

California Wind Energy Collaborative Final Report

January 2008 – June 2009

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ABSTRACT

The California Wind Energy Collaborative supports the development of safe, reliable, environmentally sound, and affordable wind electric generation capacity within the state of California. To fulfill this mission, the Collaborative manages a focused, statewide program of scientific research, technology development & deployment, and technical transfer and outreach. These efforts are conducted in close cooperation with industry, state and federal agencies, and other institutions to maximize the benefits of wind energy resources in California for its citizens. The Collaborative is a partnership between the University of California and the California Energy Commission, established in February 2002. This report summarizes the activities and deliverables for the period from January 2008 through June 2009.

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INTRODUCTION

The mission of the California Wind Energy Collaborative (CWEC) is to support the development of safe, reliable, economic, and environmentally sound wind power in California. CWEC performs its mission through a program of engineering research, inter-sector coordination, and education. In doing so, CWEC directly supports the fulfillment of current state, federal, and industry goals for wind power.

In this document, we provide a brief status of wind energy in California, an overview of the Collaborative, and a description of its activities for the period from January 2008 through June 2009.

STATUS OF WIND ENERGY IN CALIFORNIA

With approximately 2.5 gigawatts of wind power, California currently has the third most wind capacity of any state in the USA. Wind generated electricity provides more than six billion kilowatt-hours of electricity to California ratepayers every year (Fig. 1).

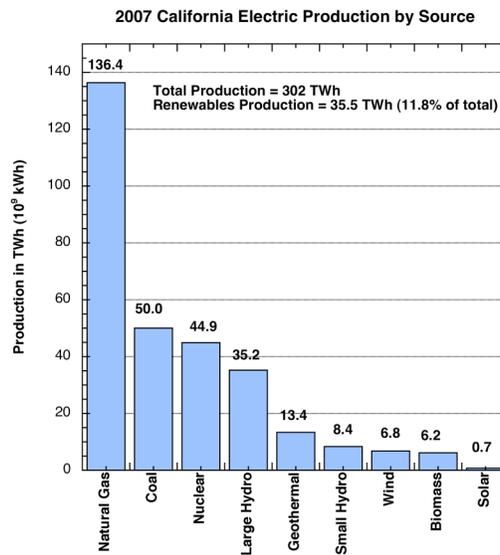


Fig. 1 California electricity production by source for 2007. RPS eligible production (biomass, geothermal, small hydro, solar, wind) totals 35.5 TWh out of a total of 302 TWh or 11.8%. (Source: CEC-200-2008-002)

These impressive numbers belie a tumultuous history of wind power development in California. Wind developments occurred first in Asia, Europe, and other parts of the United States, but it was not until the early 1980s in California that the first modern wind plants were built. In early 1985, the installed wind-based electric power generation capacity in California was 535 MW. This rapidly increased to more than 1,500 MW by the end of 1990 (<http://ewprs.ucdavis.edu>). At the same time, the total U.S. capacity was only 1,525 MW and the total global capacity was 1,930 MW. Clearly, California was the global leader in wind energy (Fig. 2). Unfortunately, as interest in alternatives to fossil fuels faded nationally in the following years, the growth in California slowed and

Denmark and then Germany took over the lead. As wind power technology matured and concerns over emissions and global climate change escalated, wind power began a revival in the United States at the end of the 1990's. By the end of 2008, total global capacity soared to 121,000 MW with more than 25,000 MW of this in the United States, including 2,500 MW in California. In 2006, with wind power garnering significant interest and attention as a viable energy source, California lost its leadership in the United States with most of the new capacity going into the Midwest and Texas, as shown in Fig. 3..

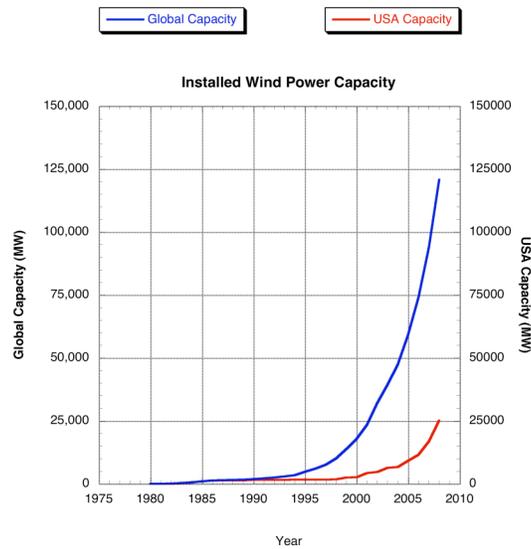


Fig. 2. Installed wind-based electric power capacity in world and USA.

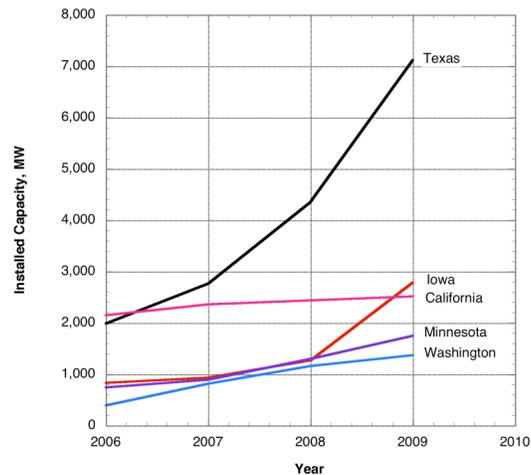


Fig. 3. Recent growth in installed wind power in states with most capacity.

The energy policy targets of California are summarized in Fig. 4. The key policy for wind power is the Renewables Portfolio Standard (RPS), requiring that 20% of electric energy from investor owned utilities (IOUs) come from renewables by 2010 and targeting 33% by 2020. In 2007, wind provided 2.2% of the total generation and the other renewables (biomass, geothermal, solar, small hydro) generated an additional 9.6% (Fig.

1). In 2008, these percentages slightly improved, mainly because of a drop in electricity demand. From these numbers it is clear that more renewable energy must be developed for the utilities to meet the RPS goals.

In 2008, the U.S. Department of Energy (DOE) published a report that examines the technical feasibility of wind generating 20% of the electric used in the U.S. by 2030. The report, titled “20 Percent Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply”, identifies requirements for achieving this goal including reducing the cost of wind-based electric energy, installing new transmission infrastructure, and enhancing domestic manufacturing capability. At the start of 2009, a total of 25 GW of wind was installed in the U.S. (Figs. 2 and 3) where it is estimated that an additional 280 GW is required to meet the 20% wind energy goal by 2030. In the 20 Percent Wind Energy by 2030 study, California is listed to have the potential of more than 10 gigawatts or more than four times the current capacity.

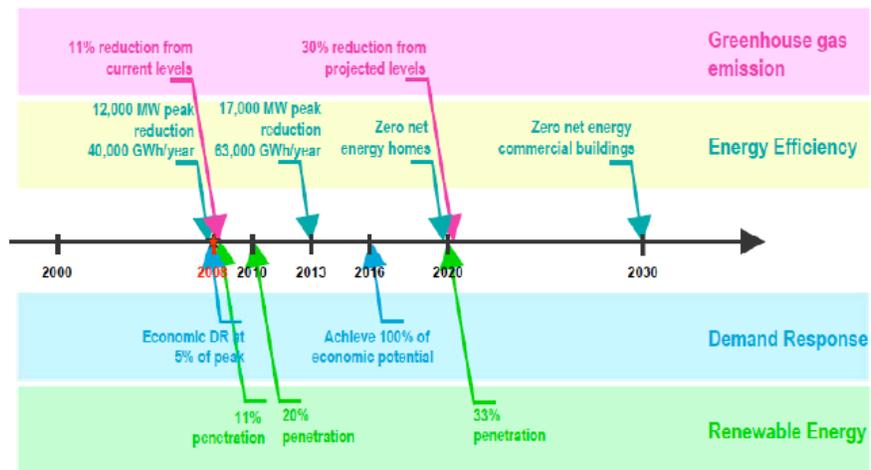


Fig. 4. California energy policy targets (Source: CEC/PIER)

CALIFORNIA WIND ENERGY COLLABORATIVE

Wind power in California is built through the products and work of numerous contributors. They include domestic and international industry, agencies and offices at all levels of government, large and small utilities, research labs, academia, and many more. A few of these entities work cooperatively, some are competitive, and most simply work relatively independently, with little coordination among one another. California’s wind resources could provide up to four times the present wind generating capacity. Developing these wind resources successfully into reliable, valuable, economic, and environmentally sound contributors to the state’s electricity system requires coordination among all of these entities.

The Energy Commission supports wind energy development through the Renewable Energy Program and the PIER Renewables Program, but neither has established a forum for ongoing coordination of wind energy development in California. Outside of

California, the American Wind Energy Association (AWEA) has traditionally acted as a clearinghouse of information about wind energy activities and sponsored wind energy conferences covering a variety of wind energy related topics. Similarly, the Department of Energy (DOE) and the National Renewable Energy Laboratory (NREL) have directed wind energy development efforts. However, AWEA, DOE and NREL all have maintained a national perspective rather than a California specific one. The California Wind Energy Collaborative was established in 2002 to meet the need for coordination with a state-level perspective. Its mission is to support the development of safe, reliable, environmentally sound, and economic wind power within the state of California. To fulfill this mission, it manages a focused program of scientific research, education, and coordinative activities. These efforts are conducted in close cooperation with the many contributors to wind power in California – commercial, government, and academic – with specific focus on California issues and California based industry to maximize the benefits of the state’s wind energy resources for its citizens (Fig. 5).

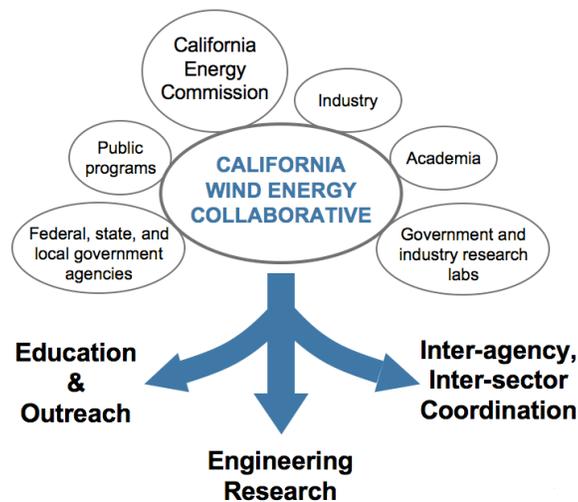


Fig. 5. California Wind Energy Collaborative.

CWEC is a partnership of the University of California, Davis (UC Davis) and the California Energy Commission. The California Energy Commission has long recognized the importance of wind energy. It supports research and development in renewable energy including wind through its Public Interest Energy Research (PIER) Program. The University of California, particularly UC Davis, has a history of wind energy related efforts dating back more than twenty-five years. Several of its faculty have been working with industry, national laboratories, and other universities on a wide range of wind energy related problems. Many of its graduates have prominent positions throughout the wind industry.

CWEC provides a forum for a coordinated approach for developing wind energy systems beneficial to California’s unique topology. It also provides expertise to the Commission to help supplement and support wind energy development programs specific to California. CWEC advisory board members include representatives from California's wind energy industry, Energy Commission staff involved in wind energy development,

representatives from DOE and NREL's wind energy programs, members of the environmental community involved with environmental impacts from wind energy, and representatives from the academic community conducting wind energy research.

TECHNICAL TASKS

This report covers the period from January 2008 through June 2009. The scope of work for this period involved the following technical tasks:

- Task 2 Collaborative Organization and Advisory Board
- Task 3 Wind Project Performance Reporting System
- Task 4 Wind Energy Training, Outreach, and Technology Transfer
- Task 5 Windplant Optimization
- Task 6 Wind Verification and Measurement

Task 2 – Collaborative Organization and Advisory Board

The goal of this task is to enhance the interactions of the wind energy industry, state and federal agencies, universities and other institutions by (1) continuing and expanding CWEC and its Advisory Board, and (2) providing a physical focal point (i.e., office) for wind energy related questions/activities in the state. The purpose of these interactions with these institutions is to focus statewide activities related to wind energy and to advise on measures in support of wind energy in the state.

An important component of the Collaborative is the Advisory Board. The Board includes (but is not limited to) representatives from each segment of the California wind energy industry: private industry (manufacturers, developers, consultants, etc.), utility companies, state and federal agencies, universities, research organizations and others. Membership is evaluated annually based on the technical needs of the Collaborative and member availability, regular contribution, and expertise. The current Advisory Board membership includes a variety of stakeholder perspectives.

Stakeholder Group	Members
Industry	<ul style="list-style-type: none"> - Michael Bergey, Bergey Windpower - Craig Christenson, Clipper Windpower - Ron Davis, BEW Engineering, Inc. - Ed Demeo, Renewable Energy Consulting Services, Inc. - Jeffery Ghilardi, GE Wind Energy, LLC - Kevin Jackson, Dynamic Design Engineering, Inc. - Emil Moroz, DeWind, Inc. - Brent Reardon, Garrad Hassan America, Inc. - Hal Romanowitz, Oak Creek Energy Systems, Inc.
System Operators & Utilities	<ul style="list-style-type: none"> - Dave Hawkins, CalSO - Mike Marelli, SCE - Hugh Merriam, PG&E - Richard Wallace, Sacramento Municipal Utility District (retired) - Dora Yen-Nakafuji, Hawaii Electric Company

Environmental	- Charles Bennett, Environmental Science Associates
State & Federal Agencies	- Gerald Braun, California Energy Commission, California Institute for Energy and Environment - Mike Kane, California Energy Commission - Mather Kearney, California Business Investment Services (CalBIS)
Research Organizations	- Brian Smith, NREL
Collaborative PIs	- Bruce White, UC Davis - C.P. (Case) van Dam, UC Davis

During the period of January 2008 – June 2009, the Advisory Board met once on May 18, 2009 at UC Davis. The minutes of this meeting are documented in a separate report [1].

In March 2002, CWEC established an office in Academic Surge Building (ASB) on the campus of the University of California at Davis. Its phone number is 530-752-2261 and its web address is <http://cwec.ucdavis.edu>. Around the same time, Henry Shiu was hired as an engineer to provide full-time support. In 2008, Scott Johnson was hired to provide additional full-time engineering support. Their offices are in 2120 ASB.

The sixth California Wind Energy Forum was conducted on March 4, 2009. In past years this event was held at various sites including Napa, San Diego, and Palm Springs. To keep costs down this time, the event was held at the Buehler Alumni Center on the campus of UC Davis. The proceedings are available at the Collaborative's web site, <http://cwec.ucdavis.edu/forum2009/> [2]. The proceedings include electronic copies of all the Forum presentations, audio recordings of the speakers, and contact information of all registered Forum attendees

Task 3 – Wind Performance Reporting System

The purpose of this task is to maintain, help streamline, and further develop the electronic version of the Wind Performance Reporting System (WPRS) for the Commission, leveraging the web and computing infrastructure located at the University of California, Davis.

Under a previous contract, CWEC developed a publicly accessible web-based database that includes WPRS data from 1985 to present. The web accessible WPRS data represent a valuable public resource, providing quantitative insight into the history and state of California's wind industry. The initial work on the Electronic WPRS (eWPRS) included basic querying capabilities so that the most commonly sought data (e.g., installed capacity, number of turbines, capacity factor) could be easily retrieved. With the ready availability of this data, the usefulness of the WPRS data has become fully recognized and requests have been made for additional querying capability including searching and sorting by Qualifying Facility (QF) number and IOU service territory. Such queries are useful for a variety of applications, including tracking regional growth of wind capacity within the state. The Electronic WPRS is accessible at <http://wprs.ucdavis.edu/> or <http://ewprs.ucdavis.edu/>.

In 2008, CWEC received the WPRS data for 2006 data from the CEC. Unfortunately the information was incomplete and could not be added to the eWPRS database. We are still awaiting the 2007 and 2008 data. As soon as these data files are received from the CEC, they will be added to the database.

The Collaborative also developed a web-based WPRS that allows performance report submittal via the web. However, upon consultation with the CEC-PIER staff it was decided to shelve this effort until a meeting could be set up to coordinate this effort with the Energy Commission's IT group

Task 4 – Wind Technician Training, Outreach and Technology Transfer

In recent years, wind power has emerged into greater awareness in several sectors. With the installation of more and more new windplants with highly visible utility-scale megawatt-size turbines, the general public is recognizing that wind makes significant contributions toward meeting California's energy needs. Investors, manufacturers, developers, etc. see the economic viability and opportunities presented by an active and healthy wind energy industry. Technicians and engineers are inquiring about job opportunities in an expanding field. Government planners and regulators are asking for more information to better assess the impact of wind energy. System and transmission operators and other power industry players are trying to better understand wind power as they grapple with emerging issues associated with impending high penetrations. However, few resources available to address growing interest nor are they tailored for a particular state.

Through a series of pilot training and outreach programs, CWEC has begun to bridge the information gap through training and outreach programs aimed at California needs. The need for such courses was first introduced by industry representatives on CWEC's Advisory Board. Meeting this extensive goal will, ultimately, require a coordinated effort between academic institutions, the wind industry, and the broader power industry including utilities. Under this effort, CWEC will continue to focus on 1) providing comprehensive wind energy training for industry professionals and small wind energy systems for the general public, 2) develop a new initiative to adapt curriculum to include the specific interest of the power industry and regulatory agencies and 3) develop a transition plan to sustain these courses within the public education mainstream (i.e. community college, associate degree programs).

The materials for a two-day short course titled Wind Energy for Technicians were previously developed. The course contains nine components for a total of 12 lectures:

1. Introduction and History of Wind Energy
2. Wind Characteristics and Assessment
3. Rotor Aerodynamics – two lectures
4. Electrical Systems – two lectures
5. Structures and Loads – two lectures
6. Grid Integration
7. Economics, Operations and Maintenance
8. Environmental and Site Issues

9. Wrap-Up and Discussion

The course materials were lightly revised and updated for the third offering of the course in Palmdale on Saturday October 11 and Sunday October 12, 2008 [3]. The course instructors were Mike Behnke (BEW Engineering), Kevin Jackson (Dynamic Design Engineering), and Henry Shiu, and C.P. van Dam of the Collaborative.

The offering of the above course attracted attention from representatives of the California Community Colleges and provided the nucleus for wind energy technician training programs at the California Community Colleges. Since early 2009 a number of Colleges have offered Wind Turbine Technician programs including Cerro Coso Community College in Ridgecrest and Shasta College in Redding. The two-day course program developed by CWEC will continue as a self-sustaining outreach program that provides information on wind energy and the training and job opportunities in the field. The plan is to continue to offer the course once a year.

The materials for the short course titled Small Wind Energy Systems were previously developed. The one-day course includes an Overview and Perspective of Wind Energy and lectures on Wind Resource Assessment for Small Wind, Small Wind Economics and Incentives, Sitting Considerations and Challenges, and Small Turbine installation. The fourth and fifth offering of the course were on April 25, 2008 in Davis and April 26, 2009 in Sacramento. The instructors were Dora Yen-Nakafuji (LLNL), John Obermeier (Otech Engineering), Sean Kenny (Fresco Solar) and C.P. van Dam of the Collaborative. The one-day course program will continue as a self-sustaining outreach program that provides information on small wind energy systems. The plan is to continue to offer the course once a year.

The offering of these courses has attracted national attention and provided the stimulus to create a training program for small wind installers at the California Community Colleges as well as in other states. The efforts to develop this training program will continue in the second half of 2009.

On October 29, 2008, CWEC hosted a Small Wind Workshop designed to identify the issues facing small wind development in California and to discuss appropriate actions that can be taken to overcome them. A diverse set of parties participated, including industry professionals, established and emerging manufacturers, installers, county representatives, utilities, environmental consultants, policy advisers, and other people engaged in small wind activities and issues. The proceedings from the workshop can be found at the following website <http://cwec.ucdavis.edu/smallwindworkshop2008/>. The workshop consisted of eight speakers, each focusing on a particular issue, followed by breakout discussion with participants asked to choose a discussion group. The groups' tasks were to identify short-term (1-3 years) and long-term (3-5 years) goals. This task was not relevant to a couple of the groups. Discussion group notes and additional comments are included in the report [4]. The notes listed are a compilation of all of the group members' suggestions and do not necessarily represent unanimous support from all of the group members. The six breakout groups focused on:

- Permitting Issues
- Turbine Certification, Testing, and Standards
- California Incentive Program
- Wind Resource Assessment and Siting
- Urban Wind
- Opportunities for Wind in Agriculture

Based on recommendations from participants of the above small wind workshop, CWEC conducted a survey of installers of small wind energy conversion systems in California. The goal was to document the challenges faced by many of the installers as they attempted to acquire permits from local jurisdictions for small wind installations. The Collaborative contacted over 25 installers within California and asked them to participate in the study. Nine installers returned surveys. The findings from the returned surveys are presented in [5].

In addition, CWEC performed a study reviewing the permitting fees for small wind turbines in California counties. The Collaborative reviewed fees for all 58 counties. Less than half have standard requirements for small wind systems. The range of fixed fees varied widely, from as little as \$0 to as much as \$10,000. The Collaborative recommended setting a permit fee ceiling of \$1,000. This figure is based on fees from several counties with requirements in accordance with California Assembly Bill 1207, and is considered reasonable in comparison to lower solar permitting fees. The findings from this review are presented in [6].

Also CWEC has been developing a new initiative to adapt curriculum to include the specific interest of the power industry and regulatory agencies. CWEC will be hosting a one-day seminar on wind energy in California for state and local governments. The seminar is specifically geared towards individuals in state and local governments and it will cover a wide range of topics associated with wind energy in California. By understanding the issues revolving around wind energy, people can identify potential solutions and make educated decisions regarding future development. The seminar details are presented in Appendix A.

Task 5 – Windplant Optimization

A wide range of factors that have not been comprehensively studied affect the performance of commercial windplants. Seasonal changes in wind velocity, air density, blade soiling (insect debris, dust, etc.), control system interactions with turbulent winds, windplant maintenance procedures, windplant connection issues to the electric grid, repowering procedures, etc. can have large impacts on electric power production. Turbine permitting issues control the number of turbines for a given wind site. The goal of this task is to evaluate windplant performance issues and identify methods and procedures for maximizing energy capture and/or electricity sales revenue through a series of studies and scenario based white papers.

White Paper: Repowering in California - Hurdles and Barriers

Much of California’s valuable wind resource areas are occupied by aged fleet – relatively inefficient turbines from the initial “wind rush” of the early 1980s. Successfully meeting

state renewable goals will require both new installations and repowering of some of California's existing two GW of windplants. While conceptually simple, repowering is, in practice, difficult to effect for a variety of reasons: existing power purchasing contracts which favor the status quo; the shortage of turbines in the most commonly preferred sizes; the availability and applicability of the PTC; environmental concerns, especially avian. The height of newer turbines also presents many difficulties: conflict with military flyways, radar interference, FAA restrictions both for daytime use and in regard to nighttime lighting, county/local height limits.

The study was headed by Wayne Leighty, a PhD graduate student in Sustainable Transportation Energy Pathways, and summarized in a report titled Repowering California Wind: A Summary of Potential Benefits and Barriers [7].

Support Development of Wind Energy Research Plan and RD&D Priorities

In 2006, the PIER program developed a long-term (15 years) integrated roadmap to identify the RD&D requirements for the renewable energy sources to help California meet its policy goals. Wind energy is an important component of the State's renewables portfolio. The goal of this effort is to develop, in close cooperation with the PIER Renewables group, CEC Renewable Energy program, CPUC, IOUs, NREL, and other stakeholders, a research plan for wind energy that covers the period through 2020. The wind energy research plan will help lay out the RD&D required to meet key renewables policy goals in California.

CWEC conducted two studies in support of the wind energy research plan developments. First a stakeholder's meeting to discuss a wind energy research plan for California was conducted at UC Davis with the report, summarizing the input provided by the participants, submitted in January 2008 [8]. Second, a strategic plan for CWEC and wind energy in California was formulated in 2009 [9].

California Windplant Lighting Study

In a prior study [10] revised obstruction lighting standards by the Federal Aviation Administration (FAA) for windplants were reviewed and a flight experiment conducted by the FAA in Oklahoma to determine the required spacing and layout of warning lights for individual wind plants was discussed. These new standards work well for new windplants. However, the problem encountered when repowering individual windplants in a wind resource area consisting of many windplants (e.g., Altamont) is that specifying the spacing and layout of obstruction lights for individual windplants based on these standards may lead to a less desirable lighting layout for the resource area as a whole. Hence, an obstruction lighting approach encompassing the entire or most of the wind resource area may be preferred.

The goal of this subtask was to start the dialog with the FAA about the feasibility of a wind resource area approach and to evaluate the feasibility of a flight experiment in California to determine the required spacing and pattern of obstruction lights for an area consisting of multiple windplants. However, because of lack of progress of repowering in the Altamont Wind Resource Area this subtask was cancelled for the moment and may be revisited at a future date.

Task 6 – Wind Verification and Measurement

The adequate assessment of wind resources in the state is critical to expedite the increase in wind energy production. This task focuses on the assessment of the wind resource in California and making this information easily accessible to the public.

CDEC Data Verification and Collation

Many wind energy studies are hindered by the availability of accurate, historical wind data. The CDEC (<http://cdec.water.ca.gov>) contains a large database of meteorological data from many sites throughout California. This is a valuable resource of actual, historic wind data from actively maintained anemometers and measurement systems. However, the systems were not designed for wind resource assessment for wind energy applications. CWEC will review the CDEC meteorological data and inspect CDEC meteorological stations to identify data that is of sufficient quality for wind energy applications. If the data is not easily accessible, CWEC will extract and collate it and make it easily accessible to the public, possibly leveraging the existing eWPRS. CWEC will also work jointly with the meteorological station maintainers to examine the equipment and cost changes required to bring existing anemometer installations up to the standards necessary for wind energy applications.

Besides wind data, CDEC's meteorological data includes insolation/radiance and rainfall data that are valuable for resource assessment of other renewables. CWEC will also review the CDEC meteorological data and inspect its meteorological stations to identify data that is of sufficient quality for solar energy applications and, if not already easily accessible, extract and collate it and make it easily accessible to the public, possibly leveraging the existing eWPRS.

This study was headed by Matthew Seitzler of CWEC and Kevin Jackson of Dynamic Design Engineering, Inc. They visited several CDEC sites in northern and southern California and presented their findings in a report [11.]

California Wind and Solar Datasets

The availability of adequate input data remains a hindrance to efforts studying the increasing penetration of renewables in California. With its experience in the RPS Integration Costs Study, Intermittency Analysis Project, and a variety of other field-data sources, CWEC has become the go-to organization for wind data in California. Over the past few years, CWEC has responded to a number of inquiries for information on wind and power data. This information is currently being summarized in a publicly accessible website. The final URL of the website will be: <http://cwec.ucdavis.edu/data>.

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APPENDIX A
SEMINAR ON WIND ENERGY FOR STATE AND LOCAL
GOVERNMENTS

June 2009

The California Wind Energy Collaborative (CWEC) will be hosting a one-day seminar on wind energy in California. The seminar is specifically geared towards individuals in state and local governments and it will cover a wide range of topics associated with wind energy. By understanding the issues revolving around wind energy, people can identify potential solutions and make educated decisions regarding future development.

CWEC is a part of the California Renewable Energy Collaborative, which is a partnership between the University of California and the California Energy Commission. CWEC supports the development of safe, reliable, cost effective, and environmentally responsible wind power in California. To meet this goal, the Collaborative performs three primary functions. One, conduct and manage scientific and engineering research. Two, coordinate efforts to address issues and interested in California. A broad set of parties are involved with wind power development, including industry, national labs, state agencies, county offices, trade organizations, private consultants, academia, and others. The third function is to provide and promote education, training, and outreach. The Collaborative understands that education and training is key to the future success of the wind industry. We develop and teach courses from university-level engineering curriculum to vocational training to public seminars.

Seminar Details

The seminar will be a one-day event held in Sacramento. The presentations will be broadcasted live on the internet via Webcast. Recording will be posted online for future viewing.

Location: TBD

Date: TBD

Time: TBD

Webcast: TBD

Who should attend?

While the material was developed with state and local governments in mind, the information presented may appeal to others as well.

- County and city planners
- Zoning officials
- Regulators
- State and local policy makers
- Legislative aides
- Government agencies
- Environmental groups
- Utility representatives
- Industry members
- Individuals interested in learning more about wind energy

Seminar Layout:

The seminar is broken into five sessions, each lasting about 45 minutes. There will be a 15-minute break between the sessions and an hour break for lunch.

- 9:00 – 9:45 *Session One: Wind Energy Overview, Status, Projected Growth*
 The introductory session will lay the framework for the seminar by providing an overview of the course topics and presenting basic information about wind energy. This will include an industry overview with a brief history of wind energy, current status, and growth projections. Other topics include wind resource assessment and different turbine applications.
Presenters: CWEC
- 10:00 – 10:45 *Session Two: Policy Drivers*
 All levels of government play an intricate role in the growth of renewable energy. This session will focus on how renewable energy operates in California and some of the possible changes in the future. Specific topics include how renewable energy is credited, how policy (local, state, & federal) drives development, and the necessary procedures leading up to development.
Presenters: Nancy Rader - Crediting Renewable Energy
 Patricia Thompson - Policy Drivers
- 11:00 – 11:45 *Session Three: Project Development, Plant Operations, Grid Integration*
 This session will provide an overview on project development, plant operations, and integration of renewables onto the electrical grid. Successfully developing a wind plant has many stages and requires many partners. A walk-through of these procedures will be presented. Once a development is complete, the plant begins operating and supplying electricity to the grid. An overview of the operations will be explained. The last talk will focus on the interaction between renewable energy plants and the electrical grid, including integration and transmission.
Presenters: TBD - Project Development
 TBD - Plant Operations
 TBD - Transmission/ Grid Integration
- 12:45 – 1:45 *Session Four: Permitting Requirements*
 A number of issues can arise during the planning, development, and operation of a wind plant. This session will focus on some of the most common issues associated with permitting, legal aspects, and environmental impacts, including avian issues.
Presenters: TBD - Permitting Issues
 Anne Mudge - Legal Issues
 TBD - Environmental Impacts
- 2:00 2:45 *Session Five: Community and Building-Scale Wind*
 Many of the presented topics are geared towards utility-scale development. How these issues translate to community and residential applications will be presented in this session.
Presenters: Nellie Tong - Small Wind Specifics

Pete Price - Ordinances for Small Wind
Fred Brown – Community Wind Opportunities and Hurdles

2:45 - 3:15 Conclusion: *Wrap-Up*

The concluding session will revisit the topics discussed earlier in the day and provide additional time for discussion.

Presenters: CWEC