small wind turbines have been approved by the U.S. Navy for powering military communications.¹²

10. www.REPP.org

11. www.energy.ca.gov/reports/2002-04-03_500-02-016.PDF

12. Mick Sagrillo, “Telecommunication Interference from Home Wind Systems” AWEA Windletter, Volume 22, Issue No. 4 April 2003.



5. Safety

No public injuries have been attributed to falls from the thousands of unfenced small turbine towers installed over the past 25 years. Turbine towers should be required to have the same access restrictions — such as fencing or warning signs — as similar structures such as ham radio towers. Some turbine tower models currently on the market, primarily for the smallest turbines, are designed to be lowered to the ground for maintenance and repairs and don't have hand- and foot-holds. The small wind industry does not recommend fencing or anti-climbing devices.

Under AB 1207, turbine permit applications are required to include standard drawings and an engineering analysis of the system's tower, showing compliance with national or state building codes and certification by a licensed professional engineer, demonstrating that the system is designed to meet requirements for the most stringent wind (Uniform Building Code wind exposure D), the worst seismic class (Seismic 4), and the weakest soil class (soil strength of not more than 1,000 pounds per sq ft). Applications are also required to include a line drawing of the system's electrical components in sufficient detail to allow determination that the installation conforms to the National Electric Code.

Utility personnel unfamiliar with wind generation may mistakenly worry that turbines are a threat to utility line workers responding to power outages. In the 25 years that utilities have been required to interconnect small wind turbines, not a single liability claim has been filed against a turbine owner over electrical safety. Inverters certified by the California Energy Commission for use with small wind turbine installations are required to comply with UL 1741, which ensures safe operation on an electricity grid, including during utility outages.

Section 2827 of the California Public Utilities Code, most recently amended in 2002 by Assembly Bill 58, establishes standard terms for interconnection:

A...wind turbine electrical generating system ...used by an eligible customer-generator shall meet all applicable safety and performance standards established by the National Electrical Code, the Institute of Electrical and Electronics Engineers, and accredited testing laboratories such as Underwriters Laboratories and, where applicable, rules of the Public Utilities Commission regarding safety and reliability. A customer-generator whose ...wind turbine electrical generating system ...meets those standards and rules shall not be required to install additional controls, perform or pay for additional tests, or purchase additional liability insurance.

6. Avian Risk

Bird collisions with small wind turbines are very rare. Statistically, a sliding glass door is a greater threat to birds than a small, unlighted wind turbine. Smokestacks, power lines, and radio and television towers have been associated with far greater numbers of bird fatalities than have even larger-scale wind farms.

Motor vehicles and pollution are responsible for an even higher proportion of total bird deaths. House cats kill an estimated 100 million birds annually.¹³

Wind turbines have been associated with avian impacts primarily because of unique conditions at California's Altamont Pass Wind Development. Habitat for golden eagles and other protected species, Altamont Pass is one of the world's largest, and earliest, commercial wind installations. Much research has been conducted to make wind turbines more "bird safe," including tower design changes and better siting practices. According to a recent report from the Bonneville Power Administration, "Raptor mortality has been absent to very low at all newer generation wind plants studied in the U.S. This and other information ...strongly suggests that the level of raptor mortality observed at Altamont Pass is unique."¹⁴

Because small wind turbines have small rotor swept areas, are not usually tall enough to interfere with bird migration patterns, and are not often installed in dense enough configurations to create a "windwall" effect, they generally do not cause problems with birds or other wildlife. The California chapter of the National Audubon Society endorsed the passage of AB 1207, stating that the number of bird collisions with small-scale turbines is expected to be "similar to the deaths caused by other stationary objects that birds routinely fly into."¹⁵

13. National Wind Coordinating Committee (NWCC),
Permitting of Wind Energy Facilities: A Handbook, 2nd ed.
www.nationalwind.org

14. Synthesis and Comparison of Baseline Avian and Bat Use,
Raptor Nesting and Mortality Information from Proposed and
Existing Wind Developments, West, Inc., December 2002

15. Letter from John McCaull, California Audubon, to California
Assemblyman John Longville, July 17, 2001.

Who Says Wind Turbines Need Lights? Not the FAA.

Solara Energy President Peter Burcat takes issue with counties that require beacon lights on small wind turbines. An attorney who is also working to obtain a pilot's license, Burcat knows that even the tallest small turbine towers do not reach high enough to trigger Federal Aviation Administration (FAA) lighting requirements.

The FAA doesn't require lights on structures less than 200 feet tall, and prohibits both commercial and small private aircraft pilots from flying lower than 1,000 feet. Pilots cannot drop lower than 500 feet when approaching a runway. The only time a small wind turbine would be affected by FAA regulations is if it were proposed to be sited adjacent to an airport.

Many common structures that are taller than small wind turbines – transmission line poles, for example – are not required to be lit.

California's AB 1207 does, however, require that turbine owners alert crop duster pilots to their installations in certain regions. Section 65892.13(d)(4) stipulates that:

"In the event a small wind energy system is proposed to be sited in an agricultural area that may have aircraft operating at low altitudes, the local agency shall take reasonable steps ...to notify pest control aircraft pilots registered to operate in the county pursuant to Section 11921 of the Food and Agricultural Code."

7. Air Traffic

The height of small wind turbine towers is well below the 200-foot elevation that would require them to be lit under Federal Aviation Administration (FAA) rules. Nor does the FAA require notification of small wind turbine construction¹⁶ unless the proposed tower would be within:

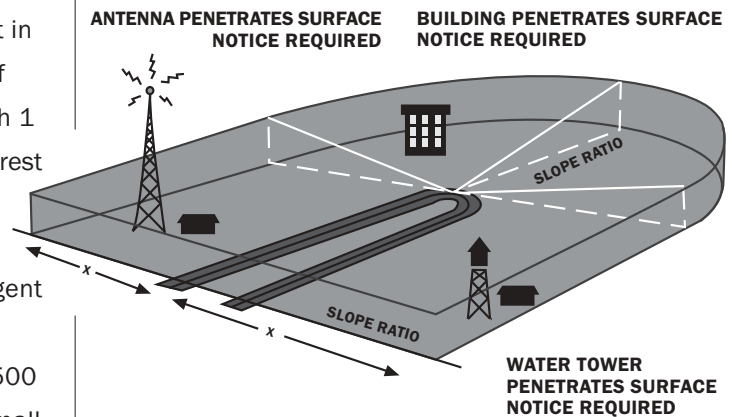
- 20,000 feet of an airport or seaplane base with at least one runway more than 3,200 feet in length and the object would exceed a slope of 100:1 horizontally (100 feet horizontally for each 1 foot vertically) from the nearest point of the nearest runway; or
- 10,000 feet of an airport or seaplane base that does not have a runway more than 3,200 feet in length and the object would exceed a slope of 50:1 horizontally (50 feet horizontally for each 1 foot vertically) from the nearest point of the nearest runway. (See figure to the right.)

The California State Aeronautics Act is less stringent than FAA guidelines, requiring Department of Transportation review for structures exceeding 500 feet, which is four times as high as the tallest small wind turbine tower available.¹⁷

Some townships in close proximity to Edwards Air Force Base Flight Test Center are subject to a recent California law (SB 1989) that requires the military be notified of small wind energy systems proposed in the zone classified R-2515. R-2515 lies mostly in Los

Angeles County, extending slightly into Kern County. The law does not prohibit small wind turbines in R-2515. It requires only that local planning agencies forward applications for small wind turbines to military authorities. The law is intended as a precaution – small wind turbines are not expected to raise problems for the air base.

Object Penetrates Airport / Seaplanes Base Surface



Airports with one runway more than 3,200 ft. X=20,000 ft. Slope ratio 100:1

Airports with no runway over 3,200 ft. X=10,000 ft. Slope ratio 50:1

Graphic: Federal Aviation Administration

16. FAA Advisory Circular AC70/7460-1K

17. State Aeronautics Act, Part 1 Division 9 Section 21656 of California State Public Utilities Code.

Vineyard Gets Good Wind Harvest

Paso Robles (San Luis Obispo County) –

Joe Mathewson says permitting staff weren't sure what to expect when he proposed the first small wind turbine in the county, but their ready acceptance of the project made for a smooth installation.

"San Luis Obispo County was very friendly toward the application," Mathewson says.

Mathewson had been spending \$15,000 annually on electricity to irrigate his 40-acre vineyard. He figured it was time to see if the wind, which blows steadily from afternoon to midnight in the summers, could do some of the work instead. Mathewson's instincts were right: his 10-kilowatt wind generator has cut his power bill from \$1,000 to \$200 per month during the grape irrigation season. All told, he has cut his annual electricity bill by nearly half.

Mathewson put up the turbine and 100-foot tower himself. The permit cost \$400, and the process took only a couple of weeks. He says county planners were primarily interested in the integrity of his tower foundation and electrical connections. Since the turbine was installed in the center of his property,



Photo courtesy of Joe Mathewson

he did not encounter any opposition from neighbors.

He's so impressed with his system that Mathewson has taken to selling small wind turbines on the side. "If you have a consistent wind resource, a suitable location, and want to reduce your electric bill, this is a good way to go," he says.

A CHECKLIST

A summary of basic steps for obtaining a permit for a small wind turbine in California¹⁸

1. Contact your county planning department or permitting agency.

- ❑ Find out if small wind energy systems are addressed by local ordinance and, if so, get a copy of the ordinance. (If not, see **2** below.)
- ❑ Learn the relevant permitting procedures.
- ❑ Ask what documents you'll need. Are you required to submit plans from a consulting engineer, or will documentation from the turbine manufacturer or dealer do?

2. Review the applicable standards and restrictions.

In California, if small wind energy systems are not specifically addressed by local ordinances in your area, or if local ordinances have not been brought into compliance with AB 1207, then your small wind turbine is an allowable use, subject to the provisions of the *California Government Code*, Section 65892.13(f), which sets the following restrictions:

- ❑ **Minimum parcel size:** One acre; must be outside an “urbanized” area unless otherwise specified.
- ❑ **Minimum allowable tower height:** Up to 65 feet must be allowed on parcels 1-5 acres; up to 80 feet must be allowed on parcels of five acres or more. Taller towers are not prohibited by state law.

- ❑ **Setback:** No part of the system, including guy wires, may be closer than 30 feet to the property boundary. (The installation must also comply with fire setbacks established by Section 4290 of the Public Resources Code.)

- ❑ **Noise levels:** Must not exceed 60 dB(A) during normal operation, as measured from the closest neighboring inhabited dwelling.

- ❑ **Equipment:** Contact the California Energy Commission for a list of certified small wind turbines¹⁹ and for recognized national certification programs.

- ❑ **Building code compliance:** Standard drawings and an engineering analysis of the tower are required showing compliance with the Uniform Building Code or the California Building Standards Code and certification by a licensed professional engineer. “Wet stamps” are not required.

- ❑ **Electric code compliance:** Requires line drawings of system electrical components showing sufficient detail to determine that installation conforms to the National Electric Code.

18. Many permit requirements are not applicable in certain California counties or outside the state. For recommended practices, see “Do’s & Don’ts” and AWEA’s model zoning ordinance, pages 27-29.

19. www.consumerenergycenter.org/erprebate/equipment.html

A CHECKLIST

❑ Federal Aviation Administration requirements:

Installations close to airports (within 10,000 to 20,000 feet of runways) may require prior FAA notification. (See “Air Traffic”, p. 16.)

❑ Other siting restrictions: Small wind energy systems may be subject to local restrictions adopted pursuant to state legislation establishing coastal areas, scenic highway corridors, or other specially designated areas.

3. For California grid-connected systems:

❑ Notify utility: You may need to show your permitting agency that you have notified the utility of your intent to install an interconnected wind generator.

❑ Reserve an Energy Commission rebate: Reserve your rebate prior to installation by submitting a Reservation Request Form and required supporting documentation to the Energy Commission.²⁰ Once your rebate reservation is accepted, you have up to nine months to install your (10 kW or smaller) system.

❑ Interconnection agreement: The state’s investor-owned utilities (SDG&E, PG&E, SCE) have simplified, consumer-friendly interconnection agreements. Utilities are required to process net metering applications within one month.²¹

20. See: www.consumerenergycenter.org/erprebate/forms.html

21. For more information see: www.awea.org/smallwind/california.html

4. Notify your neighbors.

❑ Counties may not require notice of an application to install a small wind turbine to property owners beyond 300 feet from the proposed site. (See “Communicating with Neighbors,” p. 11.)

5. Comply with permitting requirements.

Permitting requirements, procedures, and fees vary widely among counties.

❑ Building permit, use permit, zoning permit, or “plot plan” fees can range from less than \$100 to \$1600.

❑ Other costs for public notification, hearings, or environmental impact studies may range from a few hundred to several thousand dollars.

❑ If a particular fee seems excessive or inappropriate for your situation, find out the basis for the fee. You may be able to avoid it or have it reduced. (See “County Staff Make Way for Small Wind,” p. 27.)

❑ To be eligible for an Energy Commission rebate, your system must be installed by a licensed California contractor possessing an active “A,” “B,” “C-10,” or “C-46” (photovoltaic system) license.

❑ Obtain a final inspection sign-off prior to claiming your rebate. Net metering provisions take effect when the permit is obtained or the wind turbine begins operation.

II. PERMITTING SMALL WIND TURBINES UNDER AB 1207 SOME COUNTY COMPARISONS

Photo courtesy Southwest Windpower



The California Legislature's adoption of Assembly Bill 1207 in 2001 sent a clear message to local authorities that "the implementation of consistent statewide standards to achieve the timely and cost-effective installation of small wind energy systems is not a municipal affair...but is instead a matter of statewide concern."²²

California electricity customers had endured rolling blackouts that year and were facing steep electricity rate hikes. The legislature hoped to clear obstacles to small forms of "distributed generation" that would shore up both the supply and reliability of energy in the state. AB 1207 was written to standardize the small wind permitting process at the local level, removing complications that had frustrated and stymied many potential applicants, requiring local agencies to approve small wind turbine applications by right if specified conditions are met. Similar to existing state law prohibiting "the legislative body of any city or county from enacting an ordinance that prohibits or unreasonably restricts the use of solar energy systems other than for the preservation or protection of the public health and safety," AB 1207

was intended to promote and encourage the use of small wind energy systems and to limit obstacles to their use, declaring that:

*Small wind energy systems, designed for onsite home, farm, and small commercial use, are recognized by the Legislature and the State Energy Resources Conservation and Development Commission as an excellent technology to help achieve the goals of increased in-state electricity generation, reduced demand on the state electric grid, increased consumer energy independence, and nonpolluting electricity generation.*²³

As of July 1, 2002, AB 1207 is the default permitting ordinance applied to small wind energy systems in California counties that lack their own ordinance. The law also supersedes specific restrictions contained in existing county ordinances. Although, the provisions of AB 1207 are scheduled to sunset in July 2005, some counties may need additional time to bring local ordinances into compliance with the state goal of encouraging renewable energy, so small wind advocates will likely seek extension.

Key Provisions of AB 1207

AB 1207 allows counties and other local agencies to follow their own processes for permitting small wind energy systems and enforce compatibility and use issues. However, the law limits the restrictions that may

22. California Government Code, Section 65892.13 (a) (5)

23. California Government Code, Section 65892.13 (a) (5)

be imposed on tower height, notification, setbacks, noise level, turbine approval, tower drawings, and engineering analysis. Counties may not enforce restrictions more severe than those established by AB 1207, which include:

- Notice of an application to install a small wind turbine need only be provided to property owners within 300 feet of the property on which the turbine is proposed. (The law allows but does not itself require notification.)
- The allowable height for a small wind turbine tower on a site of one to five acres must be at least 65 feet; on parcels of five acres or more, the allowable height must be at least 80 feet. Counties may allow applicants to exceed these heights, but applicants must demonstrate that the proposed height for a small wind turbine tower is within the range recommended by the turbine manufacturer.
- Setbacks from the property line shall be no farther than the height of the turbine tower, provided they also comply with Section 4290 of the Public Resources Code.

“Small wind turbines are being installed all across the country without the need for a permit or the payment of any fees to local governments. It is in California’s best interests to make as simple as possible the installation of a much underutilized technology.”

— Joe Guasti, small wind turbine dealer

- Under California law, small wind turbines shall not cause a sound pressure level in excess of 60 dB(A) as measured at the closest neighboring inhabited dwelling. This level, however, may be exceeded during short-term events such as utility outages and severe wind storms.
- The small wind turbine must be certified by the California Energy Commission as qualifying under the Emerging Renewables Program, or by a national program approved by the Energy Commission. Properly certified equipment cannot be excluded by local ordinance.²⁴
- The applicant must include standard drawings and an engineering analysis of the turbine tower that demonstrate compliance with the Uniform Building Code or the California Building Standards Code. In addition, the drawings and analysis must

County Reluctance Generates Positive Interest in Wind Turbines

Madera County’s resistance to a small wind turbine installation in San Juan Bautista seems to have backfired. County officials sent a letter to neighbors of the proposed 10-kilowatt turbine explaining that they disliked the idea of approving the project, but they had no choice because of the passage of AB 1207. The controversy generated local media attention, and Solara Energy President Peter Burcat, who applied for the permit, says he subsequently received approximately 10 phone calls from local residents interested in installing wind turbines.

24. For a list of these wind turbines, see www.consumerenergycenter.org/erprebate/eligible_smallwind.html

be certified by a professional mechanical, structural, or civil engineer licensed by the State of California.

- The applicant must also include a line drawing of the electrical components of the small wind energy system in sufficient detail to demonstrate compliance with the National Electric Code.
- The small wind turbine must comply with all applicable Federal Aviation Administration requirements, including Subpart B (commencing with Section 77.11) of Part 77 of Title 14 of the Code of Federal Regulations regarding installations close to airports.²⁵ It must also comply with the State Aeronautics Act (Part 1, commencing with Section 21001 of Division 9 of the Public Utilities Code).²⁶ Small wind energy systems proposed in zone R-2515, surrounding Edwards Air Force Base, may be subject to the notification requirements of SB 1989. (See p. 17.)

County Responses to AB 1207

Even under AB 1207, the permitting process differs a great deal across counties. Many planning and permitting departments are unfamiliar with the policy rationale behind the new law. In some cases, county staff have not understood that the law trumps all local rules governing height restrictions and other permitting matters for wind turbines unless they are less restrictive than AB 1207.

Some counties have changed their permitting rules as a result of the legislation, but have not necessarily made their processes less cumbersome. Others have not changed their ordinances because of budget constraints or because they have not yet received any wind turbine applications. But some counties in windy regions are becoming increasingly good at

accommodating small wind turbines while still protecting the public interest.

Twelve counties (Mendocino, Napa, Santa Cruz, Solano, Kern, Los Angeles, San Bernardino, Sonoma, Riverside, San Diego, San Luis Obispo, and El Dorado) were surveyed for this handbook. Four (Mendocino, Napa, Santa Cruz, and Solano) elected to accept the minimum state standards included in AB 1207. Three others (Kern, Los Angeles, and San Bernardino) modified their local ordinances as a result of AB 1207, and one (Sonoma) adopted a small wind permitting ordinance which it has revised several times to resolve land use issues raised by applicants.

Riverside County simply modified its application criteria to comply with AB 1207 neighbor notification requirements without going through a local public approval process. At the time of interview for this handbook, San Diego and San Luis Obispo counties were still unaware of AB 1207. A representative of the El Dorado planning department said he would welcome a “model ordinance” to help his county conform with AB 1207. (An ordinance recommended by the American Wind Energy Association is included in this handbook. See p. 29.)



Photo courtesy National Center for Appropriate Technology

25. www.access.gpo.gov/nara/cfr/cfrhtml_00/Title_14/14cfr77_00.html

26. www.dot.ca.gov/hq/planning/aeronaut/documents/2003PUC_SAA.pdf

“We are trying to be wind-friendly. We want to promote wind energy in our general plan.” —Susan Calladao, Planner, San Luis Obispo County

The next page contains descriptions of permitting processes applied in various counties. For a summary of permitting rules and practices recommended by the authors of this handbook, please see page 31.

In Kern, Solano, and Santa Cruz counties, small wind turbines are permitted “by right” and can only

be denied a permit if they violate air safety standards. Turbine installations also require a separate building permit.

AB 1207 has actually made permitting slightly more difficult and expensive in Kern County. A process that could once be completed over the counter in a single day may now involve public hearings. Kern County added a \$325 filing fee to cover additional administration costs for wind turbines on top of the \$400 building permit fee. Both permits can be acquired in three to four weeks.

Los Angeles County, by contrast, is one of the most difficult places in the state to get a small wind energy system approved. An ordinance adopted in September 2002 subjects applicants to an expensive conditional use permit review, which generally involves a public hearing. Applicants may qualify for a minor use permit at the discretion of the planning office director if the installation meets established development standards and is opposed by no more than one person.

Will Winds Prevail in L.A. County?

Small wind advocates hope that Los Angeles County will eventually make it easier to site small wind turbines. Acting Chief of Ordinance Study Leonard Erlanger says he believes the few applicants that are trying to get through the county’s difficult permitting process will set positive precedents. “As this unfolds, things will be clarified, making it easier for small wind turbine applicants in the future,” says Erlanger.

The \$800 fee for the first stage of what the county calls a “minor” use permit is a rude surprise for many applicants. But Erlanger says the county reduced the fee for this permit below what it charges for a conditional use permit. Applicants who encounter no neighborhood opposition and avoid public hearings are charged only for the less expensive permit, though the price quickly goes up if hearings are necessary.

Recognizing that applicants “are not real happy” with the performance security the county imposes to cover the eventual removal of a turbine (an event not likely to happen for 20 to 30 years after installation), Erlanger says that “I’d back off on that provision if I had to do it again.”

Erlanger says planners could use some guidance from state officials on how best to protect scenic corridors and ensure aviation safety. He says he’s receptive to bringing the county’s lighting requirements more closely in line with FAA standards, which are less restrictive. The county currently notifies various air safety agencies of small wind turbine applications, and requires a beacon light if any agencies request it.

Photo courtesy Joe Mathewson





A small wind energy installation must meet the following standards in Los Angeles County:

- Small wind turbines over 50 feet tall may have to install an FAA-approved beacon light. The lighting specified can consume half of the electricity generated by a 1-kW wind turbine.
- Small wind turbines cannot be placed on, or within 100 feet of, a ridgeline. They cannot exceed the height of any nearby ridge by more than 25 feet.
- Small wind turbine owners must pay a performance security to cover the eventual cost of removing the wind turbine. Turbine lifespans range from 20-30 years.
- All wind turbines require fencing even if the site is already enclosed.

Anyone seeking a permit of any kind in Los Angeles County must either obtain an exemption from the California Environmental Quality Act (CEQA) or pay an \$800 fee for the first stage of a minor use permit. As a result of these obstacles, few permits have been issued. The small wind industry and local residents are working with Los Angeles County to remedy these problems (See text box previous page.)

Trial and Error in Riverside County

Moreno Valley (Riverside County) — Steve Anderson’s determination has not only helped pave the way, but also highlights the pitfalls facing small wind turbine customers. When he first explored the possibility of putting up a small wind turbine two years ago, “county officials didn’t have a clue about what I was trying to do,” he recalls. Although his wind resource was moderate, California’s energy shortage spurred him to invest the time and funds needed. “It took me six months to finalize the county paperwork and comply with all of their documentation and other siting requirements. I went down to their office five or six times, and each time I got a different answer about what I needed to do.”

Fortunately for Anderson, the passage of AB 1207 in 2001 required Riverside County to streamline its local codes governing small wind turbines.

The county previously required that wind turbine applicants notify every landowner within a half-mile radius of the site – even absentee landowners. Anderson was preparing to send letters to nearly 50 people when AB 1207 went into effect. Under the new law, which limits notification requirements to neighbors within 300 feet of a proposed wind turbine, Anderson needed only six stamps. (One notification recipient even decided to install a wind turbine himself.)

Anderson admits that a few individuals, particularly the county’s head planner, cut him quite a bit of slack. For example, his initial development fee assessment of \$10,500 was reduced to \$257. His fee assessment to protect the Kangaroo rat, a threatened species in



California, was reduced from \$2,500 to \$50.

Anderson wound up paying approximately \$4,000 in fees to Riverside County, plus another \$1,000 for required trenches, topographical maps, signs, and vegetation. Due to low wind resources at the turbine site, his investment is taking longer than he had hoped to pay for itself. He learned that his turbine needs to be elevated higher to reach good sustained winds.

Michael Freitas, senior planner for Riverside County, says Anderson's difficulties resulted from "our inexperience with small wind turbines." In the future, prospective small wind turbine owners may not have to overcome all the siting hurdles Anderson encountered, he says, though the total permitting costs will likely be similar.

The good news, says Freitas, is that there's been little public opposition to small wind turbines in the county. Still, Freitas advises permit seekers to talk to neighbors before proceeding. He also suggests that applicants carefully analyze their wind resource to select the proper tower height and make sure a turbine will repay the time and expense county permits require.

"As this unfolds, things will be clarified, making it easier for small wind turbine applicants in the future."

**– Leonard Erlanger, acting
Chief of Ordinance Study
at Los Angeles County**

San Bernardino County responded to AB 1207 by making its turbine tower height limits less restrictive than the state's. Landowners in the desert regions of the eastern and northern portions of the county can now erect turbine towers as high as 120 feet on five acres of land – 40 feet higher than the minimum allowance provided by state law.

In addition, San Bernardino permit applicants may receive a variance allowing a 30% increase in tower height, raising the limit to 156 feet. The county removed a ban on small wind turbines in urbanized areas.

Sonoma County adopted AB 1207 prohibitions against small wind turbines in urbanized areas, but later changed the way it defines those areas, concluding that the designations applied by the U.S. Census Bureau were preventing some residents with suitable sites from putting up turbines. The county deleted the federal designations and now defines urbanized areas according to the reach of city services such as water and sewer connections.

However, the county extended 2,500-foot buffer zones around its urban service areas. Wind turbines taller than 40 feet sited in those zones require a conditional use permit, which is much more expensive (\$2,044) than the zoning permit needed outside the buffer (\$71). Turbines below 40 feet in height can be installed within urban service areas and buffer zones with a minor use permit.

County Staff Make Way for Small Wind

Oak Hills (San Bernardino County) – Fortunately for Gus Sansone, San Bernardino County staff were willing to negotiate details that could have made the difficult task of permitting his small wind turbine much more expensive. Sansone first teamed up with other small wind enthusiasts to get the county supervisor to lower the permitting fee from \$1,200 to \$500. Then Sansone had to negotiate with the county assessor, who said his wind turbine would be taxed at its total installed value. Sansone eventually got the county assessment reduced by about half.

a lot of time and effort, but Sansone praises the county staff. “I have to give them a lot of credit. They worked diligently to see that my wind turbine was up and running,” he says.

County zoning restrictions limited the height of Sansone’s turbine tower to 60 feet, and setback requirements prevented him from putting the tower on high ground near the edge of his lot. (Sansone’s property was smaller than the five-acre minimum that would have allowed a tower of 80 feet.) But again, Sansone got a break. He was eventually permitted to extend the tower to 80 feet for a \$150 fee. He estimates the additional height is increasing the generation from his 10-kilowatt machine as much as 25%, based on the experience of other local wind turbine owners.

Height restrictions in Santa Cruz County were also an obstacle for Scotts Valley resident Larry Gilliam, but with the help of the county supervisor, Gilliam was able to permit his 80-foot tower through a special wind zoning ordinance Gilliam says was “left over from the last energy crisis.”

“I have to give them a lot of credit. [County staff] worked diligently to see that my wind turbine was up and running.”

– Gus Sansone of
San Bernardino County



Photo courtesy Bergey Windpower

That ordinance, in fact, stipulated minimum rather than maximum tower heights to make sure small wind turbines generated substantial amounts of electricity.

Both turbine owners are glad they persisted in negotiations with county officials.

For Sansone, the result is a reduction in power bills from \$100 per month to \$0. “I haven’t had to pay an Edison bill at all over the course of an entire year!” he says. His turbine has “accomplished everything I’ve wanted it to – and then some.”

Key compliance issues for small turbines include the following:

- Applicants must submit an architectural or artistic rendering of the proposed turbine.
- Vegetation or other natural features may be required to screen the installation from view.
- The turbine must be painted to blend in with its background.
- Turbines are prohibited on ridge tops.

Although they have adopted stringent regulations, the Sonoma County Board of Supervisors wants to be “wind friendly.” A recent ordinance drastically cut permitting fees and removed public notification requirements for zoning permits.

Riverside County imposes no height restrictions on wind turbine towers. AB 1207 greatly simplified the county’s notification requirements, but wind turbine permit fees are still quite high.

The county requires a plot plan that costs \$1,600. Most applicants also have to pay about \$600 for an initial study to determine whether an Environmental Impact Report is required. Applicants make a deposit to cover other application costs — if the county expends more than the deposit, it charges by the hour for staff time until the process is completed. Permitting for installations recently completed in western Riverside County cost up to \$5,000. Although county staff have been able to reduce some of the site-specific fees, Riverside remains one of the most costly places to install a wind system in California.

Small Wind and Solar System Prompts Lifestyle Changes

Adreine Jenik was looking for ways to tap the rich natural energy resources around her art studio in 29 Palms, a small community located in the High Desert portion of San Bernardino County. “I noticed that it was pretty sunny out here most of the time. And when it wasn’t sunny, there seemed to be quite a bit of wind,” says Jenik, an associate professor of Computer & Media Arts at UC-San Diego. She figured a renewable energy system would minimize the environmental impact of her creative getaway.

In 1998, she installed a custom-designed hybrid energy system that combines a 400-watt Southwest Windpower turbine with a 325-watt solar photovoltaic system. It took a year to work out all the technical bugs and get the paperwork straightened out, but now she’s satisfied with a system that supplies 100 percent of her electricity. “I paid the price of being an early adopter, but my electricity bills are now zero,” she reports.

“What I like the most about my own renewable energy system is that it has made me much more aware of my own energy usage. And that was a very powerful experience,” Jenik says. For example, she purchased a new heavily insulated refrigerator and put her water heater on a timer. “I made some major lifestyle changes. Sometimes I just bring a bag of ice instead of turning the refrigerator on if I’m only here for a little while.”

Though permitting took some time, there was no opposition to her hybrid wind/solar system from her neighbors. “People pretty much stick to themselves in a community like this,” says Jenik. Her “micro” wind turbine tower is less than 35 feet tall, so it didn’t present a problem for county permitting authorities. The wind and solar system requires minimal maintenance. So far, Jenik has been able to handle everything by herself, even filling her six batteries with distilled water.

III. AWEA'S RECOMMENDATIONS

Model Zoning Ordinance: Permitted Use Regulation for Small Wind Turbines

Recommended Practices

The American Wind Energy Association offers a Model Zoning Ordinance to help local officials update ordinances governing small wind turbine installations.²⁷ The following template serves as a starting point that can save planning and permitting staff valuable time. However, states often have unique subsidies or other programs designed to encourage on-site electricity generation, and local ordinances need to be fine-tuned to accommodate both existing state laws and local regulations. A list of practices recommended by the authors of this book are on page 29.

SECTION 1 PURPOSE:

It is the purpose of this regulation to promote the safe, effective, and efficient use of small wind energy systems installed to reduce the on-site consumption of utility supplied electricity.

SECTION 2 FINDINGS:

The [city or county] finds that wind energy is an abundant, renewable, and nonpolluting energy resource and that its conversion to electricity will reduce our dependence on non-renewable energy resources and decrease the air and water pollution that results from the use of conventional energy sources. Distributed small wind energy systems will also enhance the reliability and power quality of the power grid, reduce peak power demands, and help diversify the State's energy supply portfolio. Small wind systems also make the electricity supply market more competitive by promoting customer choice.

The State of _____ has enacted a number of laws and programs to encourage the use of small-scale

renewable energy systems including rebates, net metering, property tax exemptions, tax credits, and solar easements [as appropriate]. However, many existing zoning ordinances contain restrictions which, while not intended to discourage the installation of small wind turbines, can substantially increase the time and costs required to obtain necessary construction permits.

Therefore, we find that it is necessary to standardize and streamline the proper issuance of building permits for small wind energy systems so that this clean, renewable energy resource can be utilized in a cost-effective and timely manner.

SECTION 3 DEFINITIONS:

Small Wind Energy System: A wind energy conversion system consisting of a wind turbine, a tower, and associated control or conversion electronics, which has a rated capacity of not more than [100 kW/1 MW] and which is intended primarily to reduce on-site consumption of utility power.

27. Available online at:

www.awea.org/smallwind/documents/modelzo.html

Tower Height: The height above grade of the fixed portion of the tower, excluding the wind turbine itself.

SECTION 4 PERMITTED USE:

Small wind energy systems shall be a permitted use in all zoning classifications where structures of any sort are allowed, subject to certain requirements as set forth below:

4.1 Tower Height: For property sizes between ½ acre and one acre the tower height shall be limited to [80 ft/150 ft]. For property sizes of one acre or more, there is no limitation on tower height, except as imposed by FAA regulations.

4.2 Set-back: No part of the wind system structure, including guy wire anchors, may extend closer than ten (10) feet to the property boundaries of the installation site.

4.3 Noise: For wind speeds in the range of 0-25 mph, small wind turbines shall not cause a sound pressure level in excess of 60 dB(A), or in excess of 5 dB(A) above the background noise, whichever is greater, as measured at the closest neighboring inhabited dwelling. This level, however, may be exceeded during short-term events such as utility outages and severe wind storms.

4.4 Approved Wind Turbines: Small wind turbines must have been approved under the Emerging Renewables Program of the California Energy Commission or any other small wind certification program recognized by the American Wind Energy Association.

4.5 Compliance with Uniform Building Code:

Building permit applications for small wind energy systems shall be accompanied by standard drawings of the wind turbine structure, including the tower, base, and footings. An engineering analysis of the tower showing compliance with the Uniform Building Code and certified by a licensed professional engineer shall also be submitted. This analysis is frequently supplied by the manufacturer. Wet stamps shall not be required.

4.6 Compliance with FAA Regulations: Small wind energy systems must comply with applicable FAA regulations, including any necessary approvals for installations close to airports.

4.7 Compliance with National Electric Code:

Building permit applications for small wind energy systems shall be accompanied by a line drawing of the electrical components in sufficient detail to allow for a determination that the manner of installation conforms to the National Electrical Code. This information is frequently supplied by the manufacturer.

4.8 Utility Notification: No small wind energy system shall be installed until evidence has been given that the utility company has been informed of the customer's intent to install an interconnected customer-owned generator. Off-grid systems shall be exempt from this requirement.

Examples of State Zoning and Easement Laws:

See AWEA's online toolbox for links to California, Minnesota, Montana and Nebraska policies:

www.awea.org/smallwind/toolbox/default.asp

Best Practices for Counties

The following recommendations are based on California counties' experiences with small wind turbine installations since the California Energy Commission's Emerging Renewable Program was put in place in 1998. They are lessons learned through counties' responses to AB 1207 and the experiences of pioneering consumers attempting to install wind generators.

Do's and Don'ts

The Do's:

- Remember that small wind turbines reduce the threat of blackouts in your community, contribute to national security, and reduce dependence on polluting forms of electric generation. Small wind turbines are community assets, not toys or hobbies.
- Make sure that your fee structure isn't discouraging potential wind turbine buyers. Ideally, total permitting costs should not exceed two percent of the original capital cost of a small wind turbine.
- Consider following the example of San Bernardino County by allowing turbine towers to exceed the state's minimum height allowances in rural areas.
- Review design integrity of wind turbine towers, with standard drawings and an engineering analysis showing compliance with national or state building codes and certified by a licensed professional engineer.
- Identify a model project to set a high standard for future applicants and to prepare staff to address misconceptions about small wind turbines.
- When in doubt, refer to the language of AB 1207 regarding height restrictions and other rules.

The Don'ts:

- Don't supersede FAA lighting requirements. Small wind turbine towers are usually below heights regulated by the FAA or state aviation law.
- Don't require all small wind turbine applicants to obtain a conditional use permit. Instead, create a permitted use designation with appropriate requirements and restrictions.
- Don't arbitrarily prohibit wind turbines on all ridgelines. Consider the particular merits of individual sites.
- Don't require that all small wind turbines "blend in with their environments." Require such mitigation only when there is a clear public benefit.
- Don't require consumers to post a bond or performance security for removal of small wind turbines. No such obligation is required for any other type of privately financed infrastructure.
- Don't require fencing unless public safety is an issue of particular concern at a given site, or unless similar fencing is required for other similar types of structures (cell phone or amateur radio towers).

IV. REFERENCES AND RESOURCES

Publications and Websites

American Wind Energy Association — Small Wind

<http://www.awea.org/smallwind.html>

Comprehensive resource on wind energy and energy systems. Includes:

- State-by-state wind energy pages
www.awea.org/smallwind/index.html
- Small wind toolbox resource for individuals seeking to install a small wind system or for those interested in improving opportunities for small wind energy use.
www.awea.org/toolbox/default.asp

Buying a Small Wind Electric System — A California Consumer's Guide

Developed for the California Energy Commission by Evergreen Energy LLC and its principals, Tom Starrs and Rob Harmon. (February 2002)

www.energy.ca.gov/renewables/marketing/2002-04-6_WIND_GUIDE.PDF

California Energy Commission — Renewable Energy Program

Renewable energy resources and information for residents of California.

www.consumerenergycenter.org

California Energy Network

Designed to facilitate the installation of wind and solar energy in California, as part of a multi-faceted consumer education program.

www.energybuilder.calenergy.org/

Database of State Incentives for Renewable Energy

Online database compiled by the Interstate Renewable Energy Council.

www.dsireusa.org

Federal Aviation Administration

www2.faa.gov

- Advisory Circular 70/7460-1K, Obstruction Marking and Lighting (2/3/00) (ATA-400)
- Advisory Circular 70/7460-2K, Proposed Construction or Alteration of Objects that May Affect the Navigable Airspace (ATA 411)

Home Power Magazine

The hands-on journal of home-made power.

www.homepower.com

- Issue #90 includes Mick Sagrillo's article "Apples and Oranges: Choosing a Home-Sized Wind Generator."
www.homepower.com/files/hp90-50.pdf

Iowa Energy Center — Wind Energy Manual

An online manual that walks you through the considerations involved with setting up a small wind system. Written for Iowa residents, but generally applicable.

www.energy.iastate.edu/renewable/wind/wem/wem-01_print.html

Renewable Energy Atlas of the West

Depicts in full color the renewable energy resources of 11 western states, including high-resolution wind maps that are searchable in the online version. Profiles wind, solar, geothermal, and biomass potential. From the Land and Water Fund of the Rockies, Black Graphics, NWSEED, and GreenInfo Network. (July 2002)

www.energyatlas.org

Wind Maps.org

High-resolution maps of wind energy potential in the Pacific Northwest. Resource estimates are accessible to the public through an interactive Geographic Information System (GIS) website.

www.windmaps.org

Wind Power for Farm, Home & Business

Comprehensive review of wind energy from micro wind turbines to megawatt machines, including site selection, installation, and operation. Other books by Paul Gipe include **Wind Energy Basics** and **Wind Energy Comes of Age**.
www.chelseagreen.com

Windustry — Wind Energy Basics

Basic information on wind energy and small wind project resources for rural and urban landowners.
www.windustry.com/basics/default.htm

Agencies and Incentive Programs

California Energy Commission

Renewable Energy Program
1516 Ninth Street, MS-45
Sacramento, CA 95814-5512
Phone: (800) 555-7794 (in California)
or (916) 654-4058 (outside California)
www.energy.ca.gov

- **Emerging Renewables Program**

The California Energy Commission offers rebates of up to \$2.30 per watt of qualified small wind turbines (up to 10 kW) for customers of Southern California Edison, Pacific Gas and Electric Company, San Diego Gas & Electric Company, and Bear Valley Electric. Program funding was extended until at least 2012 by recent legislation.

E-mail: renewable@energy.state.ca.us
www.consumerenergycenter.org/erprebate

- **Guidebook for the Emerging Renewables Program**
Covers all aspects of the rebate program, including eligibility requirements (for consumers and equipment), incentives, application rules, and forms.
www.consumerenergycenter.org/erprebate/forms

- **List of Certified Small Wind Turbines**
www.consumerenergycenter.org/erprebate/eligible_smallwind.html
- **List of Registered Small Wind Turbine Dealers**
www.consumerenergycenter.org/erprebate/retailers.html

U.S. Department of Energy

- **Wind Energy Program**
Provides information on the latest small wind turbine research, homeowner information, wind energy basics, answers to frequently asked questions, and links to wind publications and organizations.
www.eere.energy.gov/wind
- **Wind Powering America**
Compiles state wind maps, small wind consumer's guides, wind workshops, and much more. Visit the "Regional Activities" section to read news articles, press releases, and fact sheets.
www.eere.energy.gov/windpoweringamerica

Nonprofit Organizations

American Solar Energy Society (ASES)

National organization dedicated to advancing the use of solar energy for the benefit of U.S. citizens and the global environment. ASES promotes the widespread near-term and long-term use of solar energy.
www.ases.org

American Wind Energy Association (AWEA)

Advocating the development of wind energy as a reliable, environmentally superior energy alternative in the United States and around the world.

122 C Street, NW, Suite 380
Washington, DC 20001
Phone: (202) 383-2500
www.awea.org

Golden State Power Cooperative

Helping California communities use the cooperative business model to own and operate their own nonprofit, member-controlled energy co-ops to ensure honest, efficient, affordable and reliable service.

14619 Hamlin Street
Van Nuys, CA 91411
Phone: (818) 988-8690
www.gspower.org

Interstate Renewable Energy Council (IREC)

Dedicated to accelerating the sustainable utilization of renewable energy sources and technologies in and through state and local government and community activities.

P.O. Box 1156
Latham, New York 12110-1156
Phone: (518) 458-6059
www.irecusa.org

**Northwest Sustainable Energy
for Economic Development (Northwest SEED)**

Supports and develops creative programs, policies, and financing approaches to build rural economies and meet the Pacific Northwest's power needs through affordable, renewable energy generation.

119 1st Ave South, Ste. #400
Seattle, WA 98104
Phone: (206) 328-2441
www.nwseed.org

Union of Concerned Scientists

Independent alliance of concerned citizens and scientists committed to building a cleaner, healthier environment and a safer world. UCS analyzes and advocates energy solutions that are sustainable both environmentally and economically, with a focus on supporting policies that let renewables compete successfully.

2 Brattle Square
Cambridge, MA 02138-9105
Phone: (617) 547-5552
www.ucsusa.org

California Utility Companies**Pacific Gas and Electric Company**

Phone: (415) 973-2628
www.pge.com

- **Net Metering:**
www.pge.com/gen/retail_gen_net_metering.shtml
- **Utility Tariff:**
www.pge.com/customer_services/business/tariffs/pdf/ER21.pdf

San Diego Gas & Electric Company

Phone: (858) 650-6166
www.sdge.com/Small_Wind_Electric_Systems

- **Net Metering:**
www.sdge.com/net_metering.html
- **Utility Tariff:**
www.sdge.com/tm2/pdf/ERULE21.pdf

Southern California Edison Company

Phone: (626) 302-6242 or (626) 302-9680
www.sce.com

- **Interconnection Application Form:**
www.sce.com/sc3/002_save_energy/002k_gen_your_own_power/nemfaq.htm
- **Utility Tariff:**
www.sce.com/NR/sc3/tm2/pdf/Rule21.pdf

For other utilities in California contact:

The California Public Utility Commission
www.cpuc.ca.gov/

County Planning and Permitting Contacts

For additional county information

contact: Willie Beaudet of the California State Association of Counties at (916) 327-7500 x 517

Alameda County Planning Department
James Sorensen, Planning Director
399 Elmhurst Street
Hayward, CA 94544

Alpine County Planning Department
Brian Peters, Director
17300 State Highway 89
Markleeville, CA 96120

Amador County Land Use Agency
Susan C. Grijalva, Chief Planner
500 Argonaut Lane
Jackson, CA 95642-9534

Butte County, Department of Development Services Planning Division
Tom Parillo, Director
7 County Center Drive
Oroville, CA 95965

Calaveras County Community Development
Kim Hansen, Director
891 Mountain Ranch Road
San Andreas, CA 95249

Colusa County Department of Planning and Building
Steven Hackney, Director
220 12th Street
Colusa, CA 95932

Contra Costa County Community Development Department
Dennis M. Barry, Interim Director
651 Pine Street, 4th Floor
North Wing
Martinez, CA 94553

Del Norte County Community Development Department
Ernest Perry, Director
700 5th Street
Crescent City, CA 95531

El Dorado County Planning Department

Conrad B. Montgomery, Director
2850 Fairlane Court
Placerville, CA 95667

Fresno County Public Works and Development Services Department

Carolina Jimenez-Hogg, Director
Planning & Resources
2220 Tulare Street, 8th Floor
Fresno, CA 93721

Glenn County Resource Planning and Development Department

John Benoit, Director
125 South Murdock Street
Willows, CA 95988

Humboldt County Planning

Stephen R. Nielson, Acting Director
3015 H Street
Eureka, CA 95501

Imperial County Planning/ Building Department

Jurg Heuberger, Planning Director
939 Main Street
El Centro, CA 92243

Inyo County Planning Department

Chuck Thistlethwaite, Director
P.O. Drawer L
Independence, CA 93526

Kern County Planning Department

Ted James, Director
2700 M Street, Suite 100
Bakersfield, CA 93301

Kings County Planning Agency

William R. Zumwalt, Director,
Planning and Building Inspection
Kings County Government Center
Hanford, CA 93230

Lake County Community Development Department, Planning Division

Robert Cervantes, Director
255 North Forbes Street
Lakeport, CA 95453

Lassen County Department of Community Development

Robert K. Sorvaag, Director
707 Nevada Street, Suite 500
Susanville, CA 96130

Los Angeles County Department of Regional Planning

James E. Hartl, Director
320 West Temple Street
Los Angeles, CA 90012

Madera County Planning Department

Leonard Garoupa, Director
135 West Yosemite Avenue
Madera, CA 93637-3593

Marin County Community Development Agency, Planning Division

Alex Hinds, Director
3501 Civic Center Drive, Rm 308
San Rafael, CA 94903

Mariposa County Planning Department

Eric Toll, Director
PO Box 2039
Mariposa, CA 95338

Mendocino County Planning & Building Services Department

Raymond Hall, Director
501 Low Gap Road, Rm. 1440
Ukiah, CA 95482

Merced County Association of Governments

Bill Nicholson, Director
369 West 18th Street
Merced, CA 95340

Modoc County Planning

Scott Kessler, Planning Director, AICP
202 West Fourth Street
Alturas, CA 96101

Mono County Planning Department

Scott Burns, Director
PO Box 347
Mammoth Lakes, CA 93546

Monterey County Planning & Building, Inspection Department

William L. Phillips, Director
PO Box 1208
Salinas, CA 93902

Napa County Conservation Development and Planning Department

Charles Wilson, Director
1195 Third Street, Room 210
Napa, CA 94559

Nevada County Planning Department
Mark Tomich, Director
950 Maidu Avenue
Nevada City, CA 95959

Orange County Planning and Development Services Department
Thomas B. Matthews, Director
PO Box 4048
Santa Ana, CA 92702-4048

Placer County Planning Department
Fred Yeager, Director
11414 B Avenue
Auburn, CA 95603

Plumas County Planning Department
John S. McMorro, Director
520 Main Street, Room 121
Quincy, CA 95971

Riverside County Transportation and Land Management Agency/Planning Department
Aleta J. Laurence, Planning Director
PO Box 1409
Riverside, CA 92502-1409

Sacramento County Planning and Community Development Department
Thomas W. Hutchings, Director
827 7th Street, Room 230
Sacramento, CA 95814

San Benito County Planning Department
Rob Mendiola, Director
3220 Southside Road
Holister, CA 95023

San Bernardino County Land Use Services Department
Michael E. Hays, Director
385 North Arrowhead Avenue
3rd Floor
San Bernardino, CA 92415-0182

San Diego County Department of Planning and Land Use
Gary L. Pryor, Director
5201 Ruffin Road, Suite B
San Diego, CA 92123-1666

San Francisco Planning Department
Gerald G. Green
1660 Mission Street
San Francisco, CA 94103

San Joaquin County Community Development Department
Chet Davisson, Director
1810 East Hazelton Avenue
Stockton, CA 95205

San Luis Obispo County Department of Planning and Building
Victor Holanda, Director
County Government Center
San Luis Obispo, CA 93408

San Mateo County Environmental Services Agency, Planning and Building Division
Terry Burnes, Planning Administrator
590 Hamilton Street, 2nd Floor
Redwood City, CA 94063

Santa Barbara County Planning and Development
Valentin Alexeef, Director
123 East Anapamu Street
Santa Barbara, CA 93101-2058

Santa Clara County Department of Planning and Development
Michael M. Lopez, Office Manager
70 West Hedding Street
7th Floor, East Wing
San Jose, CA 95110

Santa Cruz County Planning Department
Alvin James
701 Ocean Street, Room 400
Santa Cruz, CA 95060

Shasta County Department of Resource Management Planning Division
Russ Mull
Director of Resource Management
1855 Placer Street
Redding, CA 96001

Sierra County Department of Planning
Tim H. Beals, Director
PO Box 530, Downieville, CA 95936

Siskiyou County Planning Department
Richard D. Barnu, Director
PO Box 1085, Yreka, CA 96097-1085

Solano County Department of Environmental Management
Christopher Monsk
Planning Program Manager
601 Texas Street, Fairfield, CA 94533

Sonoma County Permit & Resource Management Department
Pete Parkinson, Director
2550 Ventura Avenue
Santa Rosa, CA 95403

Stanislaus County Department of Planning and Community Development
Ron E. Freitas, Director
1100 H Street
Modesto, CA 95354-2380

Sutter County Community Services Department, Planning Division
Tom Las, Principal Planner
1160 Civic Center Blvd., Suite E
Yuba City, CA 95993

Tehama County Planning Department
George W. Robson, Director
444 Oak Street, Room 1
Red Bluff, CA 96080

Trinity County Planning Department
John Alan Jelichich, Director
PO Box 2819
Weaverville, CA 96093-2819

Tulare County Resource Management Agency
George E. Finney, Planning Director
5961 South Mooney Blvd.
Visalia, CA 93277

Tuolumne County Planning Department
Bev Shane, Director
2 South Green Street
Sonora, CA 95370

Ventura County Planning Division, Resource Management Agency
Keith Turner, Director
800 South Victoria Avenue
Ventura, CA 93009

Yolo County Community Development Agency
John Bencome, Director
292 West Beamer Street
Woodland, CA 95695

Yuba County Community Development Department
James P. Manning, Director
938 14th Street
Marysville, CA 95901

Small Wind Turbine Manufacturers and Distributors

Abundant Renewable Energy

(Distributor, African Wind Power generators)

22700 NE Mountain Top Rd.

Newberg, OR 97132

Phone: (503) 538-8292

www.abundantre.com

Aeromax Corporation

(Distributor, Lakota Turbines)

9234 E. Valley Rd., Suite E

Prescott Valley, AZ 86314

Phone: (888) 407-9463

www.aeromaxenergy.com

Atlantic Orient Corporation

P.O. Box 832, 49 Pownal Street

Charlottetown, P.E.I., C1A 7L9

(Prince Edward Island, Canada)

Phone: (902) 368-7171

www.aocwind.net

Bergey Windpower Company*

2001 Priestley Ave.

Norman, OK 73069 USA

Phone: (405) 364-4212

www.bergey.com

Southwest Windpower*

2131 N. First Street

Flagstaff, AZ 86004 USA

Phone: (928) 779-9463

www.windenergy.com

Photo courtesy Bergey Windpower



Courtesy Southwest Windpower



Courtesy Wind Turbine Industries Corp.

Point Power Systems

843 Sevely Drive

Mountain View, CA 94041 USA

Phone: (616) 304-3374

www.abrivo.com

Wind Turbine Industries Corporation*

(manufacturer, Jacobs® Wind Energy Systems)

16801 Industrial Circle S.E.

Prior Lake, MN 55372

Phone: (952) 447-6064

www.windturbine.net

Solar Wind Works

(distributor, Proven Wind Turbines)

16713 Greenlee Road

Truckee, CA 96161

Phone: (530) 582-4503

www.solarwindworks.com

* manufacturer of California Energy Commission certified wind turbines

CALIFORNIA ENERGY COMMISSION

ANNUAL WIND SPEED at 30 METER ELEVATION

GOVERNOR - GRAY DAVIS

CALIFORNIA ENERGY COMMISSION

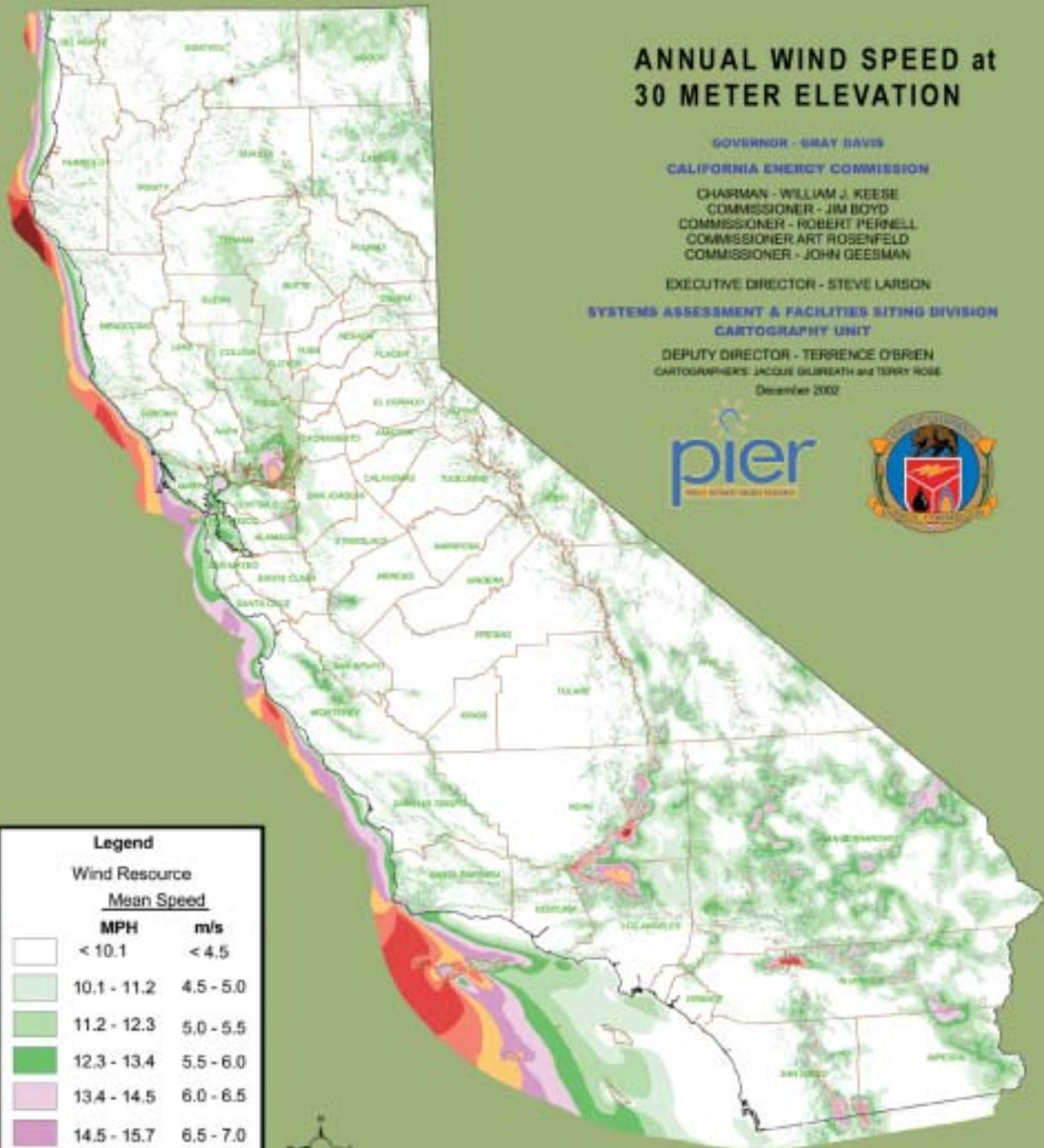
CHAIRMAN - WILLIAM J. KEESE
 COMMISSIONER - JIM BOYD
 COMMISSIONER - ROBERT PERNELL
 COMMISSIONER - ART ROSENFELD
 COMMISSIONER - JOHN GEESMAN

EXECUTIVE DIRECTOR - STEVE LARSON

SYSTEMS ASSESSMENT & FACILITIES SITING DIVISION

CARTOGRAPHY UNIT

DEPUTY DIRECTOR - TERENCE O'BRIEN
 CARTOGRAPHERS: JACQUE GILBREATH and TERRY ROSE
 December 2002



Legend		
Wind Resource		
Mean Speed		
	MPH	m/s
	< 10.1	< 4.5
	10.1 - 11.2	4.5 - 5.0
	11.2 - 12.3	5.0 - 5.5
	12.3 - 13.4	5.5 - 6.0
	13.4 - 14.5	6.0 - 6.5
	14.5 - 15.7	6.5 - 7.0
	15.7 - 16.8	7.0 - 7.5
	16.8 - 17.9	7.5 - 8.0
	17.9 - 19.0	8.0 - 8.5
	> 19.0	> 8.5



This map was created by TrueWind Solutions using the Mesomap system and historical weather data. Although it is believed to represent an accurate overall picture of the wind energy resource, estimates at any location should be confirmed by measurement.

CALIFORNIA WIND POTENTIAL BY COUNTY

Based on 2002 California Energy Commission Wind Map Data

COUNTY	ACRES IN WIND CLASS 2-7*	% OF COUNTY IN WIND CLASS 2-7	ACRES WITH PRIME SMALL WIND DEVELOPMENT POTENTIAL**	COUNTY	ACRES IN WIND CLASS 2-7*	% OF COUNTY IN WIND CLASS 2-7	ACRES WITH PRIME SMALL WIND DEVELOPMENT POTENTIAL**
San Bernardino	7,075,745	55%	610,514	Yolo	433,990	66%	1,577
Kern	1,588,973	30%	253,198	Monterey	214,720	10%	1,544
Imperial	1,082,929	38%	181,088	Orange	99,737	20%	1,459
Riverside	2,144,764	46%	170,398	Butte	207,861	19%	761
Los Angeles	1,038,075	40%	142,800	Trinity	132,566	6%	740
Solano	428,505	75%	120,651	Colusa	104,854	14%	635
Inyo	2,108,495	32%	112,311	Merced	90,180	7%	616
San Diego	807,947	30%	62,026	El Dorado	69,247	6%	579
Siskiyou	552,615	14%	24,937	Nevada	37,211	6%	494
Ventura	445,338	37%	22,312	San Benito	44,056	5%	447
Alameda	61,480	13%	15,545	Tulare	159,285	5%	443
Santa Barbara	514,992	29%	12,024	Napa	34,977	7%	437
Lassen	474,358	16%	10,035	Placer	61,108	6%	425
Mono	566,010	28%	9,268	Sutter	72,014	18%	292
Mendocino	189,666	8%	7,987	Fresno	130,694	3%	267
Modoc	398,353	15%	5,867	San Mateo	61,647	21%	225
Contra Costa	97,774	20%	5,631	Santa Clara	14,704	2%	217
Shasta	341,459	14%	4,996	Stanislaus	28,750	3%	175
Humboldt	315,672	14%	4,607	Glenn	170,009	20%	116
Plumas	174,705	10%	4,110	Kings	7,184	1%	108
Del Norte	145,231	22%	3,872	Tuolumne	108,706	7%	91
Marin	101,352	30%	3,767	Amador	7,621	2%	83
San Joaquin	64,952	7%	3,526	Calaveras	8,540	1%	69
San Luis Obispo	171,523	8%	2,881	Mader	35,731	3%	57
Sierra	97,198	16%	2,137	Santa Cruz	13,600	5%	7
Tehama	413,119	22%	2,135	San Francisco	12,900	43%	2
Lake	67,725	8%	1,887	Sacramento	102,566	16%	-
Sonoma	91,282	9%	1,782	Mariposa	7,091	1%	-
Alpine	133,647	28%	1,677	Yuba	726	-	-
TOTAL				24,029,276	24%	1,815,826	

* At least 11.5 mph at 30 meters above ground

** At least 13.3 mph at 30 meters above ground (wind classes 3-7); urban areas, water bodies, protected land and <20% slopes are excluded

CALIFORNIA WINDIEST ZIP CODES BY REGION

Based on 2002 California Energy Commission Wind Map Data

Northern California													
TOP ZIP CODES BY WIND DENSITY*								TOP ZIP CODES BY PRIME SMALL WIND DEVELOPMENT ACREAGE**					
95538	95958	95551	96035	95917	95974	96078	96090	94571	94585	95620	95687	94550	
96094	96021	96092	95913	95564	95970	95589	95536	94514	94512	95468	95376	93514	
95963	96067	95943	95938	95558	96112	96071	96104	95459	94533	93517	96107	96120	
96038	95920	95982	95531					93546	94923	95457	94971	95694	
								94952	94929	95443	94510	93635	
Central California													
TOP ZIP CODES BY WIND DENSITY*								TOP ZIP CODES BY PRIME SMALL WIND DEVELOPMENT ACREAGE**					
94535	94512	94966	94083	94104	94105	94123	94128	96094	96064	95531	96065	96134	
95625	95639	95680	94929	95697	94030	94571	95615	95536	96112	95543	96101	96130	
95612	95618	95641	94108	94133	94066	95690	95620	96108	96054	95587	96013	96056	
94923	95776	94005	95687	94107	94080	94937	94109	96115	95549	96114	96069	96104	
94971	94130	95698	94129	94510	95695	95616	95694	96109	95987				
94940	94134	94585	94514	95837	94111	94565	95645						
94965	94533	95937	94121	95931	94127	94525	94038						
94103	94115	94014	95627	94124	94018	95688	94561						
94015	94592	94131	95832	94555	95691	94924	95424						
96107	94010	95950	95606	95912	95957	94521	95242						
94117	94941	94112	94118	93517	95468	95450	94591						
94019	93529	95721	96120										
Southern California													
TOP ZIP CODES BY WIND DENSITY*								TOP ZIP CODES BY PRIME SMALL WIND DEVELOPMENT ACREAGE**					
93062	93021	92335	92377	91326	91330	91752	92323	92283	93536	93555	92365	92310	
92366	92398	93020	93042	93044	92336	92327	92316	93501	92239	92363	92364	93560	
91304	93502	92258	91310	91948	92509	91311	92378	92338	92304	93545	92332	91905	
91739	93551	92241	93534	92337	91324	93501	92240	92278	92277	92285	92384	93527	
93536	92376	91351	93528	92808	91362	93063	91905	92259	92311	93519	92241	92240	
93065	93532	92230	92501	92222	91307	91344	93554	92004	92223	93021	93505	92220	
92602	92282	91350	92285	92862	92223	92807	92259	91350	92230	93551	93436	92407	
93542	92365	93519	91384	92308	93243	92329	93505	92327	92280	93550	91384	91962	
93527	92267	93066	92284	92340	92252	93043	93560	93243	92356	92308	93561	92274	
91962	92312	93510	93504	92310	91325	91321	92203	91906	92066	92262	92070	92555	
92886	91934	92322	92326	92276	92304	91340	93552	92582	91720	93518	91934	93203	
93550	92338	92364	90265	92066	92278	91360	92887	92036	92282	91752	93283	92377	
92311	91760	92356	92220	93033	93012	92869	92345	92314	92267	93437	92336	93065	
91342	92283	92555	92239	91931	92262	92280	91301	93066	93510	91739	91351	92561	
92505	92610	92277	93437	92536	92004	92823	91320	92284	92509	92536	93532	92065	
93950	92036	93283	93555	92341	92676	92407	93041	93452	93225	93063	92371	92242	
93545	92332	93429	91306	92618	92392	93255	92371	92316	92539	92376	93552	92307	
92709	92404	92256	91709	92363	92561	91761	91331	91342	92276	93920	92252	92544	
91720	92539	91759	91963	93561	92582	91906	93436	93429	92309	90704	92086	91710	
92405	92314	91710	90704	92325	91980	92307	92620	92320	91311	93255	93453	92347	
92384	93117	93035	93960	92317	91381	93015	90272	93117	92258	91948	93020	92323	
91916	91343	92320	92352	92391	92339	93518	92242	92366					
92065	93516	92385	93240	91042	92782	93040	91361						
92328	93434	91303	92070	92867	93543	93441	93953						
92368													

* 30% or more of land in Wind Class 2-7 (at least 11.5 mph at 30 meters above ground)

** At least 500 acres or at least 10% of land in Wind Class 3-7 (at least 13.3 mph at 30 meters above ground); urban areas, water bodies, protected land and <20% slopes are excluded

CALIFORNIA ENERGY COMMISSION

COMPLETED WIND FACILITIES FUNDED BY THE RENEWABLE ENERGY PROGRAM



SMALL WIND ENERGY INSTALLATIONS BY COUNTY

196 small wind turbines have been installed in 40 of California's 58 counties under the Emerging Renewables Program, for a total of 862.1 kW installed capacity as of March 31, 2003.

Source: California Energy Commission

Pacific Gas and Electric Company					COUNTY	INSTALLED CAPACITY (Watts)	CITY	ZIP CODE	DATE COMPLETED
TOTAL NUMBER OF UNITS COMPLETED: 108					Humboldt	38762			
TOTAL INSTALLED CAPACITY (kW): 373.4 kW						846	Freshwater	95503	25-Sep-00
COUNTY	INSTALLED CAPACITY (Watts)	CITY	ZIP CODE	DATE COMPLETED		9200	Ferndale	95536	10-Dec-01
Alameda	10070					9200	Ferndale	95536	21-Dec-01
	630	Albany	94706	16-Aug-02		9200	Ferndale	95536	21-Dec-01
	9440	Livermore	94550	27-Nov-02		9200	Alton	95540	26-Dec-01
Amador	11331.36					1116	Fortuna	95540	18-Oct-02
	472	Sutter Creek	95685	08-Nov-01	Lake	3167			
	453.12	Pioneer	95666	27-Nov-01		887	Kelseyville	95451	18-Dec-00
	453.12	Ione	95640	10-Jan-02		1140	Kelseyville	95451	27-Nov-01
	453.12	Ione	95640	18-Jan-02		1140	Kelseyville	95451	27-Nov-01
	9500	Fiddletown	95629	28-Aug-02	Madera	3988			
Butte	14457.5					1756	Raymond	93653	26-Jul-02
	855	Chico	95926	11-Jun-99		2232	Madera	93638	04-Sep-02
	2850	Oroville	95965	07-Mazr-02	Marin	1344.8			
	2820	Cohasset	95926	13-May-02		448.4	Lagunitas	94938	11-Jul-01
	2850	Oroville	95966	28-Jun-02		448.4	Bolinas	94924	06-Nov-01
	2232.5	Chico	95973	25-Nov-02		448	Tiburon	94920	04-Mar-02
	2850	Bangor	95914	26-Dec-02	Mendocino	1888			
Calaveras	12380					1440	Laytonville	95454	09-Mar-99
	2880	Copperopolis	95228	08-Jun-01		448	Albion	95410	21-Dec-99
	9500	Burson	95225	31-Jan-03	Merced	1779.4			
Colusa	2820					1331	Gustine	95322	25-Jul-01
	2820	Colusa	95932	04-Sep-02		448.4	Los Banos	93635	22-Feb-02
Contra Costa	24010				Napa	897			
	9600	Brentwood	94513	28-Jun-00		897	Pope Valley	94567	12-Jun-00
	9200	Clayton		14-Jan-02	Nevada	4223.68			
	470	Brentwood	94513	25-Feb-02		443.68	Nevada City	95959	11-Oct-01
	4740	Brentwood	94513	05-Feb-03		960	North San Juan	95960	30-Sep-02
El Dorado	3384					2820	Grass Valley	95949	27-Nov-02
	3384	Greenwood	95635	20-Nov-00	Placer	4176.48			
Fresno	443					1920	Auburn	95603	07-Dec-99
	443	Tollhouse	93667	15-May-00		1812.48	Loomis	95650	15-Jan-02
Glenn	9943.68					444	Newcastle	95658	13-Aug-02
	443.68	Willows	95988	08-Aug-01	Sacramento	472			
	9500	Orland	95963	14-Nov-01		472	Rancho Cordova	95670	16-May-01
					San Francisco	443.68			
						443.68	San Francisco	94107	08-Nov-01

COUNTY	INSTALLED CAPACITY (Watts)	CITY	ZIP CODE	DATE COMPLETED	COUNTY	INSTALLED CAPACITY (Watts)	CITY	ZIP CODE	DATE COMPLETED
San Joaquin 14885.18					Sonoma 26667.4				
	9500	Tracy	95304	11-Oct-01		453	Santa Rosa	95404	01-Nov-99
	897	Lodi	95240	10-Dec-01		2880	Occidental	95465	13-Aug-01
	1812.48	Tracy	95304	21-Feb-02		2054.4	Penngrove	94951	27-Aug-01
	2232	Linden	95236	02-May-02		9200	Glen Ellen	95442	05-Aug-02
	443.7	Acampo	95220	12-Aug-02		9200	Casadero	95421	14-Aug-02
						2880	Santa Rosa	95404	09-Oct-02
San Luis Obispo 31898					Tehama 14250				
	285	Arroyo Grande	93420	10-Mar-99		5760	Corning	96021	08-Nov-01
	9200	San Luis Obispo	93401	01-Nov-01		2850	Gerber	96035	16-Nov-01
	4013	Atascadero	93422	23-May-02		2850	Corning	96021	02-May-02
	9200	Paso Robles	93451	30-May-02		2790	Manton	96059	06-Sep-02
	9200	San Luis Obispo	93405	20-Feb-03					
San Mateo 2724					Yolo 15703.8				
	972	Pacifica	94044	20-Jan-00		9600	Winters	95694	01-Nov-99
	897	Burlingame	94010	22-Jan-02		4320	Esparto	95627	07-Nov-00
	855	Pacifica	94044	24-Jan-02		896.8	Capay	95607	25-Nov-02
						887	Capay	95607	19-Feb-03
Santa Barbara 1116					Yuba 5277.8				
	1116	Santa Ynez	93463	01-Aug-02		331	Oregon House	95962	28-Jun-02
Santa Clara 11245						878	Oregon House	95962	27-Sep-02
	887	San Jose	95117	25-Jan-01		836.8	Oregon House	95962	30-Sep-02
	1359	San Jose	95123	10-Jan-02		897	Oregon House	95962	03-Oct-02
	2850	Gilroy	95020	14-Jan-02		448	Oregon House	95962	06-Dec-02
	2242	Morgan Hill	95037	28-Jun-02		887	Oregon House	95962	13-Feb-03
	2151	Morgan Hill	95037	28-Jun-02					
	1756	Morgan Hill	95037	22-Jul-02					
Santa Cruz 11235.12					Southern California Electric				
	376	Los Gatos	95033	22-Sep-00	TOTAL NUMBER OF UNITS COMPLETED: 83				
	453.12	Davenport	95017	11-Oct-01	TOTAL INSTALLED CAPACITY (kW): 479.3 kW				
	9500	Santa Cruz	95066	06-Nov-01					
	906	Santa Cruz	95060	29-Nov-01					
Shasta 20415									
	887	Whitmore	96096	08-Jun-01	COUNTY	INSTALLED CAPACITY (Watts)	CITY	ZIP CODE	DATE COMPLETED
	9200	Redding	96001	25-Feb-02	Kern	140965			
	9200	Bela Vista	96008	18-Dec-02		2880	Rosamond	93560	29-Oct-99
	1128	Redding	96062	23-Jan-03		1410	Tehachapi	93561	01-Nov-99
Siskiyou 9200						7200	Tehachapi	93561	01-Nov-99
	9200	Corning	96031	01-Nov-02		7200	Tehachapi	93561	01-Nov-99
Solano 58764						9500	Tehachapi	93561	18-Apr-00
	9600	Rio Vista	94571	20-Jan-00		9600	South Lake	93240	01-Jun-00
	10000	Birds Landing	94512	16-Aug-00		10000	Tehachapi	93561	02-Aug-00
	9200	Suisun	94585	23-Oct-01		384	Rosamond	93560	02-Aug-00
	9200	Suisun	94585	01-Nov-01		9500	Tehachapi	93561	05-Mar-01
	9600	Suisun	94585	02-Nov-01		9500	Tehachapi	93561	05-Mar-01
	9600	Vallejo	94591	15-Nov-01		453	North Edwards	93523	17-Jul-01
	448	Martinez	94533	30-Apr-02		448	Tehachapi	93561	25-Jul-01
	1116	Vacaville	95688	19-Jul-02		9200	Tehachapi	93561	13-Sep-01
						9200	Rosamond	93560	25-Sep-01

COUNTY	INSTALLED CAPACITY (Watts)	CITY	ZIP CODE	DATE COMPLETED	COUNTY	INSTALLED CAPACITY (Watts)	CITY	ZIP CODE	DATE COMPLETED
Kern Continued...					San Bernardino Continued...				
	9200	Tehachapi	93561	27-Nov-01		9200	Barstow	92311	15-Mar-02
	9200	Willow Springs	93561	23-Jan-02		9200	Apple Valley	92308	15-Mar-02
	9200	Rosamond	93560	24-Jan-02		9200	Hesperia	92345	22-Jul-02
	2850	Boron	93516	01-Jul-02		5700	Barstow	92311	16-Aug-02
	2820	Ridgecrest	93555	13-Aug-02		897	Victorville	92392	03-Sep-02
	2820	Mojave	93501	04-Dec-02		9200	Apple Valley	92308	17-Sep-02
	9200	Tehachapi	93561	13-Feb-03		9200	Phelan	92371	30-Oct-02
	9200	Tehachapi	93561	25-Mar-03		9200	Phelan	92371	03-Jan-03
						2850	San Bernardino	92407	09-Jan-03
						9200	Apple Valley	92308	15-Jan-03
						9500	Lucerne Valley	92358	04-Feb-03
						9200	Apple Valley	92308	05-Feb-03
						9200	Lucern Valley	92356	05-Feb-03
						9200	Hinkley	92347	11-Feb-03
						9200	Oak Hills	92345	13-Feb-03
						9200	Phelan	92371	19-Feb-03
						9200	Hesperia	92340	21-Feb-03
						9200	Yermo	92398	13-Mar-03
Los Angeles 30750.42					San Diego 2850				
	1410	Pomona	91768	03-Jun-99		2850	Ranchita	92066	09-Aug-01
	960	Castaic	91384	09-Aug-01	Santa Barbara 9200				
	1992.72	Norwalk	90650	04-Sep-01		9200	Goleta	93117	30-Oct-02
	2850	Lancaster	93536	27-Dec-01	Tulare 453.12				
	2850	Sauges	91350	17-Jan-02		453.12	Tulare	93274	16-Jan-02
	444	Lancaster	93535	16-Jul-02	Ventura 1166.9				
	443.7	Torrance	90501	01-Aug-02		1166.9	Simi Valley	93065	20-Mar-02
	2850	Agua Dulce	91350	05-Aug-02	San Diego Gas & Electric Company				
	2850	Acton	93510	27-Aug-02	TOTAL NUMBER OF UNITS COMPLETED: 5				
	5640	Palmdale	93550	19-Dec-02	TOTAL INSTALLED CAPACITY (kW): 9.4 kW				
	5640	Palmdale	93550	19-Dec-02	COUNTY INSTALLED CAPACITY (Watts) CITY ZIP CODE DATE COMPLETED				
	2820	Palmdale	93550	21-Jan-03	San Diego 9418.8				
Riverside 27270						444	El Cajon	92019	22-Sep-00
	3625	Riverside	92509	07-Dec-99		2850	Warner Springs	92086	28-Nov-00
	940	Winchester	92596	18-Apr-00		2850	El Cajon	92019	24-May-01
	960	Winchester	92596	09-May-00		424.8	San Diego	92111	30-Nov-01
	2395	Temecula	92592	03-Apr-02		2850	Jamul	91935	19-Nov-02
	950	Hemet	92545	23-May-02	San Bernardino 266601				
	9200	Moreno Valley	92557	03-Jan-03		897	Alta Loma	91737	21-Dec-99
	9200	Moreno Valley	92557	04-Feb-03		897	Hesperia	92345	21-Dec-99
						270	29 Palms	92277	15-Nov-00
						887	Apple Valley	92307	24-May-01
						443	Johnson Valley	92285	30-May-01
						9200	San Bernardino	92407	13-Sep-01
						9500	Oak Hills	92345	13-Sep-01
						9500	Apple Valley	92308	11-Oct-01
						2880	Phelan	92371	11-Oct-01
						9200	Victorville	92392	01-Nov-01
						9500	Hesperia	92345	01-Nov-01
						9200	Phelan	92371	14-Nov-01
						855	Lake Arrowhead	92352	27-Dec-01
						9200	Apple Valley	92308	16-Jan-02
						425	Morongo Valley	92256	14-Feb-02
						9200	Hesperia	92340	15-Feb-02
						9200	Oak Hills	92345	27-Feb-02
						9200	Devore	92407	01-Mar-02
						9200	Hesperia	92345	15-Mar-02
						9200	Phelan	92371	15-Mar-02



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