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ENERGY
COMMISSION

2005 ENVIRONMENTAL PERFORMANCE REPORT OF CALIFORNIA'S ELECTRICAL GENERATION SYSTEM

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EXECUTIVE SUMMARY

This report assesses the environmental performance and related impacts of California's electric generation facilities and updates the status and trends that were initially reported in the *2001* and *2003 Environmental Performance Reports*. In addition, as provided in section 25503(b) of the Public Resources Code, this report has been prepared in support of the Integrated Energy Policy Report.

The *2005 Environmental Performance Report* provides an analytical basis for policy discussions and options that may be incorporated into the *Integrated Energy Policy Report*. Its findings will be presented at a series of public workshops on June 27 and 28, 2005. Interested parties are encouraged to review this staff report and to provide comments relating both to the report's content and to possible policy options that may follow from the environmental status and trends discussed in the report. Comment letters received on the Staff Draft version of this report will be produced, along with staff's responses, in late summer 2005.

California's electricity is supplied by a wide range of generating facilities located throughout the state, the western United States, Western Canada, and the Northern Baja California Peninsula of Mexico. The *2001 Environmental Performance Report* provided an initial evaluation of the environmental performance of the state's electric generating system from World War II to the year 2000. Environmental performance improved substantially during that time period, primarily due to switching from oil to natural gas, improvements in combustion technologies, and implementation of pollution controls. The *2003 Environmental Performance Report* focused on the performance of the system between 1996 and 2002, during which time the changes from deregulation of the state's energy markets were enacted. The *2003 Environmental Performance Report* improved the analytic methods and data sources from the first report, established a quantified 1996 environmental baseline, and identified lack of sufficient environmental data as a major hindrance for assessing changes in environmental performance. The *2003 Integrated Energy Policy Report* adopted two policy options from the staff report: a policy change on the use of fresh water for power plant cooling, and encouragement of ongoing Energy Commission staff support to state agencies working on hydropower relicensing.

This *2005 Environmental Performance Report* builds from the 2003 recommendations and substantially expands the range of topics analyzed by Energy Commission staff. Staff's goal is to focus more on policy level environmental issues that are of interest to policy makers and the public. As required by statute, staff continues to report on the status and trends of all the major environmental performance aspects of the state's large and diverse electricity supply system and its electric and natural gas transmission systems.

New to this year's report are assessments of once-through cooling impacts to the marine environment and avian mortality from wind turbine collisions, plus a preliminary assessment of the environmental profile of out-of-state power imported to California markets. Each of these assessments is presented in a series of staff papers that are appended to the main report.

In response to staff's concerns about the lack of environmental data, and at the Commission's direction, Energy Commission staff received environmental data on 453 power plants totaling 53,441 megawatts (MW) from private and public power generators that were used to begin creating a robust environmental data base and alleviate the data shortfalls identified in 2003. These data are used in the air quality, water use, and socio-economic sections, and will be used for the hydropower paper later in the year. Staff was unable to make full use of the data because of problems with timeliness of submittal and widely varying quality levels.

Major Findings of the 2005 Environmental Performance Report

General Trends

As reported in 2001 and 2003, the overall environmental performance of California's diverse 61,000 MW power generation system is good and continues to improve. The environmental footprint of the energy system needed to power the state's people and economy is relatively small compared with the energy impacts in other parts of the nation and the world. However, there are continuing discrepancies in levels of impact to various parts of the natural environment.

Poor air quality is one of the predominate environmental and public health concerns in California, but emissions from power generation facilities comprise an ever smaller portion of emissions inventories in most California air basins. Due to stringent regulation by state regulatory agencies, power plant air emissions are no longer the main issue of concern for power sector environmental performance. While this is a positive trend, California's power generation system can severely affect many other parts of the natural environment. Power generation in California causes ongoing, often poorly understood impacts to aquatic ecosystems, to hawks and eagles related to wind turbines, and fresh water supplies used for power plant cooling.

A key current challenge is to reduce ongoing impacts to aquatic ecosystems in our oceans, estuaries, rivers, and streams. The continuing use of once-through cooling systems from 21 coastal power plants is creating significant, widespread impacts to near shore marine ecosystems. California's 14,000 MW hydropower system also continues to impact rivers and streams throughout the Sierra Nevada and Cascade mountain ranges, many of which are so degraded that they can no longer support wild, sustainable populations of salmon, steelhead trout, native trout, and amphibians.

As reported in previous *Environmental Performance Reports* and in a major 2004 Public Interest Energy Research program paper, California's wind energy farms are killing thousands of hawks, eagles and other birds each year. Thousands more are killed through collision or electrocution with electric power lines.

Air Emissions and Air Quality

Air emissions from California's thermally-fired power generation fleet are highly controlled and comprise very small elements of the air emissions inventory for most California air basins. Implementation of the NOx emissions control retrofit rules for utility boilers over the last decade has resulted in 80 to 90 percent reductions in NOx emission rates per megawatt hour from these facilities. At the statewide level, generation-related NOx emissions for 2004 comprised one percent of all NOx emissions. From 2001 to 2003, NOx emission rates continued to improve, further decreasing from 0.5 pounds per MWh to less than 0.4 pounds per MWh. At the regional level, relative contributions of power sector emissions between the state's major air basins with air quality problems vary slightly. NOx emissions rates for the South Coast Air Quality Management District held steady for the 2001 to 2003 period, ranging between 0.45 pounds per MWh to about 0.65 pounds per MWh. In the Bay Area Air Quality Management District, the NOx emissions rate declined from nearly 0.7 pounds per MWh to about 0.3 pounds per MWh, due to the continued implementation of the NOx retrofit rule (BAAQMD Rule 9-11) and deployment of new combined-cycle combustion turbine power plants.

The *2005 Environmental Performance Report* identifies important differences in emissions rates between different generation technologies. Emissions from the 7,200 MW cogeneration fleet (natural gas and coal) and the 1,062 MW waste-to-energy fleet (biomass and landfill gas) are disproportionately large compared with their capacities. These two technologies produced 48,654 gigawatt-hours (GWh) of energy in 2003, but emitted more total air pollutant emissions than the 30,712 MW of natural gas-fired combined-cycles, simple cycle peakers, and retrofit steam boilers, which produced 55,534 GWh in the same year. New gas-fired combined-cycle combustion turbines (8,612 MW) and retrofitted steam boilers (19,100 MW) have very low emission rates and are the most environmentally efficient elements of the thermally-fired fleet, but they tend to be last in the queue for dispatch. Combustion turbines (3,000 MW) used to meet peak load are generally the resource of last resort and typically have higher emissions rates than combined-cycle and steam boiler units. However, their emission rates have improved as modern peaking turbines are added to the resource mix.

California's relatively low-polluting power generation fleet also produces low risks to public health. Toxic air pollutant emissions from the normal operation of electric generation facilities are not major contributors to regional public health risk, and there are no significant localized cancer or noncancer risks associated with the normal operation of any individual electric generation facility. Mobile source

emissions, especially diesel particulate matter, dominate regional air quality and public health risks in most areas of the state.

Marine and Estuarine Environments Are Impacted by Once-Through Cooling

Twenty-one power plants totaling 23,883 MW rely on once-through cooling systems that use hundreds of millions of gallons of sea water each day. This water is habitat for marine life. The plants are located along the California coast or in sensitive bays or estuaries. Impacts to marine and estuarine ecosystems from the entrainment and impingement of aquatic organisms ripple through affected ecosystems and food webs. These ongoing impacts from the natural gas and nuclear power plants using once-through cooling are under-studied and generally under-appreciated by government agencies and the public.

In 2004, Governor Schwarzenegger established the Ocean Protection Council in order to implement the new California Ocean Protection Act and coordinate the work of state agencies related to the "protection and conservation of coastal waters and ocean ecosystems." This initiative follows from the findings of two major federal reports on the state of the nation's oceans and fisheries: the U.S. Commission on Ocean Policy and The Pew Oceans Commission. The common theme of the reports is that ocean ecosystems are imperiled, water quality is poor, and fisheries are collapsing. Also, at the federal level, the U.S. Environmental Protection Agency recently enacted a rule change for section 316(b) of the Clean Water Act, which regulates once-through cooling systems. New rules may require these systems to be substantially modified or replaced to reduce their effects on marine organisms.

Energy Commission staff has compiled and presented the results of multiple investigations and studies on different aspects of the once-through cooling issue in a major staff report, *Issues and Environmental Impacts Associated with Once-Through Cooling at California's Coastal Power Plants.* The report incorporates the impacts from once-through cooling into the broader concern about declines in marine ecosystems. Staff draws from recent experience with repowering proposals at five coastal power plants, where energy developers included modern technologies that meet current air emission standards, but relied on the continued use of 1950s-era cooling technologies that perpetuate impacts to aquatic ecosystems. A new Energy Commission report determines that more than two-thirds of the 21 power plants using once-through cooling have not conducted the studies needed to accurately determine their impacts. To increase scientific understanding of the scope and severity of once-through cooling impacts to the marine environment, the Energy Commission's Public Interest Energy Research program is helping to establish a research center through a $1.5 million grant to the Moss Landing Marine Laboratories.

Hydropower Operations Impact Inland Rivers and Streams

Development and operation of California's 14,000 MW hydroelectric system has created significant, on-going, under-mitigated impacts in rivers and streams. Many riverine ecosystems have been altered and degraded and can no longer support populations of wild salmon, steelhead, native trout, or amphibians. Fish passage for endangered migratory species like salmon and steelhead trout is generally lacking. As of 2005, only 29 of the 119 FERC-regulated hydropower projects meet, or will soon meet, current water quality standards as established by the State Water Resources Control Board through Section 401 Clean Water Act Certification or other methods. Thirty-seven percent – 5,000 MW – of California's hydroelectric system is expected to be relicensed by the Federal Energy Regulatory Commission between 2000 and 2015, presenting important opportunities to mitigate impacts and bring a large portion of the state's energy infrastructure into conformance with modern science and regulatory standards.

Energy Commission staff is working to support state agencies by providing analytic expertise on three projects that could result in decommissioning or re-operation; the Klamath relicensing effort, the Kilarc – Cow Creek decommissioning proposal, and the Battle Creek decommissioning proposal. The Public Interest Energy Research program is conducting a major study for the State Water Resources Control Board on the environmental effects of pulse flows, which result from the rapid changes in hydropower production in order to meet peak summer loads.

Impacts to Avian Species from Wind Turbines

Wind farms, and the transmission line system needed to link them to the grid, are projected to expand in coming years in order to help meet California's Renewable Portfolio Standard goals. Bird mortality from strikes with turbine blades continues to be the primary biological resource issue concerning wind energy. However, the severity of the avian mortality issues appears to vary among the state's five main wind resource areas. At the Altamont Pass Wind Resource Area in Alameda County, estimates of bird mortality range from 881 – 1,300 raptors and 1,766 – 4,721 total birds killed annually. Alameda County has instituted a moratorium on wind energy development at Altamont at the existing level of 580 MW until the avian collision issue is resolved.

Studies from the Solano County Wind Resource Area indicate that raptor species such as red-tailed hawks and kestrels are even more prevalent than at Altamont Pass, which is resulting in higher levels of mortality for some raptors and bats. Developing wind energy resources in Solano County without addressing bird, raptor, and bat mortality could create problems with slow permitting, unacceptably high mortality rates for avian species, and negative publicity for the wind energy industry at a second major wind resource area. In order to reduce avian collisions and mortality in Solano County, mitigation measures need to be developed and implemented that are based on thorough field research that determines the extent and causes of mortality.

Avian collisions with wind turbines in the Tehachapi Pass, San Gorgonio Pass, and Pacheco Pass wind resource areas have not been studied as thoroughly as Altamont and Solano. The studies that have been completed report lower bird use and fatality rates in these wind areas. Studies using more current research protocols could confirm that birds and bats are not as heavily impacted in these areas, which would allow for more wind development and lower rates of avain mortality than at Altamont Pass.

New research funded by the Energy Commission's Public Interest Energy Research Program seeks to determine what mitigation measures can effectively reduce bird kills at the Altamont Pass to a level that allows for expansion and repowering. A few turbine owners have agreed to implement new measures to reduce the number of bird collisions, and some high-risk turbines will be removed or shut down during the winter season when bird collisions are highest.

Several agencies and an industry consortium have prepared guidance documents that describe best practices for reducing avian collisions and mortality, but the guidance is not widely used or uniformly adopted. Fragmented jurisdiction between local, state, and federal agencies and non-coordinated regulatory programs contribute to an inefficient regulatory approach. Most species of birds and raptors are protected under the Migratory Treaty Bird Act and the Bald Eagle Protection Act, but neither statute is being used effectively to reduce fatalities of hawks and eagles.

Additional Findings from the 2005 Environmental Performance Report

Biological Resources

- **Habitat Loss Impacts:** The 23 operational natural gas-fired power plants licensed by the Energy Commission between 1996 and 2003 caused the permanent loss of 1,039 acres; 86 percent of the impacted acreage was natural habitat (898 acres) while 14 percent of the total (144 acres) was on existing industrial and agricultural land. Impacts to sensitive ecosystems were mitigated through permanent conservation of 2,229 acres of habitat.
- **Nitrogen Deposition Impacts:** Nitrogen deposition impacts from new power plants are emerging as a new concern due to the potential cumulative effects on endangered species habitats when power plants are near nitrogen sensitive habitats, such as serpentine soils and desert plant communities, that contain protected species and their habitat.

Water Resources

- **Increasing Demands for Fresh Water**: Competition for the state's limited fresh water supplies is increasing as a result of rapid population growth and economic development; in some years contractual obligations to supply water cannot be

met. Competition for limited water supplies is greatest in Southern California where water historically used for agriculture is being displaced for municipal purposes.

- **Power Plants Are Using Fresh Water More Efficiently**: Power plants developed since 1996 are using fresh water more efficiently due to increasing uses of recycled water for cooling, more efficient cooling technologies, and zero-liquid discharge systems. Between 1996 and 2004, 22 percent of the new electric capacity brought on-line used recycled water for cooling, while 52 percent of the electric capacity currently under construction, permitted, or in licensing review will use recycled water. In response to concerns about the use of fresh water for power plant cooling, the Energy Commission adopted a Water Policy in the *2003 Integrated Energy Policy Report* that requires power plant developers to use alternative water supply sources and alternative cooling technologies unless they prove to be environmentally undesirable or economically unsound.
- **Alternative Cooling Technologies Are Increasingly Viable:** Water conservation through use of more efficient dry and hybrid cooling systems is gradually increasing in regions with limited water supplies. Two projects using dry or air-cooling became operational between 1996 and 2002, and a third project is under construction. Water spray enhancement of air-cooled condensers is an emerging technology that is low-cost and improves cooling efficiency while using only 10 to 15 percent of the water required for wet cooling.
- **Waste Water Discharges Are Decreasing:** Water quality impacts from wastewater discharge to surface water bodies, groundwater, and land are being reduced or eliminated altogether through use of zero liquid discharge systems. The use of zero liquid discharge has increased from 35 percent of the 7,554 MW of new capacity brought online between 1996 and 2004 to 46 percent of the projects currently under licensing review at the Energy Commission or under construction. The 2003 Water Policy also requires power plant developers to use zero liquid discharge systems unless they prove to be environmentally undesirable or economically unsound.

Societal Effects

Land Use Compatibility

- **Regional and State-Level Energy Infrastructure Is Often Not Incorporated into Local Land Use Planning:** Local land use planning is mainly focused on addressing the needs and development of local government and is limited in addressing regional and state energy generation and transmission needs. Local agencies rarely identify potential sites for power generation facilities and transmission lines in the context of their respective general plans.
- **Brownfield Sites Can Be Good Locations for New Power Plants:** Brownfield sites often have available infrastructure (e.g., natural gas and water supply pipelines, electrical transmission facilities, roads), are frequently designated in

local government land use plans for industrial development, and may be excellent opportunities for new power plants.

- **Urban Sites for New Power Plants Can Create Community Concerns**: In urban areas, development of new energy infrastructure and upgrades to existing facilities often occur close to residential areas, schools, and recreation areas, which can lead to intense controversy and delay the licensing process.
- **Repowering Coastal Power Plants Can Cause Community Concerns:** Modernization and expansion of existing coastal power plants have often been controversial because the coast is viewed as a visual, recreational, and ecological resource.

Environmental Justice

- **Changing Demographics**: As of Census 2000, minorities (ethnic groups other than non-Hispanic white) comprise the majority of the population in the state, so environmental justice be a will likely consideration in most future power plant siting cases. Power plants proposed in densely-populated urban areas are often sited where residential land uses encroach on older industrial areas.

Cultural Resources and Tribal Issues

- **Increasing Recognition of Native American Interests**: Native Americans are becoming more involved in project planning and cultural resources management. A new state law, SB 18, requires local government to consult with tribes as general plans are developed. The Federal Energy Regulatory Commission has enacted a new tribal policy that provides for government-to-government consultation during hydro relicensing.

Out-of-State Power

Energy Commission staff presents an initial assessment of the environmental profile for power imported to California. In an average year, California imports about 31 percent of its electricity from out-of-state generating units. Nine percent comes from the "dedicated units" that are owned and controlled by California utilities. Coal, hydropower, natural gas, and nuclear plants located throughout the West supply portions of the state's electricity.

- **Coal Is an Important but Hidden Part of California's Electricity Supply:** California utilities own more than 6,200 MW of out-of-state power, and about 75 percent of this power (4,744 MW) comes from coal. From 2001 to 2003, total imports of coal-generated electricity from California-owned and other coal plants in the Western States averaged 80,000 gigawatt-hours (GWh) per year, or 31 percent of the electricity consumed in California.
- **Air Emissions for Imported Electricity Are Higher Than for In-State Generation:** Air pollutant emissions from imported out-of-state generation sources are on average considerably higher per megawatt hour (MWh) of generation than the average from in-state generation. The California power

generation fleet's average emission factor for NOx was 0.36 pounds per MWh between 2001 and 2003, while the NOx emission factor for the Western States averaged 1.4 pounds per MWh – nearly four times higher. Unlike California, the air pollutant emissions from power generation can be a significant fraction of certain pollutants (such as SO_2) emitted annually. Air pollutant emissions from certain coal-fired plants are contributors to significant Class 1 Area visibility problems; for example, emissions from the Mohave and Navajo power plants contribute to the Grand Canyon's significant visibility problems.

- **Coal Generation Is a Large and Growing Portion of the Western Resource Mix:** The primary fuel source for western North America is coal. Coal-fired capacity totals 31,857 MW in the Western States, 33 percent of all generation capacity (excluding California). About 90 percent of coal-fired plants use pulverized coal combustion (PCC) technology, which produces more air pollutant emissions than newer technologies and natural gas plants. While 2,760 MW of natural gas capacity were added between 1996 and 2003, coal appears to be the preferred resource for future development. Twenty-seven new coal facilities totaling just over 15,900 MW are planned in the Western States, 17 in the Southwest Region and 10 in the Northwest Region. Twenty-three of the new plants will use PCC, three will use Circulation Fluidized Bed Combustion technology and one plant is proposed to use Integrated Coal Gasification technology.
- **Hydropower Predominates in the Pacific Northwest:** Hydroelectric generation is a significant source of electrical power for the Pacific Northwest. While hydropower does not cause air pollution, large-scale hydropower generation affects the flow of rivers and alters riparian ecosystems. The construction and operation of hydroelectric dams directly impacts the diminishing fish populations of chinook, sockeye and coho salmon, and steelhead. More than 500 Federal Energy Regulatory Commission (FERC) licenses will expire in the next decade.
- **Water Use Is a Key Environmental Issue for Power Generation in the West:** Dedicated coal plants (those owned by California utilities) and natural gas plants use approximately 7,000 to 28,000 acre feet of water per year, most of which comes from fresh water sources. Use of water for power plant cooling has a significant impact on water use in the Southwest. The five-year drought has caused some projects to be denied because of their dependence on local water sources and has caused existing facilities to change their operations to ensure an adequate supply of water. With the demand to build additional facilities in response to the energy shortage of 2000-2001 and the fact that coal-fired plants are a dominant source of electrical power in the Southwest, the stress on water resources is expected to worsen.
- **Renewables Development Is Affecting the Resource Mix:** The development and use of renewable energy sources (wind, biomass, and geothermal) for power generation may affect the amount of imported power generation and the generation mix. In Los Angeles, an area that depends on imported energy, the city has committed to expand its use of renewable energy from 3 percent to 20

percent by 2017. In addition, the Los Angeles Department of Water and Power (LADWP) has withdrawn its involvement with the proposed expansion of the intermountain coal power plant to increase its use of renewable energy sources.

Emerging Themes and Trends

Energy Commission staff is tracking several emerging trends and present themes that may be useful in interpreting a rapidly evolving electricity generation system that creates different types of energy-related impacts than society generally expects.

Renewable Energy

Renewables are important additions to California's power generation system and offer the promise of lower-impact electricity production, but environmental issues remain. As demonstrated in the *2005 Environmental Performance Report*, cogeneration and biomass technologies, both of which are classified as renewables, emit higher levels of criteria pollutants and carbon dioxide per megawatt-hour (MWh) than natural gas-fired combined-cycle and steam boiler units, which are normally considered to be less desirable from an environmental perspective. Wind energy offers tremendous promise as a non-polluting, commercially viable alternative energy resource. Yet impacts to raptors like hawks and eagles continue at potentially significant levels, and affect expansion of the Altamont Wind Resource Area. Hydropower is often touted as a major, low-cost energy resource that does not contribute to air pollution or greenhouse gas emissions. However, as demonstrated in work of Energy Commission staff and other state and federal agencies, hydropower has degraded the aquatic habitats for native fishes throughout California and the Pacific Northwest. Policy-makers in energy and natural resources need to consider this emerging information about renewables and work collaboratively to develop and implement strategies that better balance environmental and energy goals.

Old Infrastructure Can Be Expensive to Bring into Conformance with Modern Environmental Standards

Many parts of California's energy infrastructure are old; older units at coastal power plants were built in the 1950s and 1960s, and much of the hydropower system was developed in the early 1900s. Regulatory systems have been slow to keep pace with emerging scientific understandings of the impacts of this older infrastructure on the natural environment, and owners of these facilities are understandably reluctant to make the substantial investments needed to bring them into conformance with modern environmental law and environmental performance standards. While society requires that expensive state-of-the-art air pollution control systems – such as selective catalytic reduction – be installed retroactively on all major power plants, there is no such consensus on the need to retrofit and modernize older power plants that are impacting aquatic environments.

Disputes over the need to modernize old infrastructure are playing out before the Energy Commission, as evidenced by 5 repowering applications for coastal power

plants that did not include modernization of once through cooling systems, and before the Federal Energy Regulatory System as thousands of megawatts of hydropower are relicensed for the first time in decades. In some instances, it may make more sense to retire a facility than retrofit it. In fact, several California hydropower projects with low power production levels that are also significantly impacting salmon habitat will be fully or partially decommissioned. For coastal power plants, what made sense 50 years ago may no longer make sense in light of the increasingly troubled nature of the state's coastal marine resources. The coast is a critical resource for the state's inhabitants, two-thirds of whom live in the general coastal zone. Coastal waters are increasingly imperiled by point and nonpoint source discharges, coastal development, over-fishing, and now once-through cooling. While it makes economic sense for power plant owners to re-use old infrastructure as much as possible, it may not be a clear-cut decision when all the externalities and shifting public values are considered.

More Research Is Needed for Rapidly Growing Parts of Our Energy Infrastructure

Two parts of our energy infrastructure will grow rapidly in the coming decades. Wind power and other renewables will expand rapidly as concern over climate change continues, and transmission lines will be expanded in order to relieve congestion, share power resources between regions, and improve local and regional reliability. The impacts and research needs for renewables have already been discussed in this *Executive Summary*. The potential impacts of electric transmission lines deserves further research and public discussion. As described in this *2005 Environmental Performance Report*, electric transmission lines can fragment wildlife habitats, cause wildfires, disrupt fragile desert ecosystems, cause high levels of avian mortality, and interfere with agricultural operations. Few people find them to be aesthetically appealing, yet most understand the need for new transmission. As existing lines are reconductored and new corridors are established, planners and regulators will need more information as to the environmental and social impacts of this portion of the energy infrastructure.

Understanding the Environmental Costs and Benefits of Out-of-State Power

In an average year, California imports 31 percent of its energy from the Western States, Western Canada, and the Northern Baja California Peninsula of Mexico. Major fuel types include coal, hydropower, and nuclear. Coal, natural gas and wind facilities are projected to expand in order to help serve California's growing demand for electricity, and major new transmission lines are being proposed to access these new resources. To accommodate market and regulatory changes spurred by deregulation and concerns for improved reliability, the western grid is increasingly managed as a large integrated entity. The procurement proceedings underway at the California Public Utilities Commission are laying the groundwork for future power purchases and power plant development by the investor-owned utilities, which include out-of-state purchases. Concerns about global climate change gases are also changing the way energy and environmental policy makers think about power imports. While the environmental performance of California's in-state resource is

generally good and improving, most Californians are unaware of the environmental performance of its power imports.

Two points of view prevail in assessing the environmental costs and benefits of imported power. For many, power imports are a logical and economically efficient way to share energy resources throughout the Western U.S. Regions which are rich in hydropower or coal resources can offer energy surpluses to help meet California's growing electricity demand. These regions also have good air quality, water resources, and healthy ecosystems and can therefore more easily develop energy resources without significantly degrading environmental quality. For example, much of the Western U.S. does not suffer from the same air quality and attainment problems that characterize California's air quality.

The other point of view is that Californians are exporting their energy-related pollution by importing out-of-state power and that it is inconsistent to require in-state generators to meet strict environmental standards while generators in other states do not have to meet the same environmental standards. Concerns over California-induced production of carbon dioxide and other climate change gasses from coal-fired power plants are a key element in the current debate. California's electricity generation accounts for 10 percent of total in-state greenhouse gas emissions. When out-of-state power is factored in, the relative contribution from electricity generation jumps to 20 percent. The potential for expanded coal plant development in the West over the next decades may become the flash point for this public debate about out-of-state power imports, unless clean coal technologies are successfully introduced.

Understanding and Adapting to the Effects of Climate Change

Global climate change will have significant effects on California's natural environment. The Energy Commission's Public Interest Energy Research Program is sponsoring important research on these effects through contracts with the University of California at Berkeley, Lawrence Berkeley National Laboratory, and other California research institutions. Energy Commission staff has conducted an initial assessment on climate change effects on hydropower production, which is presented in the Water – Energy series of papers.

Habitat impacts from new energy development are often mitigated through purchases of permanently preserved acreages in habitat conservation banks that have fixed boundaries. Climate change will shift vegetation cover, which will, in turn, shift populations of endangered plants and animals as they seek to adapt. The danger with conserving small islands of habitat surrounded by development is that there may not be natural areas to which plants and animals can shift and adapt. Assessment and research are needed to ensure that what is supposed to be mitigation in perpetuity remains as such.

Much of the current climate change research in California focuses on changes in hydrology and corollary changes to water supplies. Little if any research is being

done on the ecological effects of climate change on the same rivers and streams that supply water and hydroelectricity for human uses. Competing demands on rivers and streams are already acute, and aquatic habitats generally suffer. The potential for stress to aquatic ecosystems increases as hydrology changes and the competition for water supplies intensify. Research is needed on the impacts of global climate change to imperiled aquatic ecosystems.

Policy Options for Consideration by the Integrated Energy Policy Report Committee

Once-Through Cooling

Staff suggests that the Energy Commission consider doing the following:

California Ocean Protection Council

The Energy Commission has an opportunity through the new California Ocean Protection Council (Council) to coordinate with other agencies, environmental organizations and the concerned public to address once-through cooling issues. Ocean protection and restoration is a major policy initiative for the Schwarzenegger administration. The Council is charged with implementing the California Ocean Protection Act of 2004 (SB 1319) and it would provide an appropriate forum for agencies and concerned environmental groups to develop state-wide policies to address the impacts of once-through cooling. Ocean protection and restoration is a major policy initiative for the Schwarzenegger Administration. The Energy Commission may want to consider working through the Ocean Protection Council in developing methods to educate responsible agencies, industry, and the public regarding the impacts of once-through cooling and to develop and support statewide policies to address the impacts of once-through cooling.

Develop A New Policy For Siting Cases

The Commission could develop a policy similar to the one adopted in 2003 for conservation of freshwater sources. The new Commission policy could state “The Energy Commission may approve once-through cooling by power plants it licenses, or for licenses it amends related to cooling system modifications, only where alternative water supply sources or alternative cooling technologies are shown to be both environmentally undesirable and economically unsound.” The Commission interprets “environmentally undesirable” to mean the same as having a significant adverse environmental impact,” and “economically unsound” to mean “economically or otherwise unfeasible.”

Create Incentives to Promote the Use of Alternative Cooling

Costs have kept project owners from readily utilizing alternatives to once-through cooling. The impetus created by requiring power plants to implement Phase II cooling water intake structure improvements by January 8, 2008, in accordance with Section 316(b) of the Clean Water Act, may not be adequate financial incentive by

itself to encourage replacement of once-through cooling with alternative cooling technologies. The Energy Commission could explore methods to create financial incentives that would encourage project owners to adopt alternatives to once-through cooling. Otherwise, older power plants will likely continue using once-through cooling and thus continue coastal species and ecosystem impacts indefinitely.

Update the Energy Commission Data Adequacy Regulations

The Energy Commission is in the process of updating the Biological Resources 12-month Data Adequacy Regulations to provide a much broader explanation of the types of studies and data that need to be provided as part of a complete application to the Energy Commission for a power plant project proposing to use or currently using once-through cooling. Updating these regulations would be consistent with the language found in the 2005 MOA between the Energy Commission and the Coastal Commission regarding the need for applicants to provide a discussion of the project's compliance with California Coastal Act section 31413(d) and the need for a current and site-specific analysis of entrainment impacts.

Require Current Impact Studies For Licensing Analyses

The Energy Commission may want to adopt a policy that requires filing of a current impacts study with an application for any power plant that proposes the use of once-through cooling. The Energy Commission may also want to consider developing a standardized impact analysis protocol for power plant siting cases. Staff has begun to develop a standardized impact analyses protocol as described in Appendix 3 of this paper. Without a valid assessment based on sound science, the Energy Commission cannot meet its obligations and address those impacts, determine their significance and what, if any, mitigation is necessary.

Obtain Current Impact Analyses For All California Coastal Power Plants

Current impact analyses are lacking for approximately two-thirds of California's coastal power plants. None of the nine power plants in the Santa Monica Bay region have current impact studies. The Energy Commission could work with other concerned agencies through the Ocean Protection Council to develop site-specific and cumulative-impact studies for all Santa Monica Bay power plants. As part of this study, the Energy Commission could help investigate and identify local alternative cooling water sources such as recycled water supplies from wastewater treatment facilities. The Energy Commission Public Interest Energy Research program could coordinate the impact studies under the current contract with Moss Landing Marine Laboratories to help generate sufficient information to complete a sound cumulative impacts analysis.

With Interested Stakeholders, Create Standardized Approaches To Regulations and Policies

With the other responsible agencies, the Energy Commission could update the current Memoranda-of-Understanding/Agreement with the State Water Quality

Control Board, Regional Water Quality Control Boards, and the California Coastal Commission to develop a consistent regulatory approach to once-through cooling power plants and Best Available Retrofit Technology to help minimize impacts. This would create a clear, standardized approach to administering the regulations and policies that relate to once-through cooling. Other state and federal agencies may want to participate in the Memoranda-of-Understanding.

Avian Issues

Resolving barriers to wind energy expansion is critical to meeting California's renewable energy goals. California sees wind energy as a primary source for meeting its aggressive Renewable Portfolio Standard (RPS) and Energy Action Plan goals, yet avian collisions with wind turbines have become a serious constraint to repowering and expansion. Further, most bird species being killed are protected under state and federal laws and are thus of concern to the public at large as well as environmental and wildlife law enforcement officials.

The Energy Commission Could Promote Development of New Wind Resources Only In those Areas That Have Low Risks to Birds

As wind energy production expands the rotor swept area of turbine blades increases and more birds will be at risk of collision. To lower risks to birds, the developer should conduct protocol level bird use surveys prior to development. Expansion or repower projects should be required to incorporate mitigation measures and monitoring, and to report the results so fatality rates and mitigation efficacy can be assessed. Using that information, they can then site turbines to avoid areas of high avian use. Additional wind development to meet the RPS goals is feasible while at the same time limiting the avian impacts.

The Energy Commission Could Support Statewide Guidelines Requiring the Wind Industry to Mitigate Their Impacts on Birds

The wind siting and mitigation guidelines produced by the National Wind Coordinating Committee and the U.S. Fish and Wildlife Service to date are voluntary and the level of implementation by industry and local agencies vary. Statewide guidelines for wind energy projects may be an appropriate way to gain consistency statewide when developing and mitigating projects. Statewide standards could also remove a significant environmental barrier to increasing wind energy in the state.

In the Altamont Pass Wind Resource Area, the Energy Commission Could Encourage Industry to Apply Mitigation Measures to Existing Projects, New Projects and Repowering Projects to Reduce Bird Deaths

Over the last 20 years, researchers have documented the levels of bird use and mortality in the Altamont Pass. PIER-EA funded studies to develop a list of mitigation measures that could reduce bird kills (Smallwood and Thelander 2004, Smallwood and Neher 2004, Smallwood and Spiegel 2005). As the next step, industry needs to implement and monitor those mitigation measures Altamont-wide to determine their effectiveness. Two measures that would reduce bird kills by eliminating spinning turbine blades are seasonal shutdown (winter months) or removal of wind turbines in the highest-risk areas. While this would reduce bird kills, it would also result in a loss of generation (Smallwood and Spiegel 2005). Ultimately, implementing mitigation could allow industry to expand if Alameda County were able to lift its moratorium because of a reduction in bird kills.

In the Solano County Wind Resource Area, the Energy Commission Could Encourage Industry to Reduce Existing Impacts on Birds and Bats

Past research shows that bird use for several raptor species is higher in the Solano County Wind Resource Area than at the Altamont Pass. Recent post construction carcass surveys for the High Winds Project indicate a high rate of bird mortality. High bat fatalities are a newly identified issue in Solano County; the extent of which is uncertain. There is insufficient information on bird and bat fatality rates in the entire Solano County Wind Resource Area. Research aimed at identifying the extent of the problem, and developing mitigation measures for implementation would allow for continued use of the wind resources in Solano County while minimizing the potential for another wind resource area in California with high impacts.

The Energy Commission Could Support Further Research Using More Current Protocols in the Tehachapi, San Gorgonio and Pacheco Pass Areas

Collisions with wind turbines have been studied less in these areas than at the Altamont Pass and Solano County wind resource areas. The studies that have been completed report lower bird use and fatality rates in these wind areas. Based on research results it may be appropriate for the Energy Commission to encourage repowering and expansion in these areas.

To Determine Statewide Impacts on Bats, the Energy Commission Could Support Surveys on Bat Use, Behavior and Carcasses at All California Wind Farms

The information could be used to determine statewide impacts to bats and design mitigation measures to reduce bat collisions with turbine blades.

Electrocutions and Collisions with Electrical Power Line Infrastructure Can Be Adequately Measured Using More Intensive Survey Methodologies

For years, utilities, researchers and the resource agencies have documented that electrical power line infrastructure has caused avian collisions and electrocutions but there has been a lack of standardizing the collection and reporting of data. Several studies have tried to estimate the number of bird deaths from interactions with utility structures, however, without further research they cannot be accurately quantified. Recent research suggests that up to 85 percent of collisions and electrocutions may go undetected by the utilities (Dwyer 2004).

Statewide Guidelines for Electrical Power Poles May Be an Appropriate Way to Gain Statewide Consistency

Raptor friendly power lines are only constructed in certain places and voluntarily by some utilities. Statewide construction standards that include raptor-proofing distribution pole equipment and transmission line conductors would ensure the greatest reduction in electrocutions and collisions.

The Energy Commission Could Support Long-Term Monitoring Studies

The Energy Commission could support long-term monitoring studies to understand the long-term impacts of electrocutions and collisions, the scope of the impacts and how the implementation of mitigation measures reduces bird kills. The PIER-EA program efforts to collaborate with industry, researchers, and other stakeholders to gather and share research information and continue to resolve impacts should continue to be supported.

Water

Create Water Use Guidelines for Smaller Power Plants: To help broaden opportunities for conserving the state's fresh water supplies, the Energy Commission could develop and provide power plant siting review guidelines to local agencies for the permitting of power plants less than 50 MW. The guidelines would establish a more consistent practice for conserving local water supplies and help local government officials understand power plant water conservation technologies.

Identify Alternative Water Supplies for All Power Plants: Evaluation of water conservation opportunities of existing power plants currently relying on fresh water would offer the plant owners and local water districts a basis to consider opportunities to use recycled water and water-conserving cooling methods.

More Research Can Increase Commercial Viability of Air Cooling: Continuing research and development of water spray enhancement for air-cooled condensers to improve water spray distribution and recovery will lead to more rapid commercial application to accomplish improved steam turbine-generator performance in air cooling applications.

Hydropower

Continue Investigating Environmental Damage from Hydropower: Energy Commission staff should continue ongoing efforts to expand the level of understanding of environmental damage from hydropower to allow for a broader understanding of the energy environment balance for this important energy resource. Additional assessments and PIER-sponsored research are needed.

Continue Supporting State Agencies Working on Hydropower Issues and FERC Relicensing: Energy Commission staff should continue providing technical support on energy and energy cost issues to state environmental and resource agencies with regulatory authority on water and fisheries issues as they participate in Federal Energy Regulatory Commission relicensings, or as they evaluate potential decommissioning of low power high impact projects.

Ensure Sufficient Staff Resources to Address the Relicensing Boom: The current boom in relicensing hydropower facilities offers a once-in-a-generation opportunity to bring these critical parts of the state's energy infrastructure into conformance with modern science and regulatory standards. Hydropower relicensing requires large amounts of staff time and data. The Energy Commission could encourage the state to provide sufficient staffing and funding levels for environmental and resource agencies to successfully participate in relicensing proceedings.

Environmental Data Collection

Rulemaking on Environmental Data Requests

By conducting a rulemaking to clarify and codify the procedures for collecting environmental data from California's power plant owners and operators, the Energy Commission could improve the response rate and quality of data provided to Energy Commission staff.

CHAPTER 1: INTRODUCTION

This report assesses the environmental performance and related impacts of California's electric generation facilities, and updates the status and trends that were initially reported in the *2001* and *2003 Environmental Performance Reports*. Public Resources Code section 25503(b) requires the Energy Commission, as part of the Integrated Energy Policy Report, to report to the Governor and the Legislature on the current status of the following:

- the environmental performance of California's electric generating facilities, including generation efficiency and air pollution control technologies;
- the extent to which recent resource additions have, and expected resource additions are expected to, reduce the operation of existing electric generation facilities, and the resulting environmental consequences; and
- the geographic distribution of environmental impacts from electric generating facilities, including impacts to air quality, water resources and wildlife habitat, and the geographic distribution of related socioeconomic benefits and drawbacks.

The *2005 Environmental Performance Report* provides an analytical basis for policy discussions and options that may be incorporated into the *Integrated Energy Policy Report*. Its findings will be presented at a series of public workshops on June 27 and 28, 2005. Interested parties are encouraged to review this staff report and to provide comments relating both to the report's content and to possible policy options that may follow from the environmental status and trends discussed in the report.

California's electricity is supplied by a wide range of generating facilities located throughout the state, the western United States, and in Western Canada and the Northern Baja California Peninsula of Mexico. The *2001 Environmental Performance Report* provided an initial evaluation of the environmental performance of the state's electric generating system from World War II to the year 2000. Environmental performance improved substantially during that time period, primarily due to switching from oil to natural gas, improvements in combustion technologies, and implementation of pollution controls. The *2003 Environmental Performance Report* focused on the performance of the system between 1996 and 2002, during which time the changes from deregulation of the state's energy markets were enacted. The *2003 Environmental Performance Report* improved the analytic methods and data sources from the first report, established a quantified 1996 environmental baseline, and identified lack of sufficient environmental data as a major hindrance for assessing changes in environmental performance. The *2003 Integrated Energy Policy Report* adopted two policy options from the staff report: a policy change on the use of fresh water for power plant cooling, and encouragement of ongoing Energy Commission staff support to state agencies working on hydropower relicensing.

This *2005 Environmental Performance Report* builds from the 2003 recommendations and substantially expands the range of topics analyzed by Energy Commission staff. Staff's goal is to focus more on policy level environmental issues that are of interest to policy makers and the public. As required by statute, staff continues to report on the status and trends of all the major environmental performance aspects of the state's large and diverse electricity supply system and its electric and natural gas transmission systems.

Environmental Data Collection

In response to staff's concerns about the lack of environmental data, and at the Commission's direction, Energy Commission staff developed and sent out requests for environmental data to the owners and operators of 691 utility and merchant-owned power plants. Under Commission Order, and pursuant to Title 20, California Code of Regulations, section 1203, all owners of generating facilities with a generating capacity of 1 MW or larger were requested to provide environmental data on five subject areas; ownership and location, air emissions factors, water use, hydropower operations and infrastructure, and socioeconomics. Data responses were received for 453 power plants totaling 53,441 MW. Energy Commission staff used these data for assessments in the air quality, water use and socio-economic sections. The hydropower data will be analyzed later in the year.

Environmental Performance

"Environmental performance" for energy systems consists of several factors:

- Thermal efficiency
- Environmental discharges
- Environmental quality effects
- Environmental efficiency

Thermal efficiency is the measure of the effectiveness of converting the heat content of various fuel sources to electrical energy. Environmental efficiency is the measure of units of environmental discharge and impact per unit of energy produced. Environmental emissions and discharges are the measure of tons of pollutants emitted to air, acres of habitat displaced, or gallons of water used. Discharges create varying levels of impact to environmental quality. A given power generation facility can cause varying levels of impact to an air basin, watershed or ecosystem.

Thermal efficiency, environmental efficiency and rates of environmental discharge result from changes in generation and pollution control technology, economics, changes in environmental regulation, and changes in scientific understandings of natural systems.

The 2005 Environmental Performance Report focuses on changes in thermal efficiency and emissions. The environmental quality effects from power generation

and transmission need to be assessed in the context of impacts from other sectors, such as vehicle use and land development. Understanding and documenting the contributions of California's power generation and transmission system to environmental quality trends for air, water and biological resources in specific geographic locations is a long-term goal for the Energy Commission. The data, analytic capacity and staff resources required for such an assessment are probably beyond the means of any singly agency.

Structure of the 2005 Environmental Performance Report

The report is divided into three main chapters and a series of staff reports. Following the Introduction, Chapter 2 provides an overview of the electricity system and its operation. Chapters 3 thru 5 provide an analysis of the environmental performance of the system relating to air quality, biological resources, and water resources. Chapters 4 thru 9 summarize the societal effects in terms of public health, land use, socioeconomic effects, environmental justice, and cultural resource and tribal issues. Staff policy options are presented as needed in the various chapters, and are compiled in the Executive Summary. Supporting technical information is provided in a series of appendices.

The staff reports are presented as stand-alone appendices as follows:

- A Preliminary Environmental Profile of California's Imported Electricity
- Issues and Environmental Impacts Associated With Once Through Cooling At California's Coastal Power Plants
- An Assessement of Avian Mortality From Collisions and Electrocutions

The Staff Report on climate change effects on hydropower production is available as part of the Water – Energy report series and workshop.

CHAPTER 2: OVERVIEW OF CALIFORNIA'S ELECTRIC SYSTEM

Summary of Findings

- **California's Resource Mix Is Diverse and Expanding**: California has a diverse mix of electricity generation technologies totaling approximately 61,000 megawatts (MW) of in-state nameplate capacity. A total of 12,611 MW in new nameplate capacity has been added to the system since 2001, including 225 MW of wind that has been added since 2003. California utilities own and control 6,200 MW of dedicated capacity that is located out of state, but is classified as residing within California control areas.
- **Imports Provide a Large Portion of California's Electricity:** Electricity imported from out of state provides about 22 percent of the energy needed to meet California's annual demand. Significant amounts of surplus generation capacity are available in the western states grid.
- **Peak Demand and Average Demand Are Significantly Different**: Peak demand in California occurs during the summer months and is driven largely by air-conditioning loads. There is significant variation between the average demand and the peak demand. Because of this variation, thousands of megawatts of in-state generating capacity sits idle for much of the year except when called upon to meet peak electricity demand periods.
- **Transmission Congestion Contributes to Potential Resource Constraints**: Congestion on the electricity grid, south of Path 15, may affect the ability to deliver electricity where it's needed this summer. This congestion results largely from lack of transmission upgrades. During peak demand periods on a very hot summer day, California may face resource constraints.
- **Viable Alternatives Are Available to Meet Peak Demand:** Alternatives to building additional capacity to meet peak electricity demand are available. Mechanisms that shift demand away from peak periods to times when more capacity is available are effective. These include time-of-use metering and rates, thermal energy storage systems, and media-driven appeals designed to educate consumers, such as the Flex Your Power program.
- **The Energy Action Plan Is Guiding Procurement:** The California Public Utilities Commission (CPUC) oversees the development of the Investor Owned Utility (IOU) electricity procurement process. As a partner in developing California's Energy Action Plan (EAP), the CPUC will follow the EAP's preferred loading order of resources in making procurement decisions for the IOUs: 1) deploy all cost effective energy efficiency measures; 2) promote renewable generation and distributed generation; 3) build new or re-power existing large centralized generating facilities; and 4) improve bulk transmission grid and distribution facility infrastructure. The IOUs are once

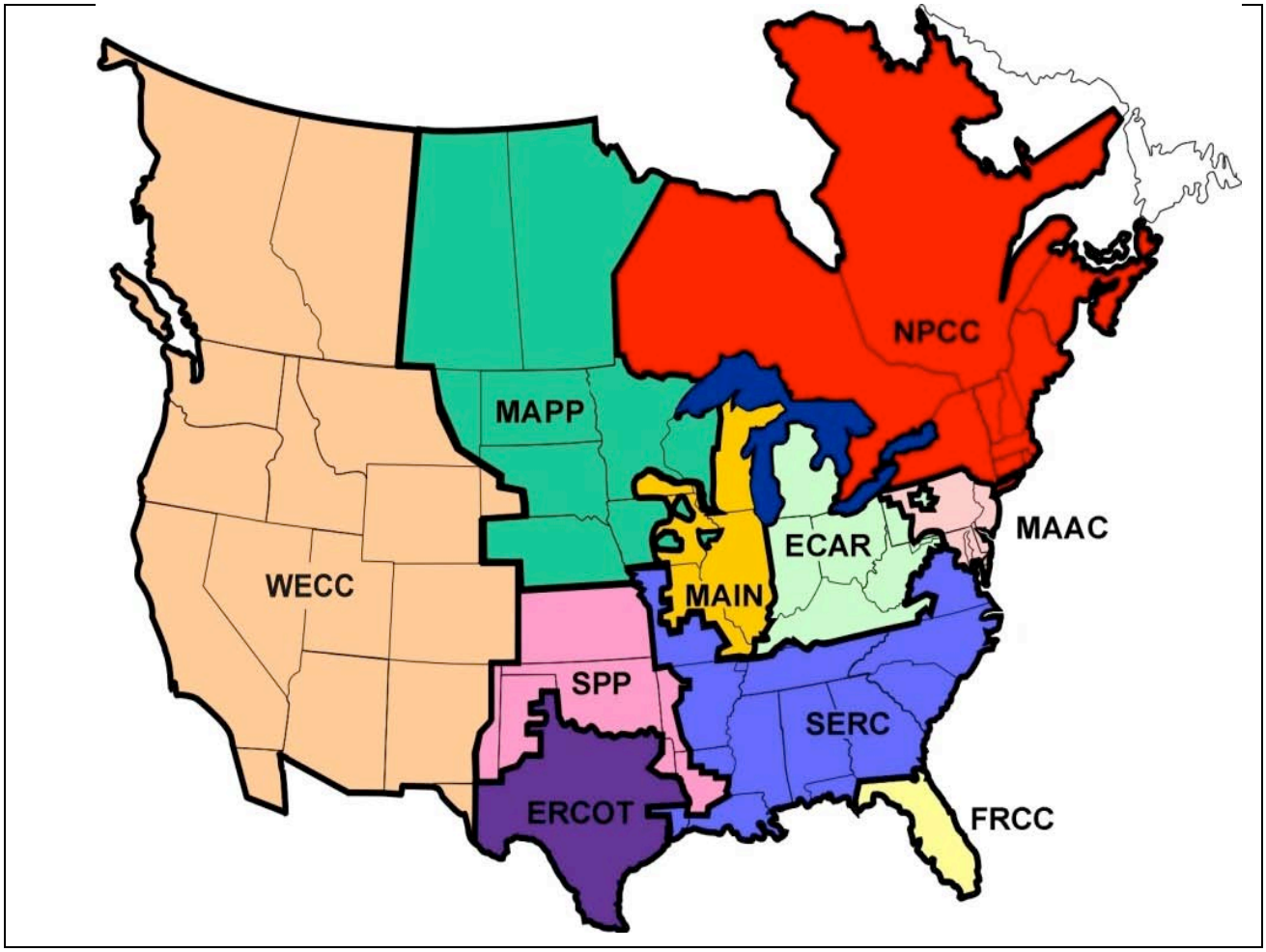
again signing contracts to procure capacity and energy. These contracts should ensure future reliability as capacity is built to meet contract terms.

Introduction

California's electricity system is organized as a unified grid of component parts: generators, transmission lines, distribution lines and control operators. The generation component includes various generation technology types from small scale rooftop photovoltaic systems designed to meet the needs of a household to large centralized generation stations that can serve the needs of cities. Power is moved around to where it is needed by a network of high- and medium- voltage transmission lines. At the distribution level, the voltage must be stepped-down so that it can be used by consumers. Control operators are responsible for system reliability. They schedule and dispatch generation when needed and always ensure that the quality of the power is maintained to prevent damage to electrical devices.

California's grid is interconnected with a larger grid that covers and serves eleven western states, parts of three other states, British Columbia and Alberta, and northern Baja California Norte. Being interconnected is mutually beneficial by allowing greater dispatch flexibility and enabling the sharing of surplus capacity. California's demand peaks during the summer while the Pacific Northwest experiences system peak demand during the winter months. Because the seasonal peaks do not coincide, each system need not build the full capacity to meet its demand but can share the excess capacity of the neighboring states. By sharing seasonal surpluses of generation capacity, the Pacific Northwest gets cheaper natural gas- and coal-fired electricity from the Pacific Southwest when it is needed during the winter, and likewise, inexpensive hydro electricity capacity from the Pacific Northwest in the summer is sent south to California via a system of transmission lines that interconnect control areas from British Columbia to Baja California. The system we have today has evolved from a group of small disparate power companies to a network that serves the electricity needs of millions. Figure II-1 depicts the sub-areas of the Western system as defined by the Western Electricity Coordinating Council (WECC).

Figure 2-1 Map Showing Western Electricity Coordinating Council

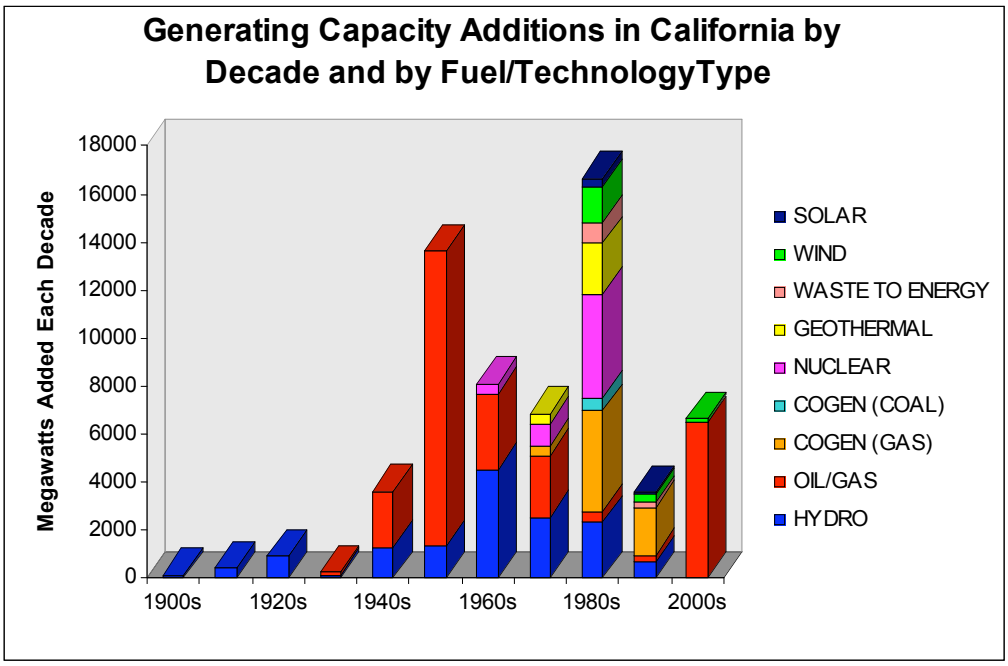


Brief History of California's Electrical System

California's electric system has been developed over the past century by investor-owned utilities (IOUs), publicly utilities (POUs), irrigation districts, and independent power producers. These electricity providers have built power plants, transmission lines, and owned distribution systems that cover the state, linking sources of electric energy to end users.

In the 1880s, private electricity companies and municipal utilities began building generation in California. Commercial scale generation was developed as an alternative to natural gas for street lights and lighting in homes and businesses. Hydro-electric and coal-fired steam turbines were the earliest generation technologies employed in California. Hydroelectric turbines, being less expensive than coal, became the predominant technology beginning at the turn of the century and peaking in the 1960s (see Figure II-2). Substantial hydroelectric pumped storage capacity was added from the late 1960s to the early 1980s. Today, most of the cost-effective sites for large hydropower projects in California have already been developed.

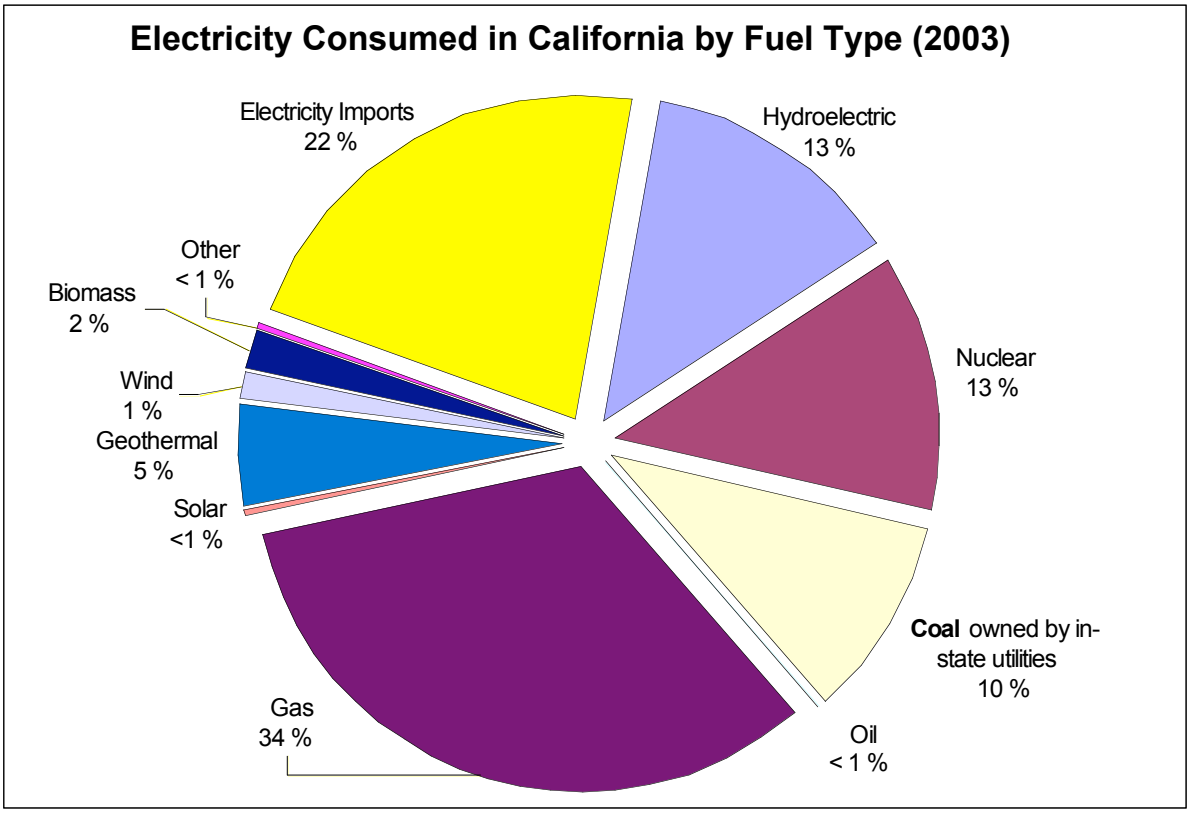
Figure 2-2: Generating Capacity Additions in California by Decade and by Fuel/Technology Type



Source: US Department of Energy, Energy Information Agency EIA 860 database (2003) with updates from the Energy Commission's Electricity Analysis Office.

Oil-fired power plant development began in the late 1930s and peaked in the 1950s. Since the 1970s, due to air quality concerns, fossil-fueled generation in California has shifted from oil to natural gas. Most new fossil-fueled plants built in California since the 1970s have used natural gas because, in addition to having lower air emissions, the performance attributes (economy, reliability and ease of dispatch), have made natural gas the dominant fuel. By 2003, approximately one third of the electricity generated in California was from natural gas generation. Figure II-3 shows the breakout of electricity consumed in California in 2003 by fuel type.

Figure 2-3: Electricity Consumed in California by Fuel Type in 2003

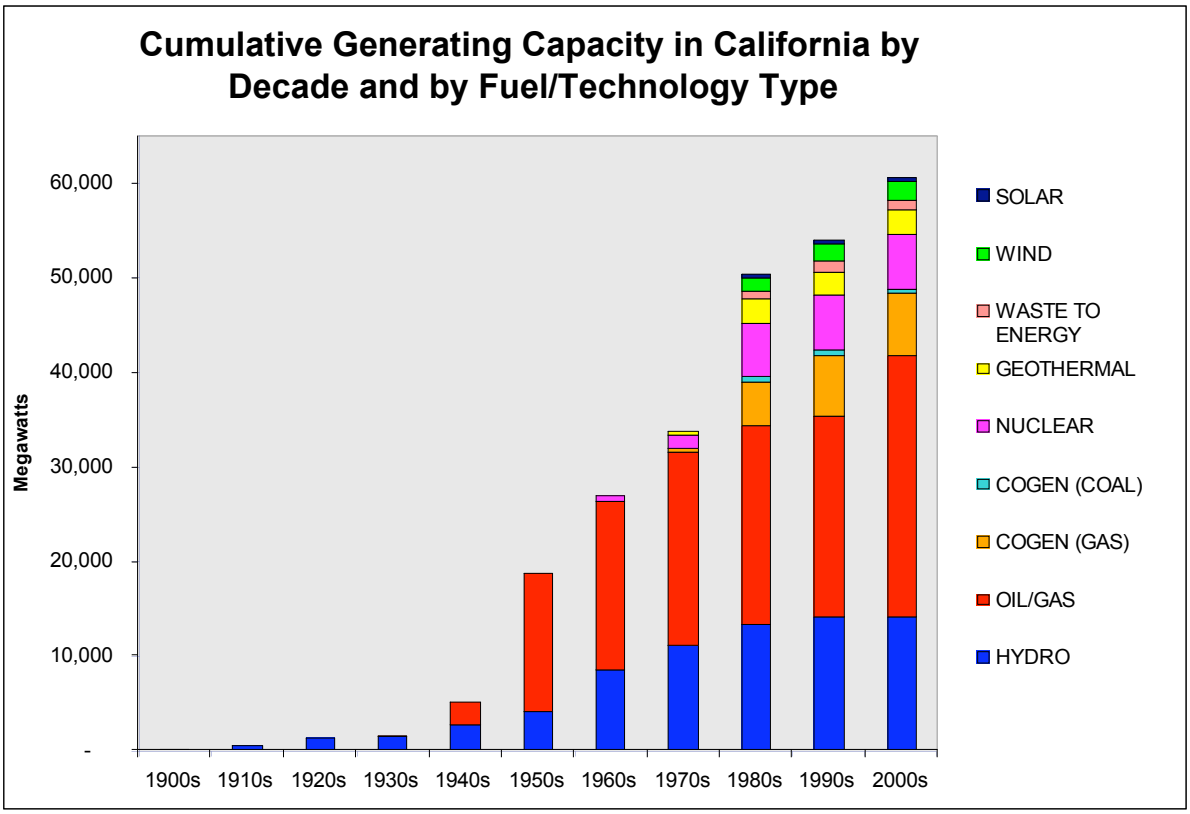


Source: California Energy Commission's 2004 QFER data, Table J-11

From the late 1960s to the mid 1980s, four nuclear power plants (Diablo Canyon, San Onofre, Humbolt and Rancho Seco) were added to California's utility system, though two (Humbolt and Rancho Seco) have since been retired.

The United States Congress passed the Public Utilities Regulatory Policies Act (PURPA) in 1978 to encourage fuel-technology diversity and reduce dependence on fossil fuels. One of the outcomes of this law was the creation of a class of generators known as qualifying facilities (QFs). QFs are independent power producers that utilize renewable technologies and/or co-generation to generate electricity. The California Public Utilities Commission (CPUC) required that major investor owned utilities, Pacific Gas and Electric, Southern California Edison, and San Diego Gas and Electric (respectively PG&E, SCE, SDG&E) sign contracts with QFs. Subsequently, during the 1980s and early 1990s, the majority of new generation built was the result of QF contracts with cogeneration systems fueled mostly by natural gas, and renewable resources such as small hydro, geothermal, wind, biomass/landfill gas, and solar energy. Figure II-4 shows the cumulative capacity for different types of power plants available at the end of each decade in California since the beginning of the 20th century.

Figure 2-4: Cumulative Generating Capacity in California by Decade and by Fuel/Technology Type (excludes retirements)



Source: US Department of Energy, Energy Information Agency EIA 860 database (2003) with updates from the Energy Commission's Electricity Analysis Office.

In 1996, the California Legislature passed another law, Assembly Bill 1890, statutes of 1996, which restructured California's electricity industry. It combined the three major IOU control areas into one California-wide control area. This legislation encouraged PG&E, SCE and SDG&E to sell off their fossil-fueled generation and required them to turn control of their transmission lines to the new control operator, the California Independent System Operator (CAISO). The CAISO, in addition to maintaining system reliability, was charged with providing dispatch of power plants using least cost criteria. AB 1890 also created the Power Exchange (PX), which was designed to act as a clearinghouse for spot market transactions. The IOUs were required to sell all of their generation into the PX and required to purchase all of their needed electricity in the day-ahead and hour-ahead markets. The day-ahead market would provide transparent price signals for the following day's transactions. A second, hour-ahead market provided an ability to correct for scheduling changes due to grid congestion and/or unscheduled outages that occurred in real time.

Restructuring Begins, Integrated Resource Planning Ends

From about 1995 to 1998 no significant new generating capacity was added and very little was even proposed due to three major factors: 1) uncertainty due to

industry restructuring resulting in changes in how new capacity was financed, and 2) a surplus capacity existed in the Western states, and 3) IOUs, no longer vertically integrated, stopped building generation and transmission. It was wrongly assumed that the PX would provide necessary price signals to spur timely investments in generation and transmission. As long as a healthy capacity surplus existed, the restructured market functioned reasonably well. By 1999, there were signs that the capacity surplus which had existed for a decade throughout the WECC was ending. The nation's economy continued to expand rapidly fueled by the success of the internet companies and the overall stock market.

From May 2000 until about March of 2001, California experienced an electricity market crisis which included rotating outages and soaring wholesale power prices. Five years after the market melt-down various explanations have been put forward to explain why Californians experienced astronomical price spikes and unscheduled outages during an off-peak season.

Market Design-Lessons Learned

After studies and analysis, a general consensus has emerged among academic and technical experts[1]. A rudimentary flaw was the requirement that all IOU capacity was required to be sold into the day-ahead and hour-ahead markets. Prohibiting the IOUs from engaging in long- and medium-term contracts eliminated opportunities to hedge against high prices due to real and manipulated supply swings, high gas prices, and reduced hydro imports. Wholesale prices were free to rise unabated while prices paid by consumers were capped by fixed retail rates.

Concerned that PG&E and SCE were headed into bankruptcy, state lawmakers responded with emergency legislation Assembly Bill 1X (AB1X), Statutes of 2001. This law addressed two major issues:

1) It enabled the State to purchase power on behalf of the big three IOUs (PG&E, SCE and SDG&E)
2) It prevented large industrial and other customers from fleeing these IOUs by restricting direct access.

AB1X succeeded in sparing SCE from bankruptcy but, not PG&E which filed on April 6, 2001.

The California Department of Water Resources (CDWR) immediately began signing contracts with generators which effectively locked up large blocks of capacity on the behalf of IOUs. Within months, spot market prices dropped to levels comparable to the prices that existed before electricity industry restructuring. The Legislature anticipated that these expensive CDWR contracts would force electric rates to rise and sought to prevent customers fleeing en masse from the IOUs. Accordingly, state lawmakers placed restrictions on consumers' ability to choose electricity suppliers (known as "energy service providers"). Existing direct access customers were

allowed to remain or switch to another energy service provider (ESP); however, no new direct access contracts have been allowed since 2001.

The limits on new direct access coupled with the Enron bankruptcy scandal and reports of widespread fraud and gaming of the electricity market took its toll on the entire electricity industry. As wholesale electricity prices fell, and credit ratings of major energy companies were repeatedly downgraded, investors quickly sold off energy stocks. Few energy trading companies emerged unscathed. By 2002, the only companies able to finance new capacity additions were those who signed contracts with CDWR or with Publicly Owned Utilities (POUs) that could self-finance construction costs.

Regulatory uncertainty, in the form of broken market mechanisms, the collapse of the PX , an obsolete and disappearing spot market, as well as reduced financing opportunities due to downgrades in utility credit conspired to dramatically slow the pace of proposals for new generation capacity. Electricity contracts signed by CDWR on behalf of the IOUs in 2001 along with capacity additions developed by POUs enabled 5,030 MW of capacity to be brought online during 2003. While statewide only 6 MW of capacity was completed in 2004; over 1,000 MW of capacity has been completed and is online in 2005. For a listing of plants that came online since 2001 see Table II-1 below.

Because wholesale prices fell, no new “merchant” capacity has been proposed. A merchant generator is one that must recoup all of its costs (capital costs, fixed and variable operations and maintenance costs, overhead, etc.) from the revenues it receives from sales of power. Unlike IOUs and POUs, there is no guarantee of cost recovery of prudent expenses unless the merchant generator can negotiate a contract that ensures full cost recovery. Most recent proposals for new capacity have come from POUs.

In 2004, proposed and existing legislative requirements on supply adequacy and fuel diversity such as the renewable portfolio standard (RPS) have begun to affect the types of new capacity being offered as the IOUs return to procuring their own resources. The RPS was created under legislative bill SB 1078, Statutes of 2002. It mandated that the state’s IOUs would generate or procure sufficient renewable generation such that 20 percent of the electricity sold to retail customers by 2017 would be from renewable technologies. State policy makers have since accelerated the target to 20 percent by 2010. If, and when, direct access is re-introduced, exit fees will be established by the CPUC to re-coup debts incurred on behalf of the departing load.

Publicly Owned Utilities: Municipals and Irrigation Districts

Publicly owned utilities (POUs) are not regulated by the CPUC. Instead, POUs are governed by a board of directors elected by the ratepayers living within the POU service territory. POUs were not directly affected by the restructuring of the industry

under legislative bill AB 1890. Nor were these utilities encumbered by the expensive long term contracts signed by CDWR on behalf of the IOUs.

POUs are able to self-finance generation and transmission projects because their board of directors have the ability to directly set the rates consumers pay for electricity. In the current generation market, the ability to finance new generation is a clear advantage. Since 2002, the majority of proposed generation projects going forward have been proposed by POUs or merchant generators who have signed contracts. As POUs are not-for-profit utilities and do not compete directly for customers, they can more easily form cooperative agreements with each other to finance transmission and generation projects.

POUs that were part of the former IOU control areas were placed under the CAISO's control. Those POUs that act as their own control area (e.g. SMUD, LADWP, IID) remain as autonomous vertically integrated utilities.

The CAISO Control Area

Prior to the industry restructuring, the CPUC recognized that it was in California's interest that the major IOUs (PG&E, SCE, and SDG&E) be operated for the good of the people. The CPUC granted each IOU the right to exclusively serve customers that resided in their respective service territories. The IOUs were "vertically integrated", meaning that each IOU generated (or procured) electricity sufficient to meet its demand and reserve requirements, self-provided distribution services, dispatched its own generation, and controlled power-quality parameters for its own control area.

Each of the large IOU service territories was separately designed as an independent control area. These control areas were linked and coordinated with the municipal control areas of LADWP and IID to allow sharing of resources in periods of high demand or in event of an emergency (e.g. power line or plant going offline). As part of the state's electricity industry restructuring, all three IOU control areas were combined. It is important to note that the CAISO electric grid as it exists now has been cobbled together in a piecemeal fashion with each of the large IOUs adding upgrades and improvements to the transmission, distribution and generation infrastructure. Control of the transmission systems of the big three IOUs was handed over to the CAISO to be able to fully regulate and dispatch the resources of the new CAISO control area.

Table 2-1: Power Plants Built in California Since 2001

Plant Name	Name Plate Capacity (MW)	Inservice Year
Additions		
Metcalf	600	2005
Haynes	575	2005
Pastoria Phase 1	250	2005
Pico Power	147	2005
Clearwater Cogen	31	2005
Fresno Cogen Expansion	25	2005
Miscellaneous	12	2005
2005 Additions	**1,640**	
Windridge Phase 2	40	2004
Windland	20	2004
Miscellaneous	1	2004
2004 Additions	**61**	
La Paloma Generating LLC	1,200	2003
High Desert Power Plant	849	2003
Elk Hills Power LLC	623	2003
Blythe Energy LLC	591	2003
AES Huntington Beach LLC	452	2003
Sunrise Power LLC	270	2003
Los Esteros Critical Energy Center	180	2003
Tracy Peaker	169	2003
High Winds LLC	162	2003
Woodland	98	2003
THUMS	57	2003
Agua Mansa Power Plant	48	2003
Creed Energy Center	47	2003
Feather River Energy Center	47	2003
Goose Haven Energy Center	47	2003
Lambie Energy Center	47	2003
Riverview Energy Center	47	2003
Wolfskill Energy Center	47	2003
Mountain View III	22	2003
Miscellaneous	26	2003
2003 Additions	**5,030**	

Plant Name	Name Plate Capacity (MW)	Inservice Year
Additions		
Moss Landing Power Plant	1,398	2002
Delta Energy Center	944	2002
Harbor	235	2002
Henrietta Peaker	98	2002
Lake	70	2002
Whitewater Hill Wind Partners	62	2002
Valero Refinery Cogeneration Unit 1	51	2002
CalPeak Power Vaca Dixon No 1	50	2002
CalPeak Power El Cajon No 6	49	2002
King City Peaking	47	2002
Yuba City Energy Center	47	2002
Valley	47	2002
Gilroy Peaking Energy Center	45	2002
Cabazon Wind Partners	41	2002
Springs Generating Station	40	2002
Ethan Taft	25	2002
Miscellaneous	29	2002
2002 Additions	**3,276**	
Los Medanos Energy Center	678	2001
Sutter Energy Center	636	2001
Sunrise Power LLC	335	2001
Indigo Energy Facility	150	2001
Larkspur Energy Facility	100	2001
Hanford Energy Park Peaker	92	2001
Gilroy Peaking Energy Center	90	2001
Mountain View	67	2001
CalPeak Power Border	50	2001
CalPeak Power Panoche No 2	50	2001
CalPeak Power Enterprise No 7	49	2001
Chula Vista I	49	2001
Escondido Power Plant	49	2001
Gates Peaker	47	2001
Century Generating Facility	45	2001
Drews Generating Facility	45	2001
Harbor Cogen	25	2001
Fresno Cogen Partners	22	2001
Miscellaneous	27	2001
2001 Additions (MW)	**2,604**	
TOTAL ADDITIONS	**12,611**	

Source: US Department of Energy, Energy Information Agency EIA 860 database (2003) with updates from the Energy Commission's Facility Siting Office.

Table II-1 shows the online dates of power plants built in California since 2001. While 22,066 MW of capacity has been certified and approved for construction by the Energy Commission, only 12,010 MW have actually been completed since 2001. A total of 225 MW in wind capacity has been added since 2003. In addition, needed transmission upgrades have lagged and congestion has increased in certain areas of the CAISO control area.

Aging Power Plants and Capacity Retirements

Capacity additions are only part of the story. As new capacity is added, other capacity may be retired or mothballed. Once a plant is retired, it is not expected to be brought back online. To mothball capacity means to shut down operations and physically prepare the plant to be put into long-term storage. In 2004, several plants were mothballed. However, some of the capacity that was recently mothballed has been brought back online due to concerns about resource adequacy. For a listing of plants that came were mothballed or retired since 2001 see Table II-2 below.

A major concern of policy makers is: how much capacity is at risk of retiring, and how much of that capacity at risk is being relied on directly or indirectly to meet the demand on the hottest days? To answer these questions, in 2004 the Energy Commission conducted a study called *Resource, Reliability and Environmental Concerns of Aging Power Plant Operations and Retirements*. This report revealed that while aging power plants may not be able to compete in the energy market due to poor fuel economy, they can, and do, serve important supply functions with regard to local reliability, ancillary services and peaking duties. There is no legal requirement that owners of aging power plants must formally forewarn the system operators before retiring generating capacity. If capacity is retired prematurely or without sufficient notice such that timely replacement capacity can be brought online, shortages could ensue. The CAISO has begun to investigate whether regulatory must-run (RMR) contracts, which are routinely employed by the CAISO to ensure local reliability and power quality, could or should be offered to aging power plants in key locations to manage congestion and/or to enhance system supply adequacy. Several of these plants have recently signed contracts with the IOUs or are considering doing so in the future.

Table 2-2: Retired and Mothballed Power Plants in California Since 2001

Plant Name	Name Plate Capacity (MW)	Inservice Year	Retirement Year
Retirements			
Long Beach Generation LLC	521	1976	2004
Haynes	328	1964	2004
2004 Retirements	**849**		
Pittsburg Power	680	1954	2003
Valley	346	1956	2003
Etiwanda Generating Station	246	1953	2003
Haynes	230	1965	2003
Etiwanda Generating Station	138	1969	2003
AES Alamitos LLC	133	1969	2003
Riverside Canal Power	100	1953	2003
Olive	62	1978	2003
Chula Vista I	49	2001	2003
Escondido Power Plant	49	2001	2003
Riverside Canal Power	40	1955	2003
Magnolia	23	1969	2003
Miscellaneous	26	Various	2003
2003 Retirements	**2,122**		

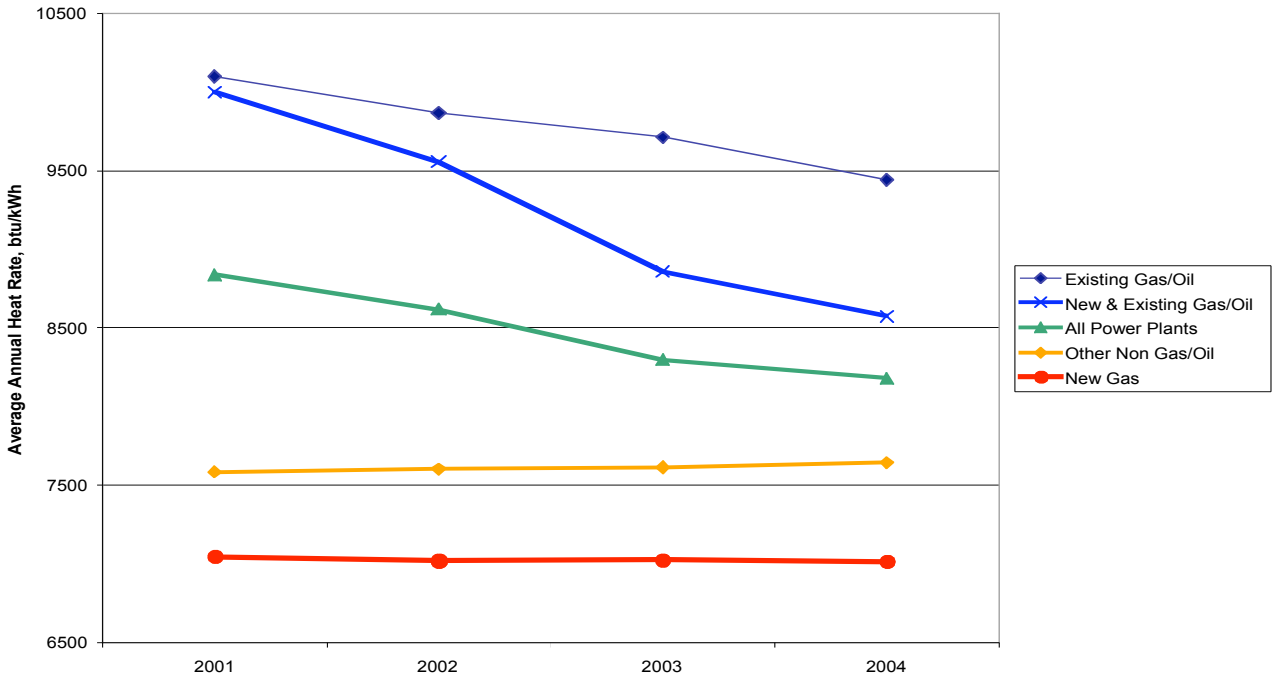
Plant Name	Name Plate Capacity (MW)	Inservice Year	Retirement Year
Retirements			
El Segundo Power	312	1956	2002
Mountainview Power LLC	131	1958	2002
Magnolia	55	1953	2002
Broadway	46	1957	2002
Broadway	46	1955	2002
North Island	37	1972	2002
Coidgen	33	1986	2002
Growgen	33	1986	2002
Grayson	31	1974	2002
Naval Station	26	1976	2002
Miscellaneous	58	Various	2002
2002 Retirements	**807**		
Patio Test Cell Solar Turbi	4	2000	2001
Patio Test Cell Solar Turbi	6	1995	2001
Humboldt Pulp Mill	28	1966	2001
2001 Retirements	**39**		
Mothballed Plants			
Morro Bay Power Plant	169	1956	
Morro Bay Power Plant	169	1955	
Total Mothballed	**338**		
Total Retirements	**3,817**		

Source: US Department of Energy, Energy Information Agency EIA 860 database (2003) with updates from the Energy Commission's Facility Siting Office.

Generation System Efficiency Has Improved

Over time, as technology has improved, and as newer more efficient capacity has been added, California's fossil generation fleet has become more fuel efficient. Efficiency of a thermal power plant is measured by 'heat rate', which is the amount of energy (in Btus or British thermal units) needed to generate one kilowatt hour of electricity. Figure II-5 shows relative efficiencies of power plant groupings supplying California and the West. The average heat rate for all power plants in 2002 was about 8,600 Btus per kilowatt-hour (Btu/kWh). This estimate includes all generating sources, even those that consume no fuel—solar, wind, geothermal, hydroelectric. The average heat rate for new and existing plants that burn natural gas was just under 9,600 Btu/kWh in 2002.

Figure 2-5: California Generating System Efficiency Trends



Source: California Energy Commission's Electricity Analysis Office.

For a given level of demand, overall system fuel efficiency can be improved by adding more generation resources that do not consume fuel, or by adding sources that consume fuel more efficiently, such as the natural gas-fired, combined-cycle power plants that have come on-line in recent years. These plants use jet engine-like gas turbines to generate electricity directly, and then re-capture the heat from the exhaust to power a steam turbine that generates additional electricity. As shown in Figure II-5, these combined-cycle power plants (labeled 'New Gas') have heat rates of about 7,000 Btu/kWh. The decline in average heat rate from 2001 to 2004 for all power plants shown in Figure II-5 reflects the addition of about 9,000 MW of new combined cycle plants, plus a few hundred megawatts of wind and geothermal resources.

Energy and Capacity

The distinction between energy and capacity is important to consider when evaluating the environmental performance of the electric generation system in California. In terms of electric system performance and operation, energy is discussed in terms of the generation or consumption of electricity, typically measured in kWh at the household and commercial levels, and in MWh for industrial scales. Capacity is the instantaneous capability of a generator or group of generators to meet a given level of demand. The ability of the system to meet the peak demand is known as the system peak and is typically measured in MW. The relation between these two concepts and measures is relatively simple – the energy

generated over a period of time can be calculated by multiplying the capacity level by a given period of time. For example, a power plant operating at its full capacity of 500 MW for one hour generates 500 MWh of energy; operated at that power level for 24 hours, it generates 12,000 MWh. This same 12,000 MWh could also be produced by the same plant working at half the capacity (250 MW) for twice the time period (48 hours).

California currently faces a potential capacity shortage this summer during peak demand periods in the southern part of the state, not an energy shortage as is often reported in the media. While it is technically feasible to build more combustion turbines to solve the peaking shortage, the demand for peaking power is fickle. Many factors, such as the amount of water stored in the hydroelectric system, the rate of economic growth, the range of summer temperatures, the rates of new capacity coming online and retirements of old capacity affect the prices paid for electricity during peak demand periods. If the peaker plant isn't able to recover all fixed and variable costs during the limited number of hours per year that it runs, the plant will eventually be shut down. Conversely, if combustion turbines are making lots of money in the spot market, it is likely that prices paid by consumers are higher than necessary. But there are other alternatives to building combustion turbine peaker plants.

From a societal perspective, a combustion turbine uses more fuel, emits more carbon dioxide and other air emissions per kWh than do technologies such as combined cycle or steam turbine. Instead of only building combustion turbines to meet the peak demand, state energy policy makers are encouraging the use of generation alternatives[2] such as demand side management, demand response programs, energy efficiency measures, and load-shifting (encouraging consumers to postpone energy use during peak demand periods).

In years where there is abundant precipitation stored in state reservoirs, hydroelectric generation is utilized more for peaking and load-following uses because it is cheaper to operate than natural gas. Likewise, during dry hydro years, the state relies on increased natural gas fired generation and increased imports (when available) from out of state. Resource planners refer to this fuel switching preference as "swing."

Duty Cycles and Generation Technology Types

Because electricity cannot be easily stored it must be generated as it is demanded. Therefore, system operators must dispatch more generation as demand rises and decrease generation as demand falls. Some generating resources are designed to ramp up and down with load, other units are designed to stay on continuously, some are intermittent (wind), and some resources only operate during peak demand periods. Some technologies, such as large hydro, can play more than one role (baseload, load-following and peaking). These roles are known as duty cycles:

- baseload duty cycle
- load-following or intermediate duty cycle
- intermittent duty cycle
- peaking duty cycle

Power plants that operate in baseload duty cycle run at peak capacity continuously for long periods until shut down for maintenance or refueling. Baseload plants do not have the ability to significantly increase or decrease output capacity and thus cannot follow the rising or falling load. Nuclear and coal-fired power plants are designed to run as baseload only. Other technologies such as geothermal, large hydro and cogeneration are flexible enough to allow plants to run in more than one duty cycle. Some hydroelectric facilities with continuous water flows operate as baseload plants but can serve as load following or peaking duty cycle.

Load-following or intermediate plants are designed to ramp up (or ramp down) output as demand increases (or decreases). In California, most of these plants are natural gas-fired or large hydro with flexible dispatch. Several coal-fired baseload plants, located outside of California, are owned by or under contract to California-based electric service providers (ESPs).

Intermittent power plants, such as wind, solar, and most small hydroelectric facilities, operate as much as they can whenever their energy supply is available.

Peaking plants are those facilities that can be called on to meet peak demand for a few hours at a time on short notice. Combustion turbines and some hydroelectric plants that can dispatch some or all their capacity when needed fit this category. Pumped storage plants are designed to generate electricity in peaking mode. Peakers are dispatched when the supply-demand balance is tight, generally when the level of demand reaches or nears its maximum. Combustion turbines are relatively inexpensive to build, but in general, have higher fuel costs and greater emissions per kWh that combined cycle or steam turbines.

Duty cycles largely determine how much utilization occurs. Baseload plants are designed to run continuously and typically have high utilization rates (capacity factors). The primary factor affecting the utilization of load following plants relates to fuel efficiency. The lower the heat rate, the less fuel is required to produce the same output. Steam turbines require a warm-up period before reaching their full capacity, so steam turbines tend not to shut down at night, but run at a lowered output level to reduce warm-up costs. Combustion turbines can turn on and produce maximum output very quickly making them ideal for peaking application. Because their relative fuel efficiency is worse than a steam turbine, peaking plants are used during fewer hours of the year.

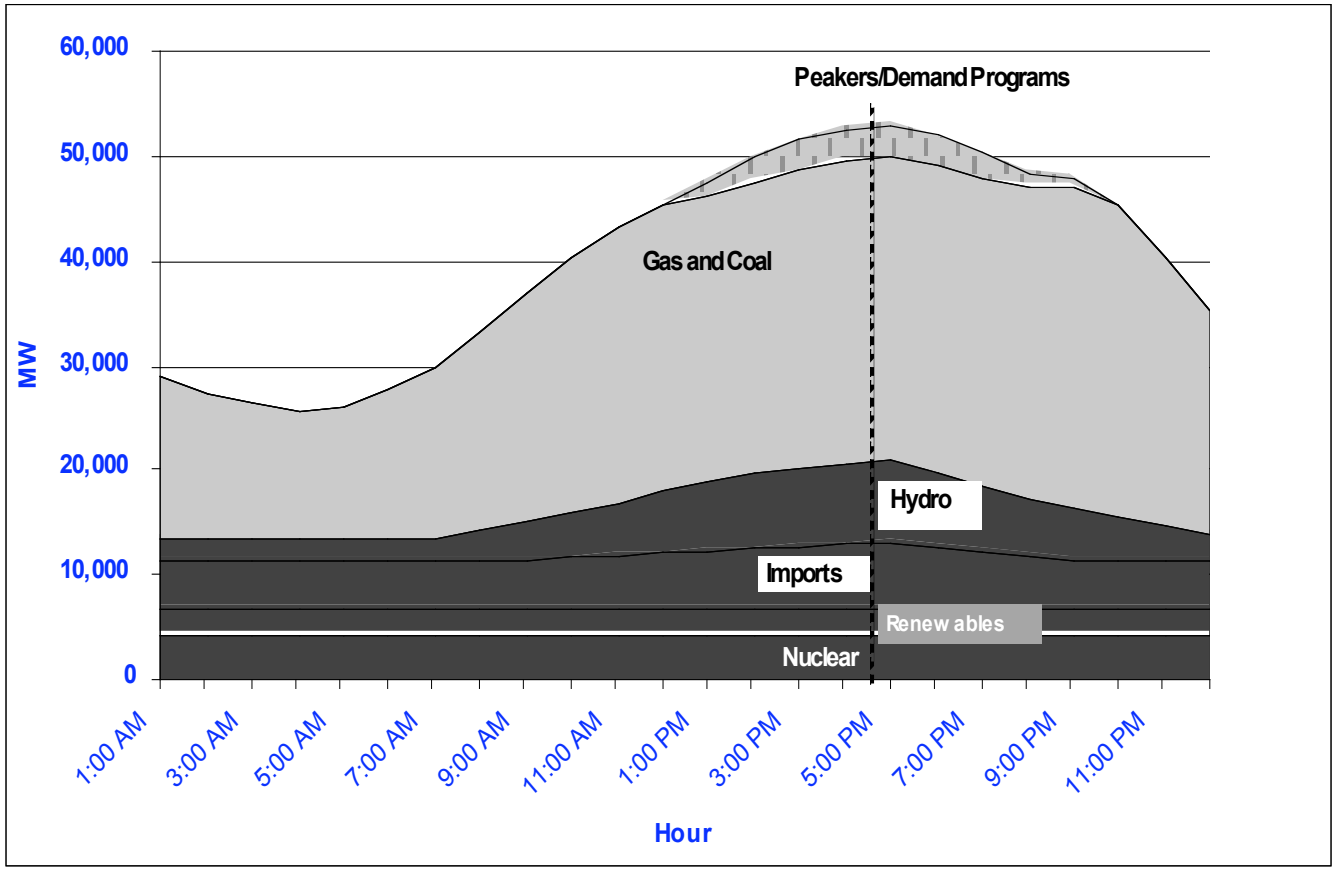
Combined cycle plants have become the most popular technology being built today by employing the best of both technologies. A combined cycle plant is a combination

of a steam turbine and a combustion turbine. Its higher fuel efficiency results from the ability to use the waste heat from the combustion turbine to produce steam for the steam turbine. Combined cycle plants yield better heat rates than combustion turbines or steam turbines.

Utilization rates can also be a function of where the plants are located on the grid. Local reliability needs dictate that a certain percentage of the electricity provided be located near the load. The CAISO regularly performs transmission studies to determine which plants are needed for reliability purposes. Such plants are given special contracts called reliability-must-run (RMR).

During peak demand periods, there are congestion spots on the transmission grid that prevent capacity from being delivered to where its needed. Part of this problem stems from transmission additions lagging behind generation additions which are driven by increases in demand.

Figure 2-6: Electricity Supply Profile for a Typical Hot Summer Day



Source: California Energy Commission's Electricity Analysis Office.

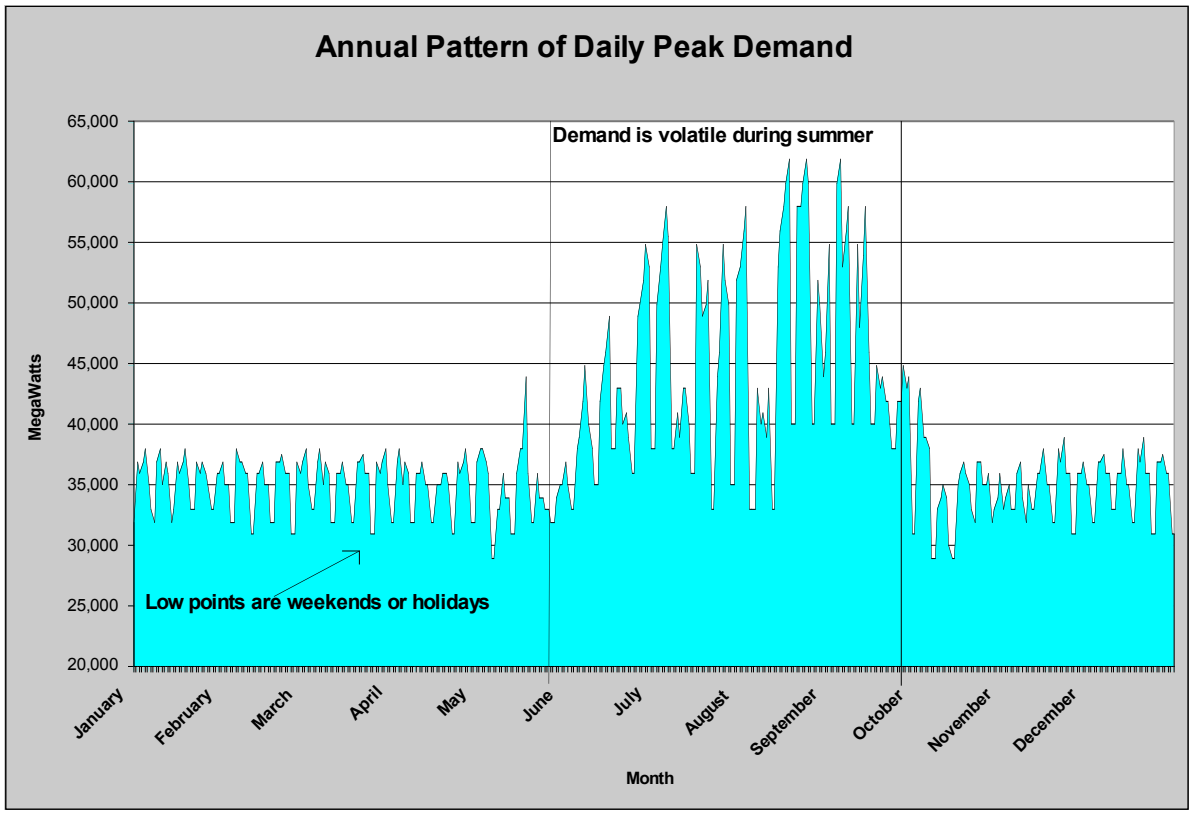
Electric Generation System Operation

Supply/Demand Balance

California and the Western states have surplus capacity available for most hours of the year. For a small number of hours annually, even capacity that sits idle for most of the year is called upon to meet peak demand.

Because air conditioning loads drive the peak demand, California sees its greatest spikes in demand during the summer months (June, July, August, and September). The difference between the average off peak capacity and the peak summer capacity is considerable—peak demand is approximately 130% of the average non-peak demand. Figure II-6 shows how generation increases to meet demand over the course of a hot summer day. Figure II-7 shows how peak demand changes over the course of a year.

Figure 2-7: Annual Pattern of Daily Peak Demand



Source: California Energy Commission's Electricity Analysis Office.

The full available capacity of the system needs to be called upon only to meet periods of peak demand, which in California typically falls on hot summer workday afternoons.

California's Energy Action Plan

California should have sufficient resources this year but the ability to meet peak demand this summer in Southern California will be challenged, should we face a hotter than normal, 1-in-10-year probability summer temperatures. The state's primary electricity planning agencies, the California Energy Commission, the California Public Utilities Commission and the California Electricity Oversight Board have worked together to address problems. The collaborative result is the Energy Action Plan (EAP).

The EAP has a proscribed loading order of supply resources which promote efficiency, fuel diversity, and reduced environmental impacts. The loading order is as follows:

1) First, all cost effective demand side management, energy conservation and energy efficiency measures must be employed during the IOU resource procurement process, which is overseen by the CPUC.
2) Second, renewable generation technologies, such as solar, geothermal, wind and biomass must be employed. The state's accelerated renewable portfolio target directs the IOUs to procure or build renewable capacity such that 20 percent of their electricity sales will come from renewable sources by 2010. Fuel diversity serves to moderate the effects of natural gas price spikes and reduces the need to import additional natural gas during years of low hydroelectric generation. Distributed generation is encouraged to reduce reliance on centralized power plants. It can also reduce transmission congestion and eliminate the need for transmission upgrades, if distributed generation is properly situated geographically.
3) Third, because preferred resources require both sufficient investment and adequate time to "get to scale", the EAP supports additional clean, fossil fuel, central station generation. The CPUC has further expressed that re-powering existing generation facilities is normally preferred[3] as it is usually more cost effective than developing an undisturbed "greenfield" site and typically results in fewer environmental impacts. Much of the savings accrue from using the pre-existing infrastructure that avoids the cost of planning, permitting and building new infrastructure such as: new gas pipelines, new transmission lines, cooling water sources, roads and electrical switching yards.
4) Finally, the EAP intends to improve the bulk electricity transmission grid and distribution facility infrastructure to support growing demand centers and the interconnection of new generation.

Concerns to Be Addressed in Procurement

On January 1, 2003, the California State Legislature returned the responsibility of contracting for generation supply resources back to the IOUs. The IOUs are now negotiating and signing contracts as part of the formal CPUC procurement process. The IOUs have also filed resource plans which were approved by the CPUC and

thereby adhere to the requirements of both the EAP and the RPS. These policy measures are designed to develop all cost effective efficiency technologies and promote the development of new renewable capacity needed to meet future demand. In addition, the procurement process puts the burden of securing sufficient planning reserves directly upon the IOUs. This measure will help ensure that timely and adequate capacity will be available as contractually specified. Signing a variety of short- medium and long-term contracts will provide flexibility as well as some hedging of electricity costs.

CHAPTER 3: AIR RESOURCES

Summary of Findings

- **Air Emissions Trends Continue to Improve:** Air emissions from the in-state power generation fleet are a small, increasingly clean part of the emissions inventories for California air basins. This is due to the state's diverse mix of clean fossil-fueled and "emissionless" generation, stringent pollution controls, retrofit rules and emissions limitations, the extensive use of clean natural gas, and electricity imports from out-of-state. Results from the 2005 Environmental Performance Report's detailed analysis of monthly generation and emissions between 2001 and 2003 reconfirm the findings and trends from the earlier 2001 and 2003 Environmental Performance Reports.
- **Power Plant Emissions Are No Longer a Principal Air Quality Driver:** At state and regional levels, emissions from the in-state generation system are low and are no longer a principle driver of air quality or attainment planning in most air districts. Due to continuing air quality and attainment problems in many air basins though, air pollutant emission reductions from the generation sector are likely to be a valuable, but minor, component of the continued air quality improvements. These reductions will depend on the location, cost and availability of cleaner generation technologies.
- **Environmental Performance Is Not A Factor in The Dispatch of California Power Plants:** Environmental attributes such as oxides of nitrogen (NOx) or carbon dioxide (CO_2) emissions are not factors in the dispatch of California power plants. Dispatch appears to be a function of contractual obligations, reliability concerns, fuel and other production costs, seasonal energy availability and location. The 8,612 megawatts (MW) of environmentally efficient combined cycle combustion turbine power plants that are coming on line appear to be displacing the 19,100 MW of existing retrofitted steam boiler power plants with quite similar environmental profiles for emissions of oxides of nitrogen, particulate matter, or carbon dioxide equivalents. The dirtiest parts of the fleet are not being displaced, while the cleanest parts of the fleet appear to be last in the queue for dispatch.
- **Some Generation Technologies Have Higher Emissions Rates:** Cogeneration and waste to energy facilities in California total 8,262 MW of capacity and produced 48,654 gigawatt-hours (GWh) of energy in 2003. These facilities have higher emissions rates and emitted more total air pollutant emissions than the 30,712 MW of natural gas-fired combined cycles, simple cycle peakers, and retrofit steam boilers, which produced 55,534 GWh in 2003. Between mid-2002 and the end of 2003, cogenerators and waste to energy facilities produced from one-half to two-thirds of all generation-related NOx in California. Cogeneration and waste to energy facilities operate at much higher capacity factors than gas-fired combined cycle and steam boiler power plants, due to contract and dispatch considerations.

Air Pollutant Emissions and Air Quality

Over 90 percent of Californians breathe unhealthy levels of one or more air pollutants during some part of the year.[4] California's relatively poor air quality results from the complex interactions of climate, topography, and air pollutant emissions. In addition to being unhealthy for humans, air pollution can threaten the health of trees, lakes, crops, and animals, can damage historic buildings, and affect global climate and the ozone layer. Air pollution emissions can also cause haze, which reduces visibility.

The common perception that electricity and air quality are linked has been a given for decades. However, while our world-class economy and quality of life rely on energy and electricity, the production of electricity for California consumption is not the primary driver of air emission inventories or air quality.

This section of the *2005 Environmental Performance Report* provides analyses of monthly air emissions and air emissions trends of California's in-state electricity generation system for the 2001 to 2003 time frame. Staff continues to analyze emissions trends at the statewide level. New to the 2005 report are more detailed analyses of air emissions and trends by region and technology. The availability of more detailed generation and emissions data enabled staff to conduct much more detailed analyses of air emissions at the regional level, and to conduct detailed comparative analyses among the four main natural gas-fired technologies of combined cycles, steam boilers, simple cycle peakers and cogeneration. "Emissionless" sources such as hydroelectric, wind and nuclear are included to give the reader a broader context and appreciation for how these resources help California have such a low level of emissions for the large amount of electricity that is generated and consumed in the state.

There are approximately 1,000 electricity generating facilities within California, and each will typically have one to six units. The Energy Commission's Electricity Assessments Office provided generation and fuel use data (as well as other relevant identification information) for each unit at each facility on a monthly basis from the Quarterly Fuels Energy Report (QFER) data files. This resulted in a database with well over 45,000 records that represents the 61,462 MW of in-state electricity generating nameplate capacity that is shown in Table 1. Environmental Office staff worked to incorporate the new data from the EPR database, but found significant disparities with unit identification and environmental data between the QFER database and the EPR database.

Environmental Office staff identified an emission factor to use for each facility primarily from the new EPR Forms[5], and alternatively from the E-GRID database system, Commission files, or the EPA AP-42 Emission Factor Compendium. Significant efforts were made by the Environmental Office staff to validate the NO_x, CO2-eq and PM10 emission totals with existing emission inventories tabulated by the California Air Resources Board (CARB) and the local air districts. While not a

perfect match, staff is confident that the results show that the emission estimates presented are reasonably representative for the facilities in question and of the monthly generation and emission swings. The slight emission inventory discrepancies stem from incorrect or old emission factors, missing generation units,[6] and units located in the wrong air districts or categories. The resulting dataset provides comparative data on generation technology and fuel type across 36 months between 2001 and 2003. However, the data and results shown should not be used for air quality planning or unit specific compliance.

Table 3-1

Environmental Office Data Base of 2003 In-State Generation Technologies and Fuels (Nameplate Capacity in MW)

	Solar	Coal	Natural Gas	Geo-thermal	Hydro	Nuclear	Waste-Energy	Liquid Fuel/Oil	Other	Un-known	Wind	TOTAL MW
Cogeneration		576	6,575				42		45	6		**7,245**
Combined Cycle			8,040							572		**8,612**
Geothermal				2,623								**2,623**
IC Engine			90					15				**105**
Large Hydro					12,017							**12,017**
Nuclear						4,456						**4,456**
Peaker			2,732					342				**3,074**
Small Hydro					1,271					2		**1,273**
Solar-PV/Gas Assis	380											**380**
Steam Boiler			19,088									**19,088**
Waste To Energy			4				1,030			28		**1,062**
Wind											1,526	**1,526**
TOTAL MW	**380**	**576**	**36,529**	**2,623**	**13,289**	**4,456**	**1,072**	**357**	**45**	**608**	**1,526**	**61,462**

Results from the 2005 report should be viewed in the context of previous air emissions analyses. In the *2001 Environmental Performance Report*[7] staff described the trends in air emissions from California generation facilities from 1975 to 2000. Environmental performance improved substantially during that time period, primarily due to switching from oil to natural gas, improvements in combustion technologies, and implementation of pollution controls. The *2003 Environmental Performance Report*[8] analyzed recent trends in emissions, generation and emission control technologies, and air regulations for California electricity generation using fuel combustion for 1996 to 2002. A staff white paper to the *2004 Update to the Integrated Energy Policy Report*[9] analyzed air pollutant emission trends from aging boiler units and the status of emission control technology retrofits.

Criteria Air Pollutants

The federal and state Clean Air Acts require both the U.S. Environmental Protection Agency (US EPA) and CARB to establish ambient air quality standards for pollutants such as oxides of nitrogen (NOx) and particulate matter (PM10 and PM 2.5). Standards and emissions levels for these criteria pollutants are set at concentration levels that are considered safe for public health. The ambient standards protect not only the general public, but also sensitive receptors that are considered to be at risk, such as the young, elderly or asthmatics. Air basins or districts are designated as being in attainment, non-attainment, or unclassified with the federal and state ambient air quality standards, based on locally monitored air quality data.

Table 3-2 shows the attainment status for three of California's largest air basins with the most serious air quality problems; Bay Area, South Coast and San Joaquin.

Table 3-2
Federal and State Ambient Air Quality Attainment Status for Three California Air Districts

Pollutants	Federal Classification	State Classification
Bay Area Air Quality Management District		
Ozone (1-hour)	Nonattainment	Serious Nonattainment
" (8-hour)	Nonattainment	3
Particulate Matter 10 (annual)	Attainment	Nonattainment
" (24 hour)	Unclassified	Nonattainment
Particulate Matter 2.5 (annual)	Attainment	Nonattainment
" (24 hour)	Attainment	no standard
Nitrogen Dioxide (annual)	Attainment	no standard
" (one hour)	no standard	Attainment
South Coast Air Quality Management District		
Ozone (1-hour)	Extreme Nonattainment	Extreme Nonattainment
" (8-hour)	Severe Nonattainment	3
Particulate Matter 10 (annual)	Nonattainment	Nonattainment
" (24 hour)	Nonattainment	Nonattainment
Particulate Matter 2.5 (annual)	Nonattainment	Nonattainment
" (24 hour)	Nonattainment	no standard
Nitrogen Dioxide (annual)	Unclassified/Attainment	no standard
" (one hour)	no standard	Attainment
San Joaquin Valley Air Pollution Control District		
Ozone (1-hour)	Extreme Nonattainment	Severe Nonattainment
" (8-hour)	Serious Nonattainment	3
Particulate Matter 10 (annual)	Nonattainment	Nonattainment
" (24 hour)	Nonattainment	Nonattainment
Particulate Matter 2.5 (annual)	Nonattainment	Nonattainment
" (24 hour)	Nonattainment	no standard
Nitrogen Dioxide (annual)	Unclassified/Attainment	no standard
" (one hour)	no standard	Attainment

1. In April 2004, U. S. EPA determined that the Bay Area had an attainment record for the national 1-hour ozone standard. EPA must approve a redesignation request, currently under development, in order for the Bay Area to be redesignated to attainment status.

2. In June 2004, the Bay Area was designated as a mariginal nonattainment area of the national 8-hour ozone standard.

3. On April 28, 2005, the Air Resources Board approved a new ozone standard that will take effect upon final approval by the Office of Administrative Law, expected in 2006

Because ozone and particulate matter are the two criteria pollutants of greatest concern in California, this discussion focuses on the primary ozone precursor from the generation sector, oxides of nitrogen (NOx). This report also looks at particulate matter less than 10 micron (PM10) and to a lesser degree PM2.5 emissions from the generation sector. About 90 percent of particulate matter emissions from fuel combustion are PM2.5, so discussing PM10 is an adequate proxy of PM2.5 emissions. Emission of carbon monoxide, reactive organic gases, and oxides of sulfur are not discussed given the limited emissions from in-state generation.

Particulate matter from all sources is of great concern to the public and regulatory agencies because of its potential health effects. Many epidemiological studies have shown that exposure to particulate matter can induce a variety of health effects, including premature death, aggravation of respiratory and cardiovascular disease, changes in lung function and increases in existing respiratory symptoms, effects on lung tissue structure, and impacts on the body's respiratory defense mechanisms. Exposure to particulate matter may also exacerbate asthma symptoms and lung development in children.

The Air Resources Board adopted new particulate matter standards in June of 2002. In addition to strengthening the standard for PM10, the Board established a new standard for 2.5. This recommendation was based on a growing body of epidemiological and toxicological studies showing significant toxicity (resulting in mortality and morbidity) related to exposure to fine particles.

Toxic Air Contaminants

Unlike criteria pollutants, toxic air contaminants (TACs) do not have associated ambient air quality standards. Some TACs may accumulate in the body from repeated exposures, and may cause a wide variety of disorders, such as cancer, chronic eye, lung, or skin irritation, and neurological or reproductive disorders. Over 200 substances qualify as TACs. As new TACs are identified, measures are adopted to reduce emissions of these contaminants and reduce the risk to the general public. Power plants typically emit TACs in much smaller quantities than criteria pollutants. The most common are ammonia, formaldehyde, and particulate matter from diesel combustion. Less common from power plants in California are mercury and lead. See the Public Health section of this report for a detailed discussion of TACs.

Global Climate Change Gases

A number of global climate change gases are released during electricity generation. Of these, carbon dioxide (CO_2) is emitted in the largest quantity, followed by nitrous oxide (N_2O), methane and alternatives to ozone-depleting gases (e.g., hydrochlorofluorocarbons in place of chlorofluorocarbons). For this report, carbon dioxide, nitrous oxide, and methane emissions from the generation sector are reported as carbon dioxide-equivalent based on weighting of global climate change effect. Carbon dioxide dominates the CO_2-equivalent emissions. The Global Climate

Change papers being prepared as part of the Energy Report provide a more detailed discussion of emission sources and control strategies. Due to different methodologies and assumptions, total estimates of CO_2-euivalent emissions vary between the two reports.

Although the possible effects of global climate change are not analyzed in this report, climate change may affect the timing, location, and persistence of poor air quality. For example, ozone formation is a function of temperature. Increases in local ambient temperatures could result in increased ozone levels. Actions taken to reduce greenhouse gas emissions can also reduce air pollutant levels. For example, increasing generation efficiency could reduce both CO_2 and air pollutant emissions per MWh generated. The capture of landfill gas and its use as a generation fuel reduces landfill emissions of methane, a greenhouse gas, while also reducing criteria pollutant emissions from "less controlled" landfill flares.

In-State Generation Emits Few Criteria Air Emissions

California continues to face significant air quality challenges; increasing population and economic activity generally increase air emissions, which in turn affect air quality. In order to focus the discussion for 2005, but address the bulk of the emissions and impacted population, staff limited the regional analyses to three air districts: the South Coast and Bay Area Air Quality Management Districts, and the San Joaquin Valley Air Pollution Control District. These three districts contain about 76 percent of the state's population and about 70 percent of the state's total air pollution emissions of NOx (an ozone precursor). NOx emissions closely correlate to population, vehicle miles traveled and industrial activity including energy production.

Anthropogenic (man-made) particulate matter, both less than 10 microns and less than 2.5 microns, originates from almost every human activity and creates human health concerns. Rural parts of California (i.e., outside the three districts) have a disproportionate share (nearly 60 percent) of particulate matter emissions. This can be attributed to activities emitting high amounts of particulate matter, such as agriculture, mining, logging, and unpaved roads in rural areas of California.

Table 3-3 from the California Air Resources Board shows the electric utilities and cogeneration emissions categories as a percentage of the district or state total emissions, for NOx, PM10 and PM2.5. These two generation categories produce very small percentages of total emissions of NOx and PM in 2004 and 2005, although the percentages are predicted to climb between 2010 and 2020 as electricity production increases, and as total emission inventories are reduced via attainment plans and district and state control measures.

Table 3-3 District and Statewide Electricity Generation Emissions as a Percent of District and State Total Emissions

Oxides of Nitrogen		**1995**	**2000**	**2004**	**2005**	**2010**	**2015**	**2020**
Bay Area	Electric Utilities % of District Total	1.6%	2.4%	0.8%	0.7%	0.9%	1.2%	1.3%
	Cogeneration % of District Total	1.2%	0.7%	0.8%	0.8%	1.0%	1.3%	1.5%
San Joaquin	Electric Utilities % of District Total	0.5%	0.5%	0.6%	0.7%	0.8%	0.9%	1.2%
	Cogeneration % of District Total	2.8%	1.7%	2.1%	2.2%	1.9%	2.3%	2.9%
South Coast	Electric Utilities % of District Total	1.3%	1.0%	0.6%	0.8%	1.0%	1.2%	1.4%
	Cogeneration % of District Total	0.2%	0.3%	0.3%	0.3%	0.3%	0.4%	0.5%
Statewide	Electric Utilities % of District Total	1.7%	1.8%	1.0%	1.1%	1.5%	1.8%	2.1%
	Cogeneration % of State Total	1.0%	0.9%	1.0%	1.0%	1.1%	1.4%	1.6%

Particulate Matter less than 10 Microns		**1995**	**2000**	**2004**	**2005**	**2010**	**2015**	**2020**
Bay Area	Electric Utilities % of District Total	0.2%	0.7%	0.4%	0.5%	0.5%	0.5%	0.5%
	Cogeneration % of District Total	0.3%	0.3%	0.4%	0.4%	0.4%	0.4%	0.4%
San Joaquin	Electric Utilities % of District Total	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%
	Cogeneration % of District Total	0.4%	0.2%	0.3%	0.3%	0.3%	0.3%	0.3%
South Coast	Electric Utilities % of District Total	0.2%	0.2%	0.7%	0.7%	0.7%	0.7%	0.7%
	Cogeneration % of District Total	0.0%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Statewide	Electric Utilities % of State Total	0.3%	0.4%	0.4%	0.4%	0.5%	0.5%	0.5%
	Cogeneration % of State Total	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%

Particulate Matter less than 2.5 Microns		**1995**	**2000**	**2004**	**2005**	**2010**	**2015**	**2020**
Bay Area	Electric Utilities % of District Total	0.4%	1.7%	1.0%	1.2%	1.4%	1.3%	1.3%
	Cogeneration % of District Total	0.7%	0.8%	1.0%	1.0%	1.0%	1.1%	1.1%
San Joaquin	Electric Utilities % of District Total	0.3%	0.3%	0.4%	0.4%	0.4%	0.4%	0.4%
	Cogeneration % of District Total	0.9%	0.7%	0.8%	0.8%	0.8%	0.9%	0.9%
South Coast	Electric Utilities % of District Total	0.6%	0.6%	1.8%	1.9%	1.9%	1.9%	1.9%
	Cogeneration % of District Total	0.1%	0.6%	0.5%	0.5%	0.5%	0.5%	0.4%
Statewide	Electric Utilities % of State Total	0.6%	1.0%	1.0%	1.1%	1.3%	1.3%	1.4%
	Cogeneration % of State Total	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%

Source: http://www.arb.ca.gov/ei/emsmain/reportform.htm

However, the relatively small contribution of generation to district and state inventories does not preclude the emissions from the generation units being subject to additional reductions via control measures as part of an air district's attainment plan. Depending on location, fuel and generation technology types, dispatch, and the mix of other sources, emission reductions from the generation sector may still prove to be cost effective. Energy Commission staff provide more regional and technology-specific analyses later in this section.

Finding: At state and regional levels, the emissions from the in-state generation system are low, and may no longer be a principle driver of air quality or attainment planning.

Finding: Regardless of the relative cleanliness of the in-state generation system, air pollutant emission reductions from the generation sector are likely to be a valuable, but minor, component of the continued air quality improvements. These reductions will depend on location and the availability and cost of cleaner generation technologies.

Diverse Resource Mix, Limited Dispatch Options

In order to understand why generation emissions are so low, we need to understand the types of resources available in California and how they are operated, or dispatched. Environmental Office staff used Electricity Analysis Office monthly generation data for 2001 to 2003, supplemented by power plant and generation data from the US Energy Information Agency. Monthly generation data for 2001 through 2003 are shown in Figure 1. Broken out on the figure is generation by technology or fuel type. Cogeneration output is fairly constant regardless of the season or overall demand, except for a dip in 2001 when the financial difficulties of the investor owned utilities created payment and operational uncertainties for some cogenerators. Cogeneration is considered to be baseload production in that it operates at a high capacity throughout most hours of the year. This is due to contracts and the use of heat and steam in host manufacturing processes. The nuclear plants' output is also constant. Note the steadily increased generation from the new combined cycle units from June 2002 to the end of 2003. In 2001, much of the load variation was shaped by the steam boilers and large hydroelectric. In 2003, the combustion turbine combined cycle and large hydroelectric sectors followed the seasonal demand variations. This figure does not include out-of state imports, but the amount of energy is generally constant from year to year and month to month. The sources vary with swings in the availability of hydroelectric power from the Pacific Northwest and Southwest.

Figure 3-1 2001 to 2003 Monthly Generation (GWh)

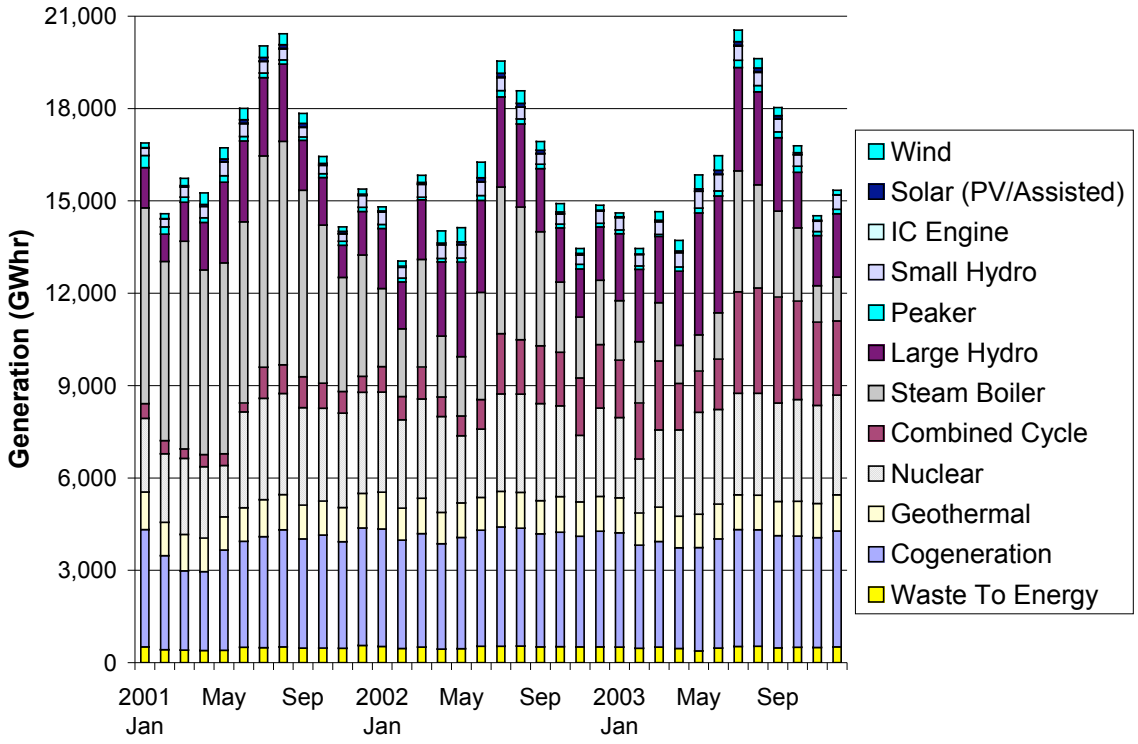
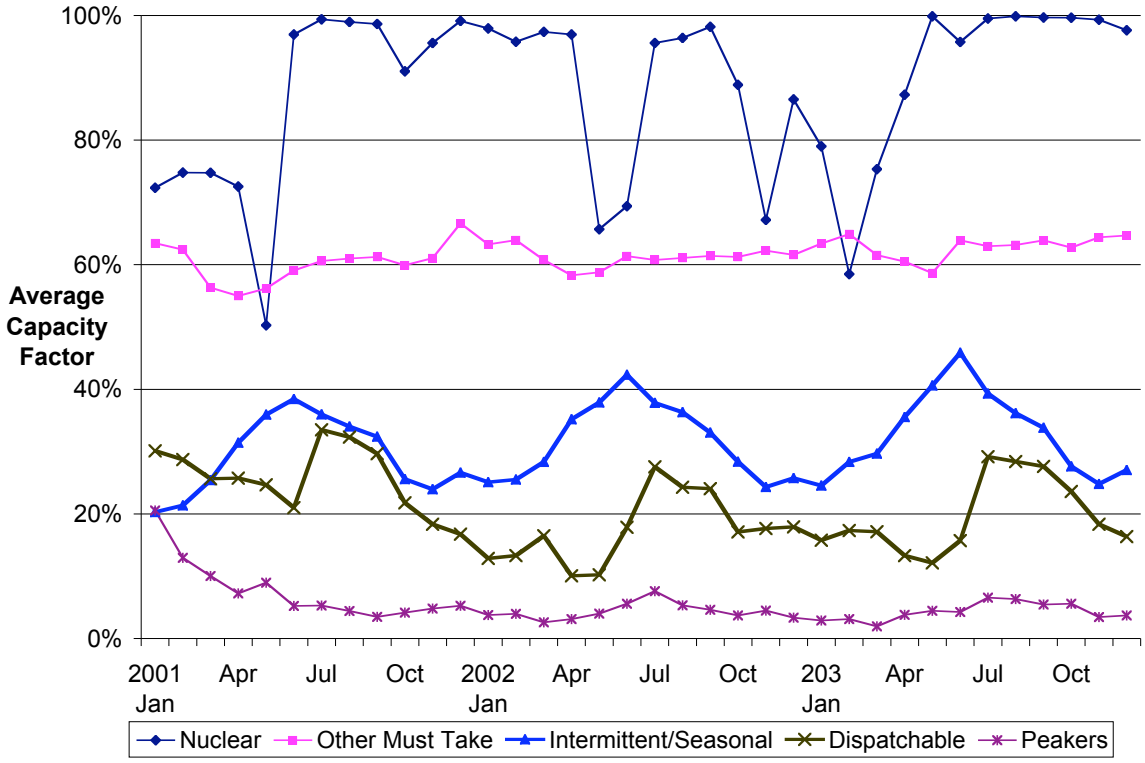


Figure 2 provides more detail on the capacity factors, or dispatch, of California generation by technologies and fuel types. As expected, nuclear generation, as a must take resource, has a capacity factor approaching 100 percent. The dips in capacity factor in the spring probably reflect planned outages. The other must take category includes geothermal, waste to energy, biomass, and cogeneration. These types of units generally have a high capacity factor because of standard offer contracts, contractual obligations to an associated steam host or fuel suppliers, or, in the case of geothermal, the type of fuel source.

Figure 3-2 2001 to 2003 California Generation Category Average Capacity Factors



Other Must Take: Renewables such as geothermal, waste to energy, biomass, and cogeneration.
Intermittent / Seasonal: Large hydro and renewables such as small hydro, wind and solar
Dispatchable: Gas-fired combined cycles and boilers
Peakers: Gas-fired single cycle turbines

The intermittent or seasonal category includes small and large hydro, wind, and solar (photovoltaic and thermal assisted). The lower capacity factor of these resources reflects the intermittent or seasonal nature of the fuel sources, although they typically have must take contracts. Figure 3 shows the capacity factors for intermittent renewable resources in greater detail. Large and small hydropower production peaks in late spring, when the snow pack melts and run-off is at its maximum flow. Note the seasonal peaks of solar in the summer and the significant dips in capacity in the winter. Wind generation has a seasonal profile similar to solar. The peak of intermittent generation generally occurs in May and June prior to summer peak demand.

California requires a significant increase in output from Dispatchable Generation, as shown on Figures 3 and 4, to match summer demand. These consist of steam boilers and combustion turbine combined cycles. Figure 4 shows that from 2001 to 2003, California increased its reliance on the combined cycles and decreased reliance on steam boilers.

Figure 3-3 2001 to 2003 California Intermittent/Seasonal Generation Average Capacity Factors

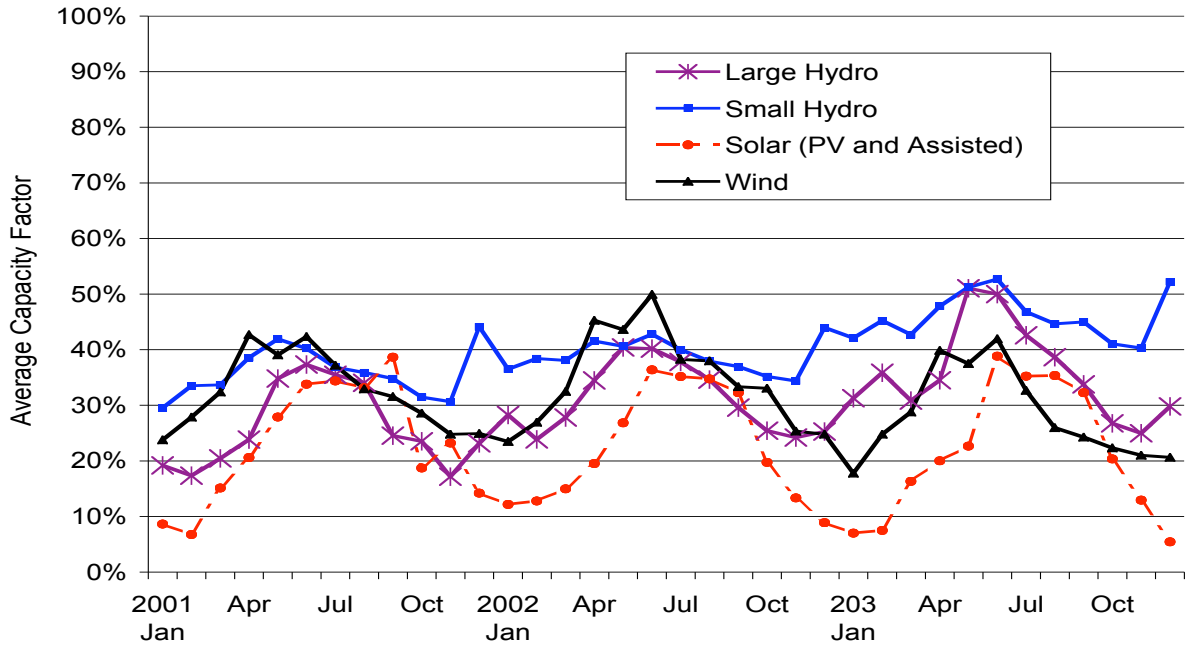
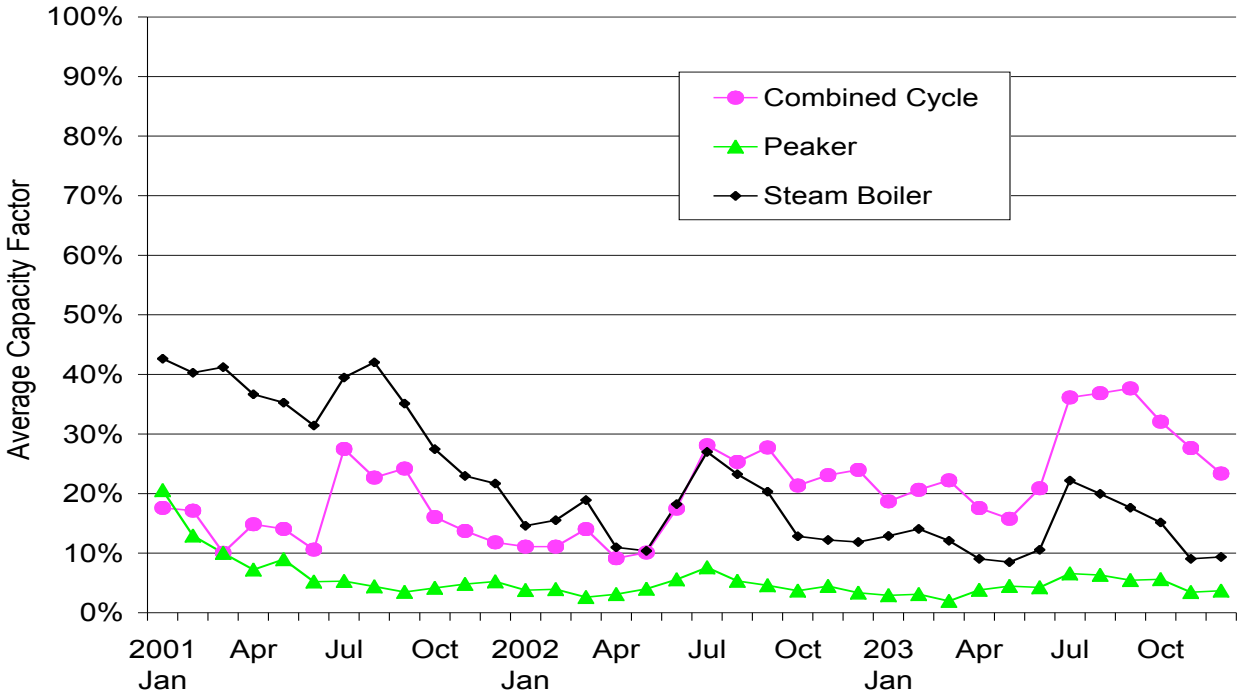


Figure 3-4 2001 to 2003 California Dispatchable Generation Average Capacity Factors



Finding: Most of the in-state generation resources are considered “must take.” Nuclear, cogeneration, waste-to-energy, and geothermal are generally operated as baseloaded resources, while hydroelectric, solar and wind are considered intermittent or seasonal resources.

Finding: In-state generation resources dispatch as a function of contractual obligations, seasonal energy availability, and cost.

Finding: The generation resources that are used to meet much of the monthly and seasonal swings in electricity demand are the steam boilers, combined cycles and peakers. Steam boilers have declined in monthly output from 2001 to 2003, while combined cycles have increased their monthly dispatch.

Generation Technology Air Emissions

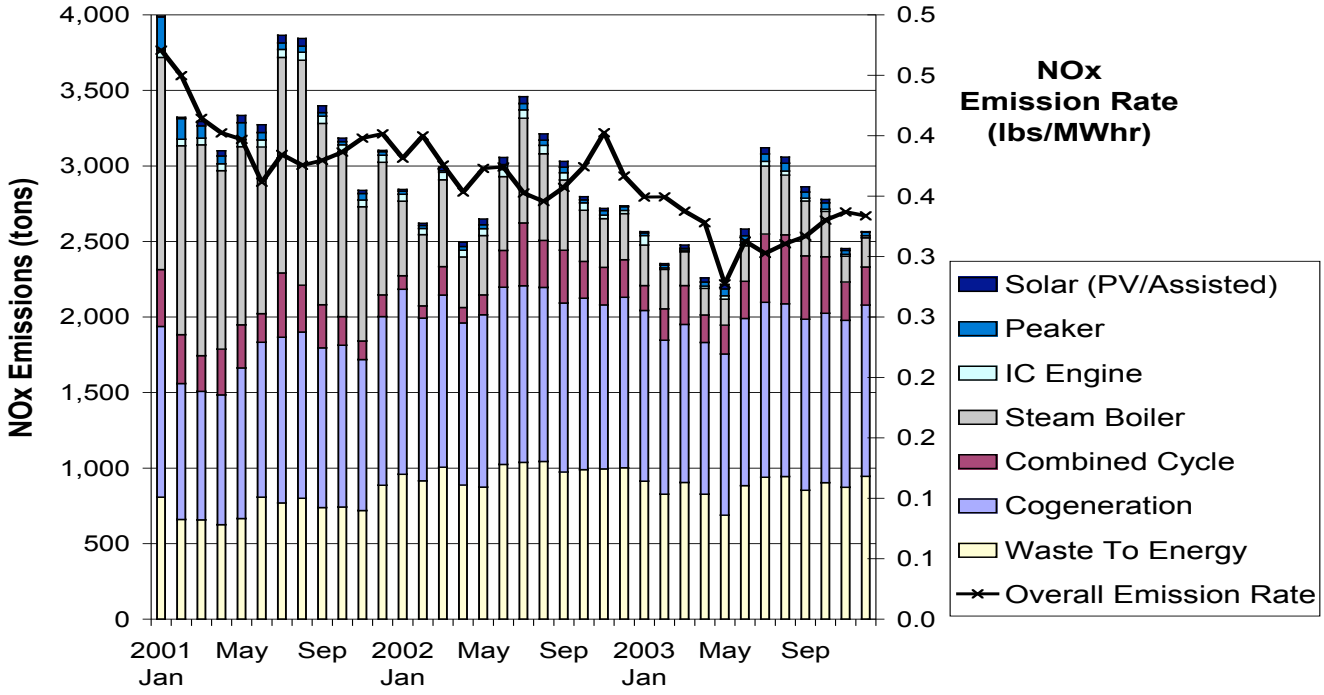
Emissions and emission trends from power generation depend on the generation technology, the energy source, the air emission controls and regulations, and the amount the unit operates or is dispatched. Fired units can be found operating throughout the state, with capacities ranging from one kilowatt to thousands of megawatts. The units are primarily either fuel-fired boilers supplying steam to a turbine or fossil fuel-fired combustion turbines operating in simple-cycle mode (just the combustion turbine) or combined-cycle mode (using the waste heat to generate steam to run a steam turbine). Internal combustion or reciprocating engines are only one percent of the total installed capacity that is fuel-fired. The boiler/steam turbine power plants have efficiencies that range from about 30 percent to near 40 percent. Older simple-cycle combustion turbines are less than 30 percent efficient, while modern simple-cycle turbines are approaching 40 percent. Most of the new capacity that has been added to the system in recent years in California consists of combined-cycle power plants that can be greater than 55 percent efficient. As the fired generation fleet turns over, with these new facilities replacing boilers and less efficient combustion turbines, total emissions and emissions per MWh will improve.

Electric generating station fuel types include agricultural and wood waste, coal/petroleum coke, diesel, digester gas, distillate oil, landfill gas, municipal solid waste, process/refinery gas, and natural gas. The largest and fastest growing segment of the generating capacity in California is fueled by natural gas. Natural gas is the preferred fuel because of its cleaner combustion compared to other fuels. It has negligible sulfur, which limits sulfur compound emissions; negligible ash, which limits PM10 emissions; and NOx emission rates that are generally lower than other fuels.

Figure 5 shows the NOx emissions and emission factor for in-state generation from 2001 to 2003. The waste to energy and cogeneration sectors are large contributors, while steam boilers reduced their contribution due to additional controls and the increased operation of combined cycles. Between mid-2002 and the end of 2003, cogenerators and waste to energy facilities produced from one-half to two-thirds of all generation-related NOx in California.

Statewide CO_2-eq emissions are shown in Figure 6. Cogeneration CO_2 is fairly constant, while steam boilers and combined cycles make up the bulk of the CO_2-eq emissions. Note that the CO_2-eq. emissions from waste to energy generation are relatively small. Most of the waste to energy in California uses renewable fuels which are calculated as zero, or neutral, CO_2-eq emissions.

Figure 3-5 2001 to 2003 Statewide NOx Emissions (tons/month) and NOx Emission Factor (lbs/Wh)

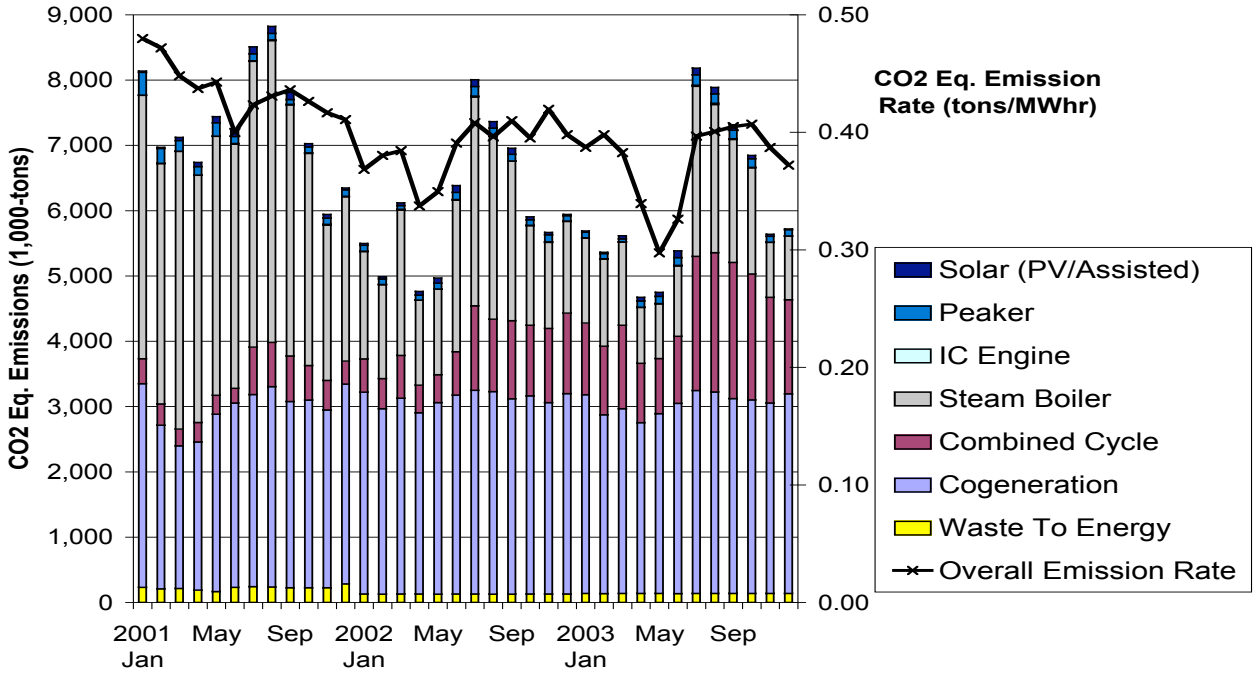


The emission factors for NOx and CO_2 are lower than shown in previous reports since the emissionless generation in included here. However, the trends in this report cycle continue downward, reflecting additional NOx control equipment being installed on steam boilers in 2001 and 2002, and the addition of clean gas fired combined cycles and peakers. The NOx emission rate improves about 20 percent from 2001 to 2003.

Finding: The more detailed analyses of monthly generation and air pollutant emissions between 2001 and 2003 reconfirm the findings and trends of earlier environmental reports, which reported at annual and state-level scales.

Finding: The in-state electricity air emissions footprint is small, and getting cleaner due a diverse mix of clean and "emissionless" generation, electricity imports from out-of-state, the extensive use of clean natural gas, and stringent rules and emissions limitations.

Figure 3-6 2001 to 2003 Statewide CO_2-eq Emissions (1000-tons/month) and CO-eq Emission Factor (tons/MWh)



Finding: Cogeneration, solar assisted and Waste to Energy generation facilities in California emit more total air pollutants and have higher emission rates than in-state natural gas fired combined cycles, simple cycle peakers, and retrofit steam boilers, even though the gas-fired fleet is nearly four times larger than this emitting portion of the renewables fleet.

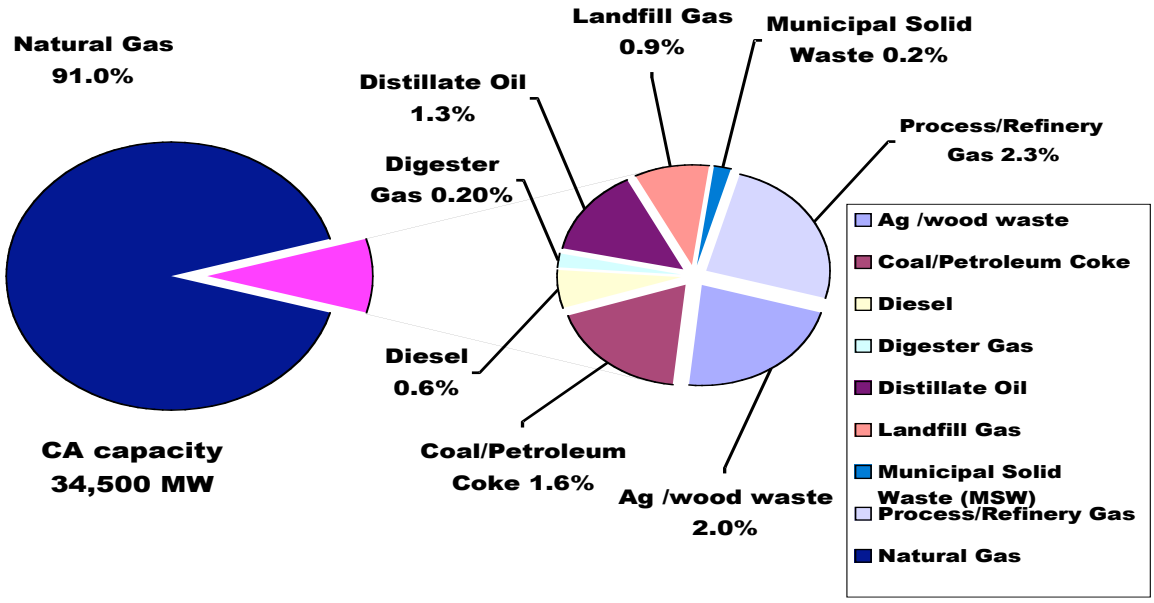
Generation Particulate Matter Levels Are Low

Although inhalation of particulate matter is a public health issue of concern, PM10 from the generation sector is a very small percentage of district or state totals, as shown in Table 2. More importantly, it would probably be difficult to garner additional reductions of PM10 emissions from in-state fuel-fired generation. Currently, over 90 percent of fuel-fired California generating units use natural gas (see Figure 7), one of the lowest particulate-emitting fuels widely available and a fuel that does not require any additional post-combustion particulate controls. (Nor are any post-combustion particulate control technologies readily available.)

The remaining fuels include oil, coal, or wastes such as agricultural and municipal wastes, shredded tires and petroleum coke, all of which are inherently higher emitters of PM10 than natural gas. However, switching to natural gas as an easy particulate control method is unlikely for several reasons. It may cause the waste materials to be disposed of by other means that may have more significant environmentally effects than the air emissions. Natural gas has become an

expensive fuel and may not allow the plant to compete effectively. Lastly, the overall amount of generation from waste to energy is small, limiting the potential PM10 reductions from fuel switching or even shutdowns (see appendix for details on emissions from waste to energy fuels).

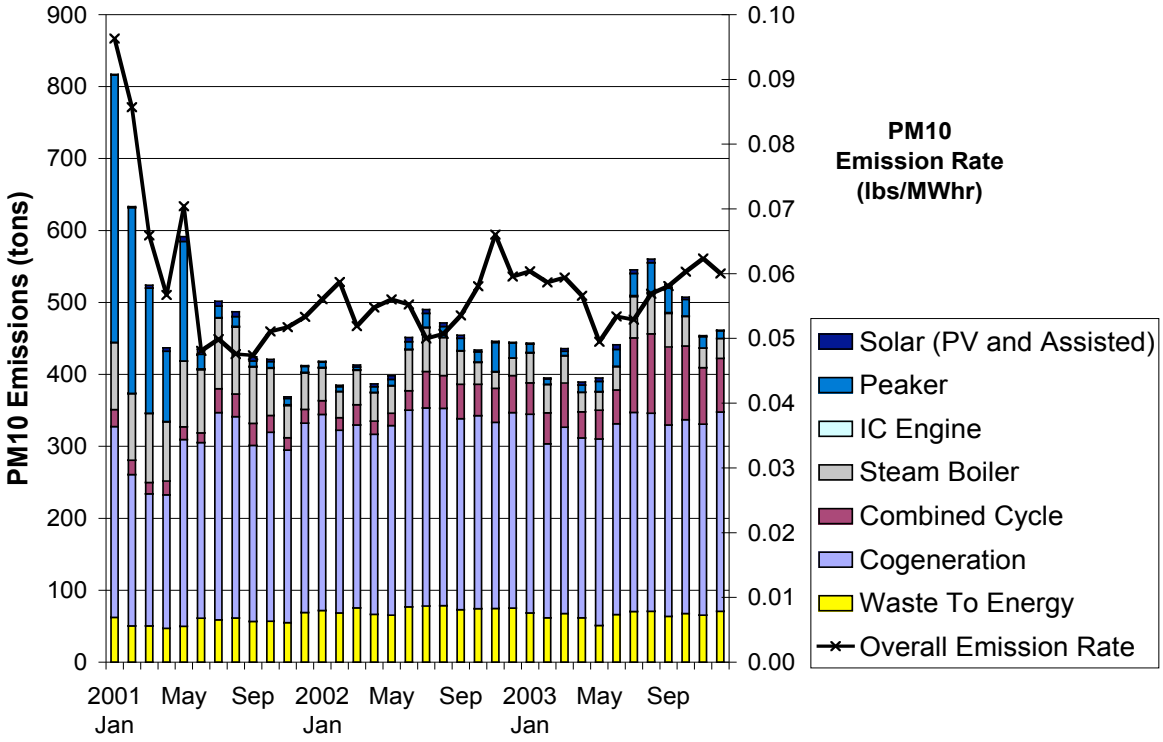
Figure 3-7 2002 California Fuel-Fired Generation Capacity



Source: 2003 Environmental Performance Report. California Energy Commission Publication # 100-03-010.

The marked effect of fuel type on particulate emissions can be seen in Figure 8 during the first few months of 2001. Peakers were called upon more often and ran significantly more than expected or normal (see capacity factor for peakers in Figure 4) in response to the energy crisis. Figure 8 shows the coincident jump in PM10 and the PM10 emission factor due to the increased operation. Some of the peakers are liquid fueled, which has much higher PM10 emission factors than natural gas fired. Additional detail can be seen in the discussion on Bay Area generation and emissions.

Figure 3-8 2001 to 2003 Statewide PM10 Emissions (tons/month) and PM10 Emission Factor (pounds/MWh)



Finding: In-state generation PM10 are very low and not likely to change much in the future due to limited opportunities for fuel switching given the already extensive use of natural gas.

Regional Generation Air Emissions

California continues to face significant air quality challenges, as increasing population and economic activity generally increase air emissions, which affect air quality. Table 1 shows the serious attainment challenges for three of the largest air basins in California; the San Francisco Bay Area, San Joaquin Valley, and South Coast or Los Angeles. In assessing the differences in emissions and emission rates, staff limited the regional analyses to these three local air districts which contain 76 percent of the state's population and about 70 percent of the state's total air pollution emissions of NOx and reactive organic gasses (ROG) (ozone precursors). NOx and ROG emissions closely correlate to population, vehicle miles traveled and industrial activity.

However, these three districts only generate about one-third to one-half of the state's electricity. Many hydroelectric and large generation assets (e.g., Diablo Canyon Nuclear Station, 2,200 MW and Moss Landing natural gas power plant, 2,700 MW) are located remotely from the population centers of the Bay Area and Southern

California. Additionally, in-basin load serving entities such as SCE and LADWP have built out of state coal facilities to serve in-basin loads. As an artifact of the historical generation build-out and the fact that load centers need local generation for system stability, the three districts have much of the emission producing generation. Therefore, in-district emissions are a slightly larger share of the state's generation emissions, as shown in Table 3, than dictated by their average share of generation.

Table 3-3 Three District Generation Emissions as Percent of State Total Generation Emissions

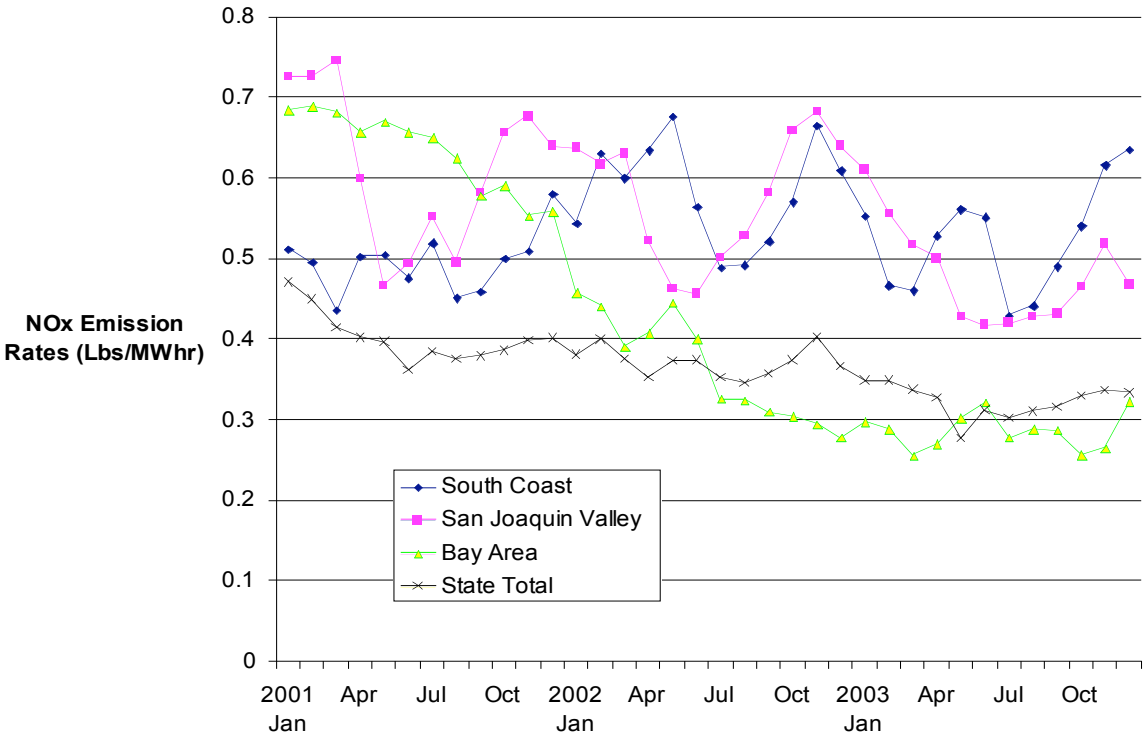
	1995	2000	2004	2005	2010	2015	2020
Oxides of Nitrogen	55.4%	49.7%	50.5%	50.6%	43.9%	44.0%	43.2%
Particulate Matter less than 10 Microns	35.8%	37.1%	48.0%	48.6%	42.9%	42.2%	40.7%
Particulate Matter less than 2.5 Microns	38.6%	42.8%	50.8%	51.2%	45.0%	44.4%	43.0%

Source: http://www.arb.ca.gov/ei/emsmain/reportform.htm

- **Regional Finding:** While the population centers of California are net importers of electricity, they have a disproportionate share of in-state generation emissions.

Before beginning the regional assessments, it is interesting to show the NOx emission rates for the Bay Area, San Joaquin and South Coast Air Districts against the statewide average. While Figure 9 is informative, the differences in NOx emission rates of the three air districts should not be interpreted as definitive or significant. Each district's NOx emission rate will differ according to differences in ambient air quality, district rules, district attainment strategies, and differences in fuel and technology types. Figure 9 shows that the South Coast and San Joaquin basins have similar NOx emission rates and similar seasonal patterns. Some of this can probably be attributed to some plants in the Environmental Office database being incorrectly located in the South Coast. The Bay Area NOx emission rate has improved as steam boiler rules were implemented and somewhat due to new combined cycle turbines coming online. The statewide average NOx emission rate has also improved, due to steam boiler retrofits, the exclusive use of natural gas in new generation, and the use of best available emission control technologies, where required, on new generation.

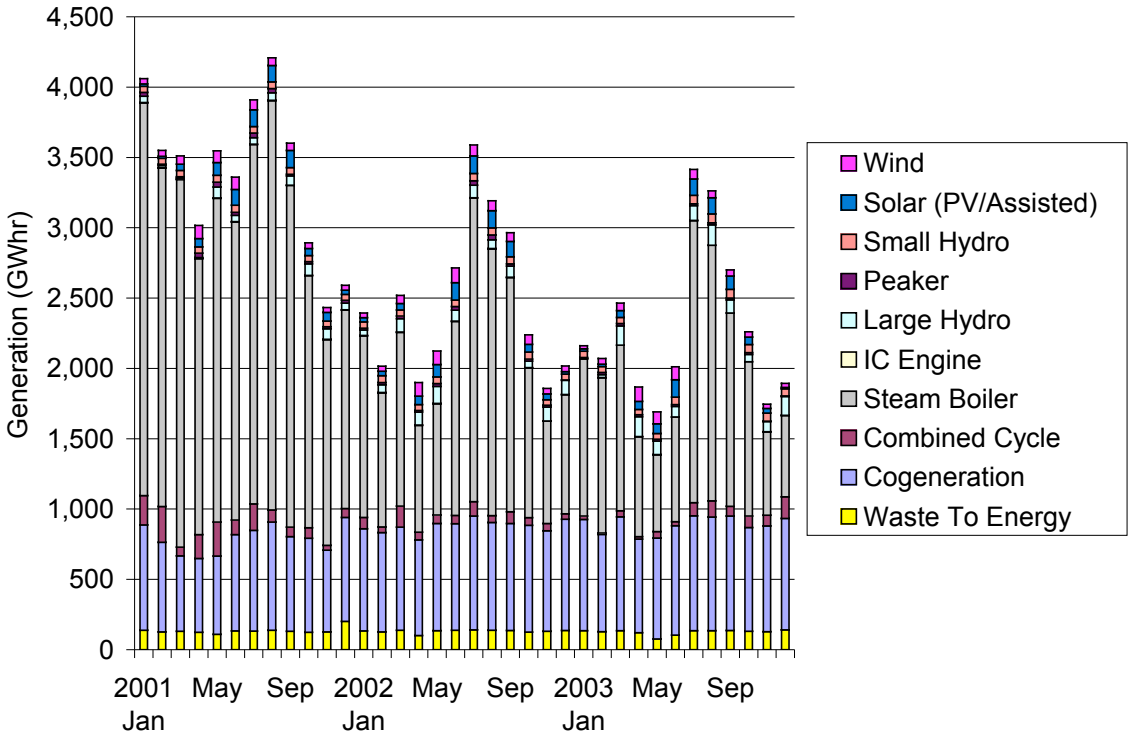
Figure 3-9 Comparison of NOx Emission Rates for Three Air Districts and the Statewide Average, 2001 to 2003



South Coast AQMD

South Coast in-basin generation, shown in Figure 10, tends to be dominated by steam boilers, which also follow seasonal variations. South Coast in-basin NOx (Figure11) and PM10 (Figure 12) emissions from generation are dominated by in-basin cogeneration to a degree that is disproportionate to the cogeneration MWhs. Waste to energy, steam boilers, and combined cycles make up the rest of the in-basin NOx emissions from generation. The emission factor varies seasonally, and actually improves during the summer months as more generation comes online, suggesting that the steam boilers and combined cycles are cleaner than emissions averages in the South Coast basin. This is discussed more in the Technology section below.

Figure 3-10 2001 to 2003 South Coast Generation (GWh)



South Coast CO_2-eq emissions, shown in Figure 13, from generation are about split between steam generation and cogeneration. It is interesting to note that the emission factor decreases slowly as generation from the steam boilers slowly decreases, suggesting that the steam boilers may be more efficient (on a carbon dioxide-equivalent per MWh basis) than the cogeneration fleet operating in the South Coast air basin.

Figure 3-11 2001 to 2003 South Coast Generation NOx (tons per month) and Emission Factor (lbs/MWh)

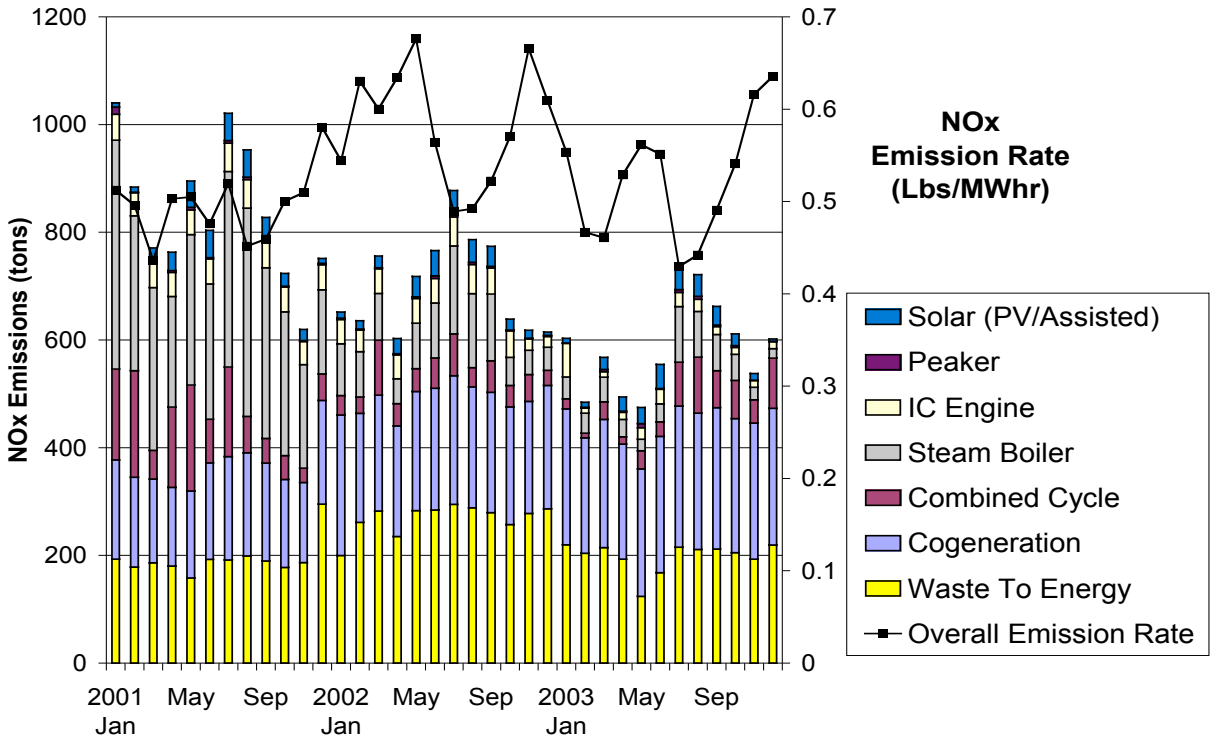


Figure 3-12 2001 to 2003 South Coast Generation PM10 (tons per month) and Emission Factor (lbs/MWh)

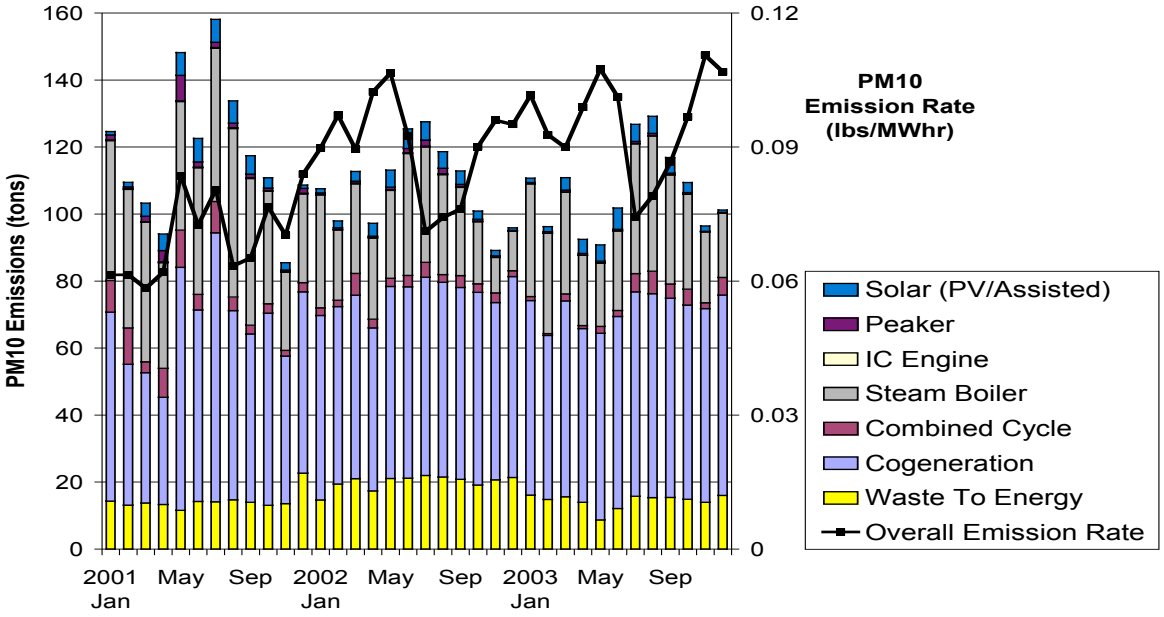
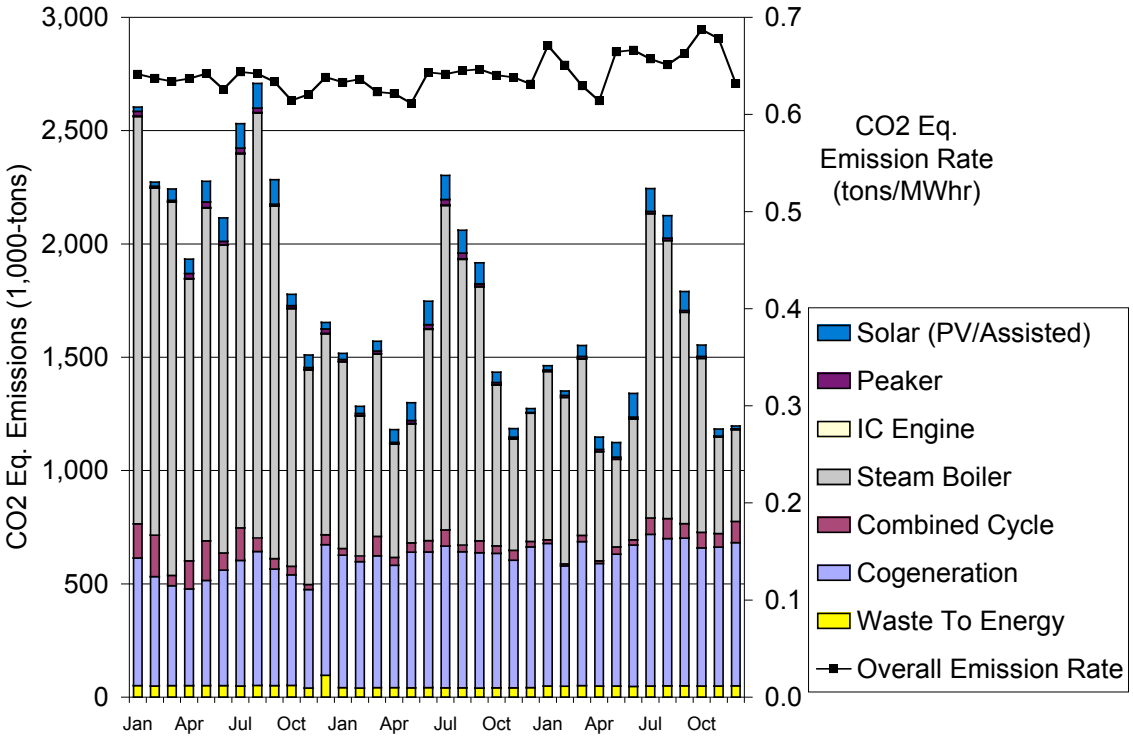


Figure 3-13 2001 to 2003 South Coast Generation CO_2 (million tons per month) and Emission Factor (tons/MWh)



Bay Area AQMD

The Bay Area generation is interesting in that the generation data shown in Figure 14 for the 2001 to 2003 time frame represents the completion and operation of several modern combustion turbine combined cycles. The cogeneration portion stays fairly constant, but combined cycle generation jumps significantly by 2003. Also shown on Figure 14 are the operations of the peakers during the early months of 2001 and the energy crisis. The operation of the peakers had a minor effect on total generation NOx emissions (see Figure 15) in the Bay Area and remarkably little effect on the emission factor (see Figure 15). Bay Area generation NOx emissions appear to be more closely related to the cogeneration sector and the steam boilers. As the generation from the steam boilers declined, emissions and the emission factor for NOx have declined.

The operation of the peakers had a marked effect on Bay Area generation PM10 emissions and the emission factor (see Figure 16) in the Bay Area. Otherwise, Bay Area generation PM10 appears to be dominated by the cogeneration sector. CO_2-eq emissions appear to be indifferent to whether steam boiler or combined cycles are operating (Figure 17).

Figure 3-14 2001 to 2003 Bay Area Generation (GWh)

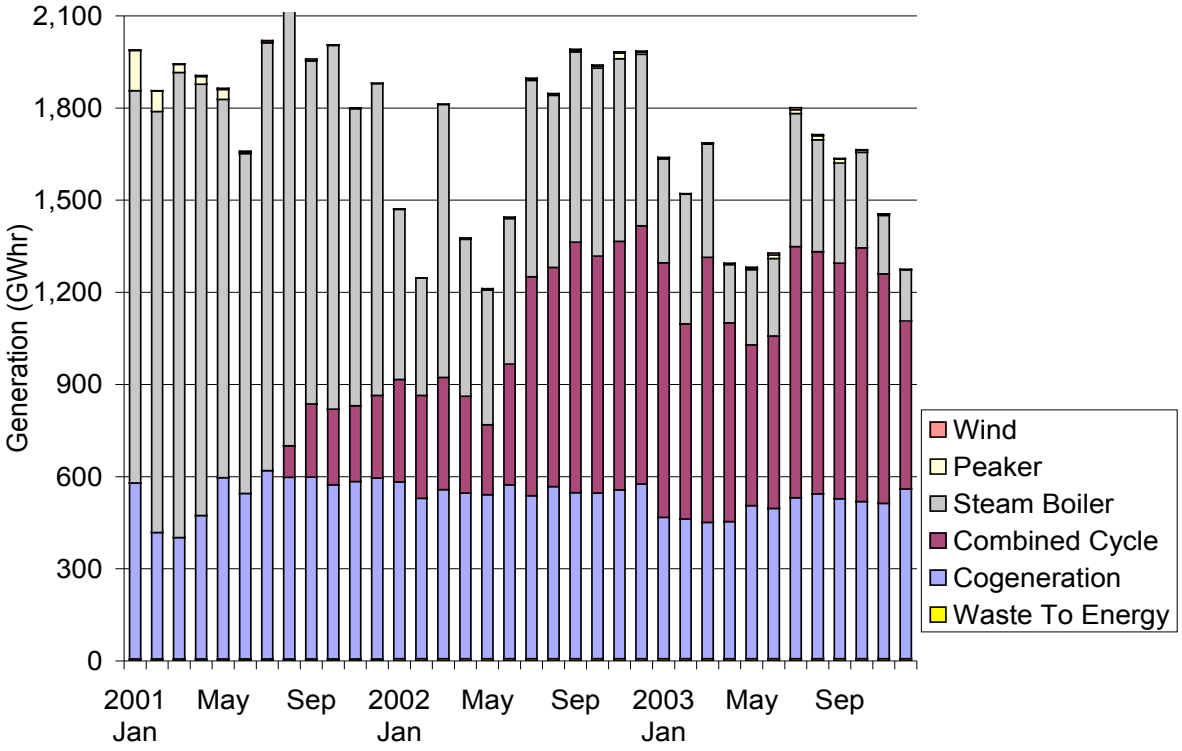


Figure 3-15 2001 to 2003 Bay Area Generation NOx (tons per month) and Emission Factor (lbs/MWh)

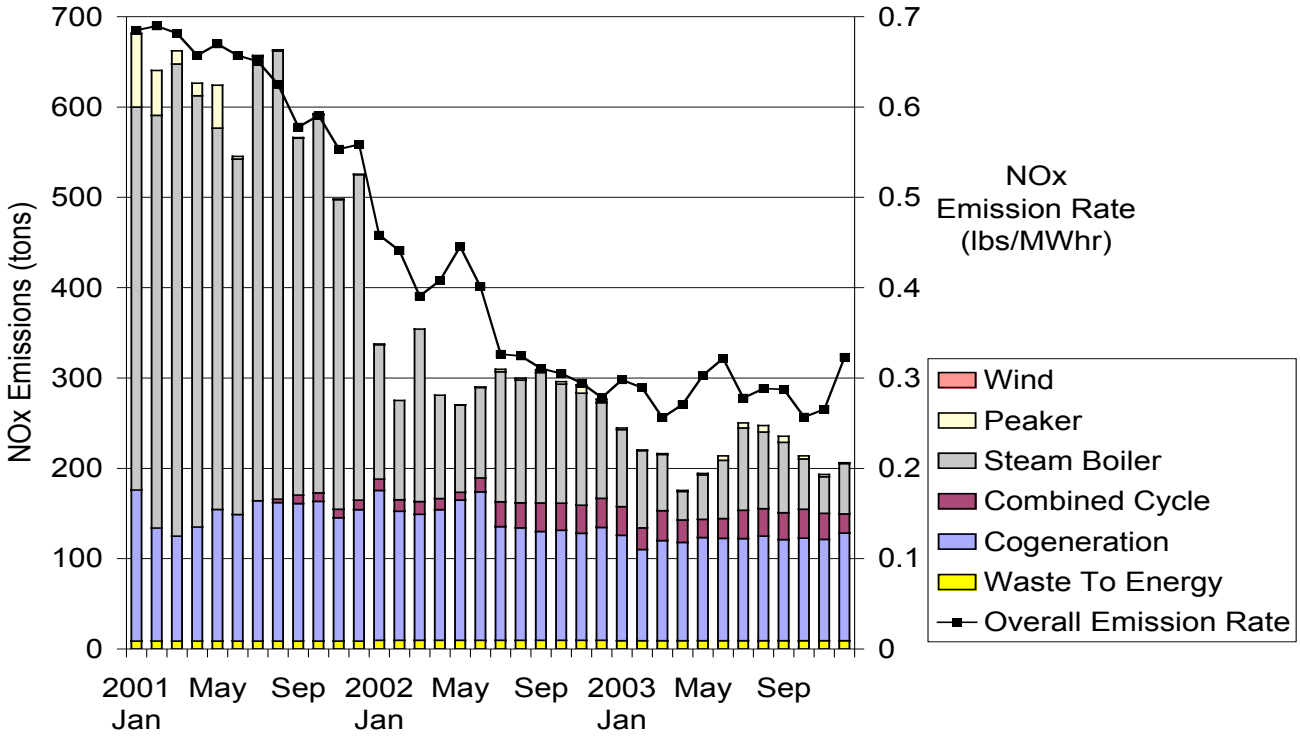


Figure 3-16 2001 to 2003 Bay Area Generation PM10 (tons per month) and Emission Factor (lbs/MWh)

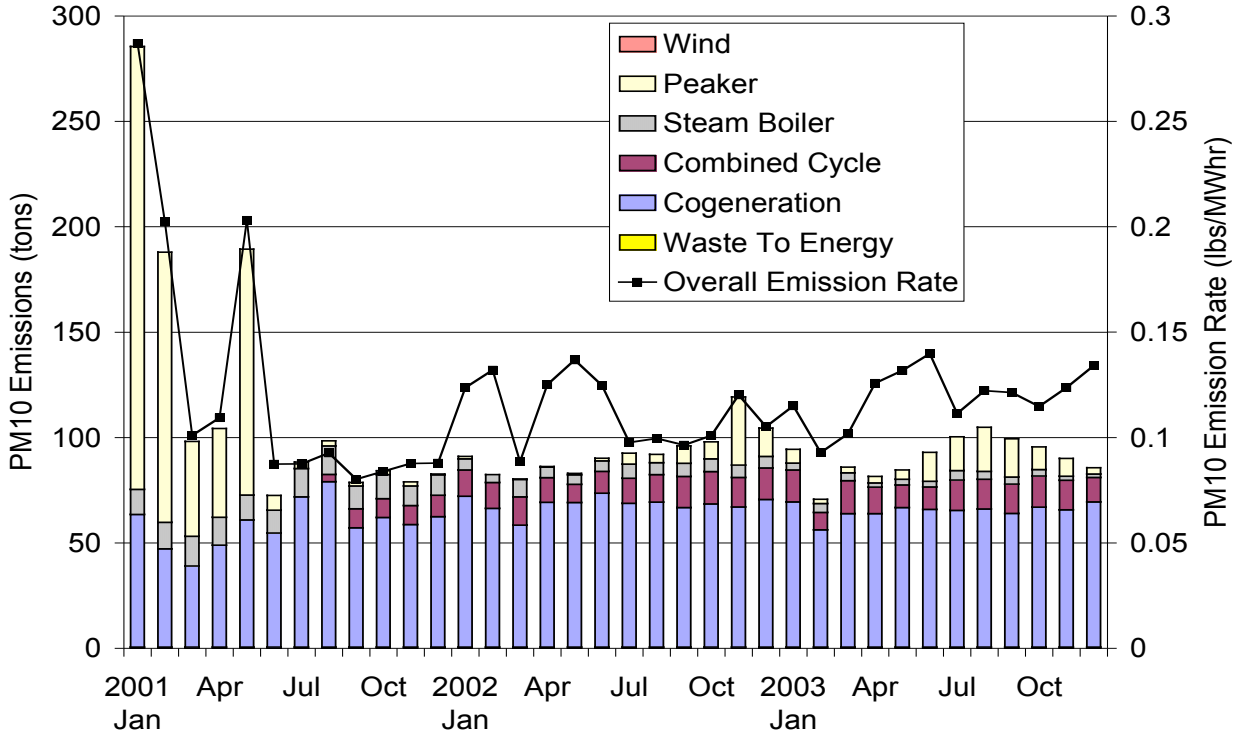
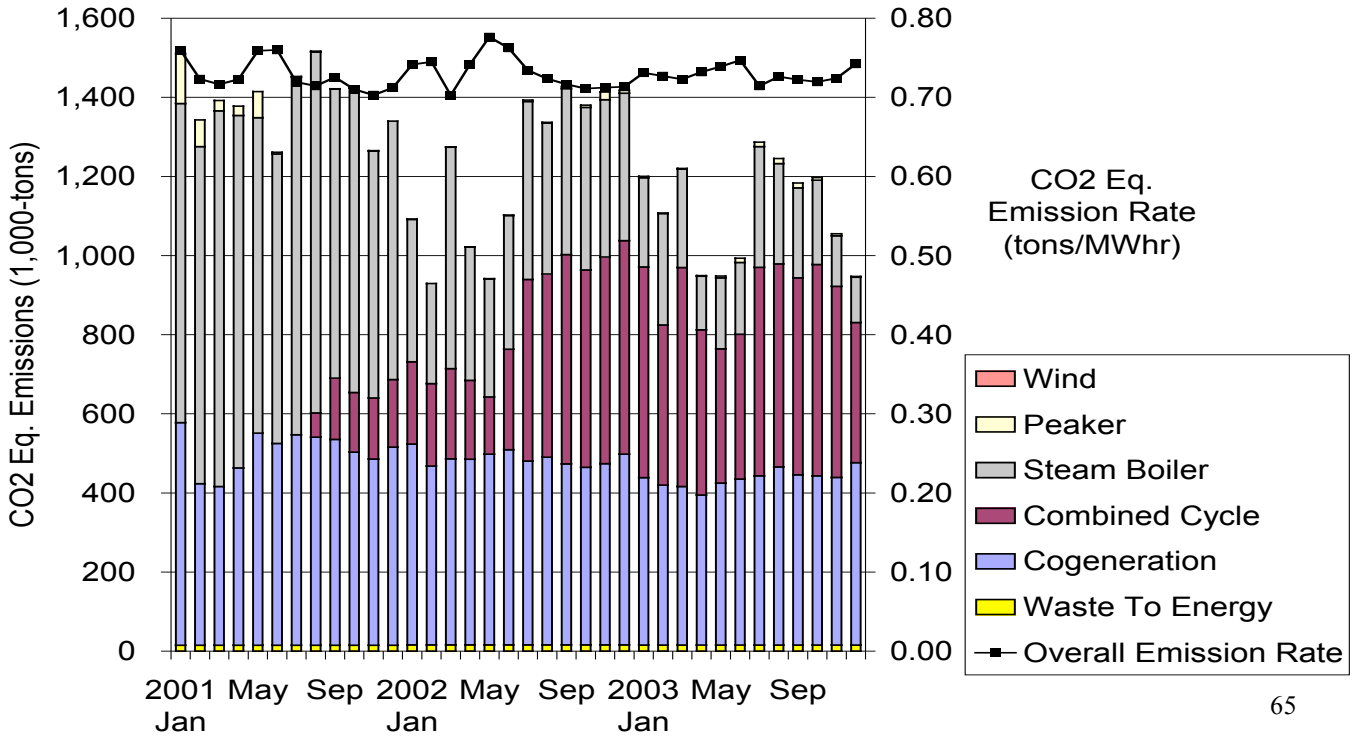


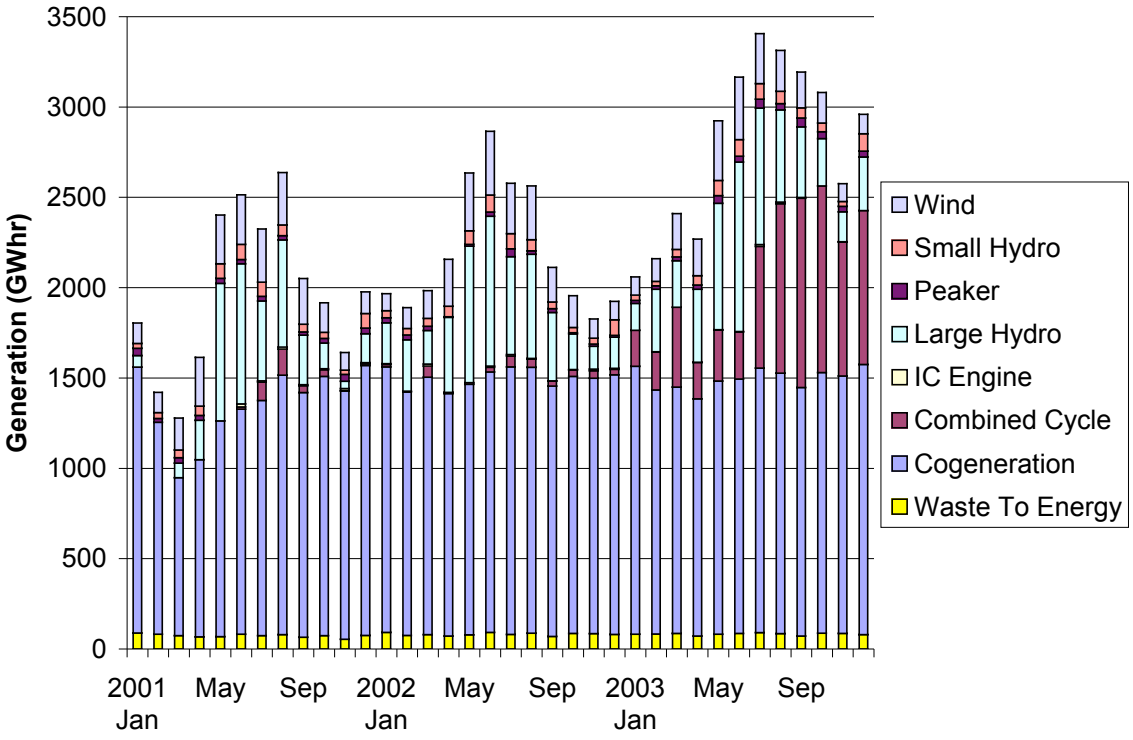
Figure 3-17 2001 to 2003 Bay Area Generation CO_2 (million tons per month) and Emission Factor (tons/MWh)



San Joaquin Valley APCD

San Joaquin Valley has several modern combustion turbine combined cycle units that came online in 2003, as shown in Figure 18. Otherwise, the generation is dominated by cogeneration. However, San Joaquin does appear to have a more diverse generation system than compared to Bay Area. This is highlighted by the CO_2-eq emission factor (Figure 21) that is lower than Bay Area (Figure 17) or South Coast (Figure 13). Otherwise Figures 19, 20 and 21 show that San Joaquin generation emissions are dominated by cogenerators.

Figure 3-18 2001 to 2003 San Joaquin Valley Generation (GWh)



The San Joaquin generation emissions (shown on Figures 19, 20 and 21) show the effect of the diverse mix of generation types available in the San Joaquin basin. Many are “emissionless” such as wind and hydro, which cause the seasonal variation in the emission factors and result in lower emission factors than Bay Area and South Coast. Note the San Joaquin air district does not have any steam boilers currently operating.

Figure 3-19 2001 to 2003 San Joaquin Valley Generation NOx (tons per month) and Emission Factor (lbs/MWh)

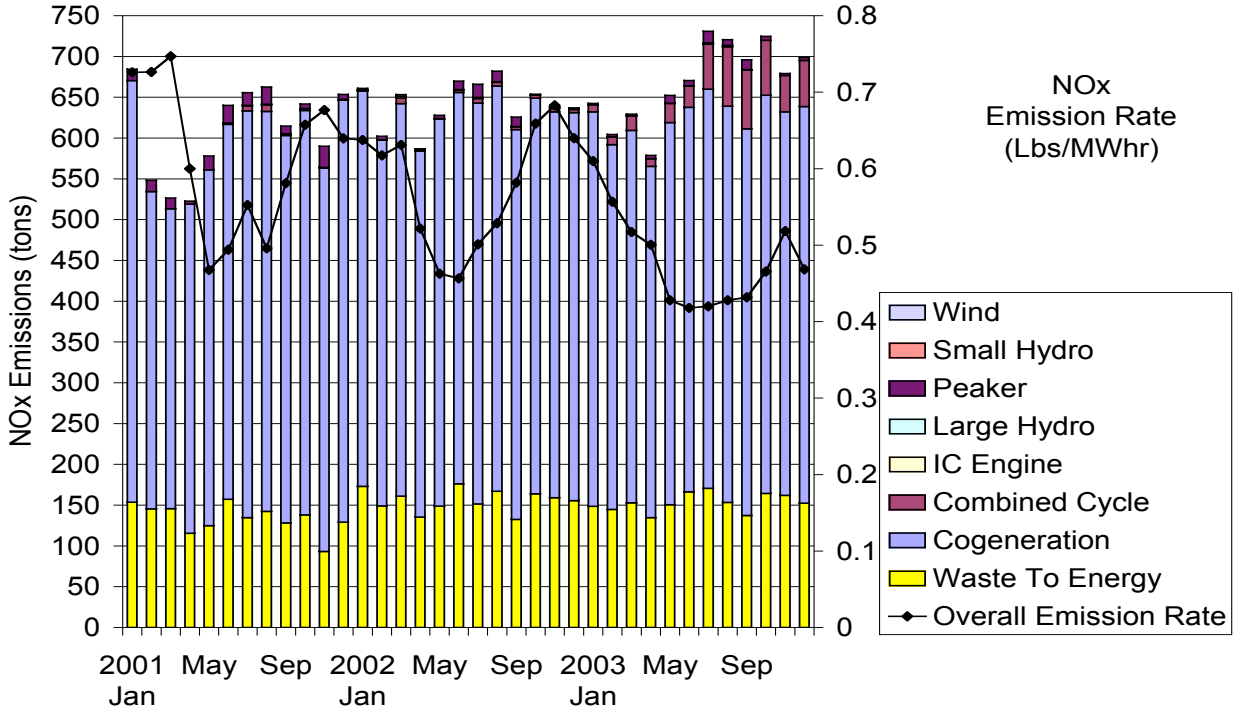


Figure 3-20 2001 to 2003 San Joaquin Valley Generation PM10 (tons per month) and Emission Factor (lbs/MWh)

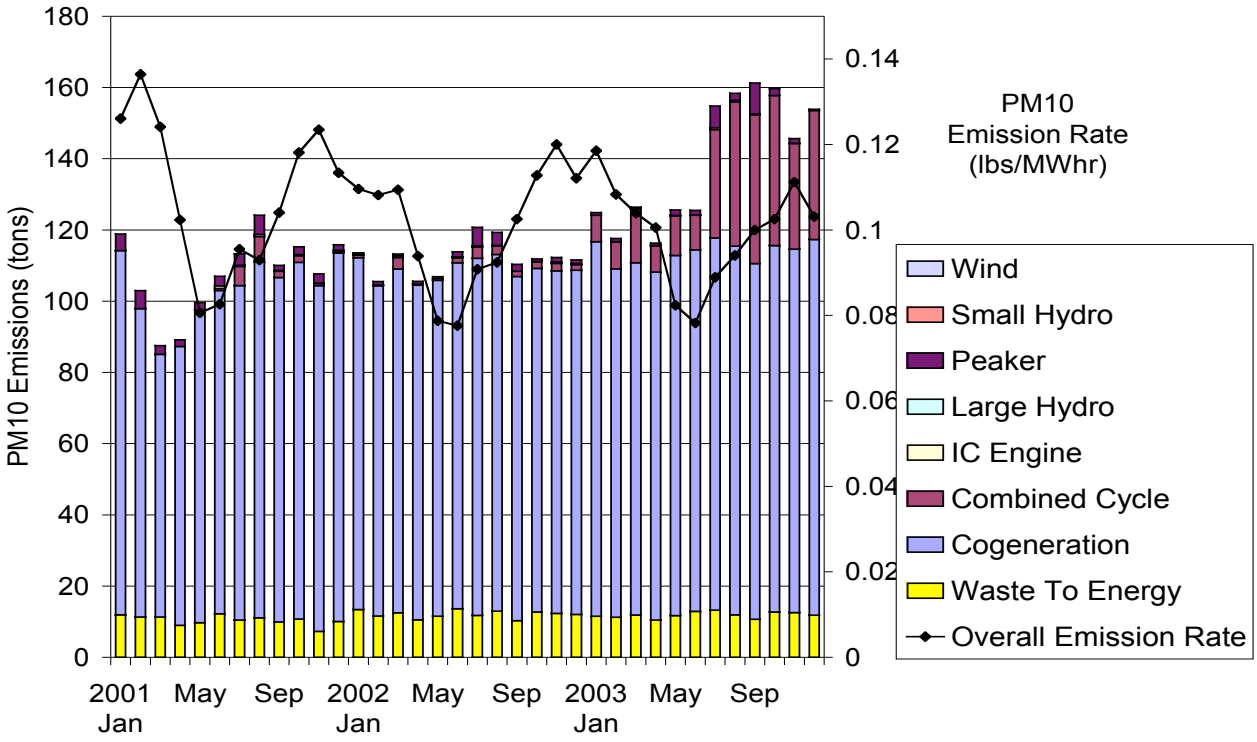
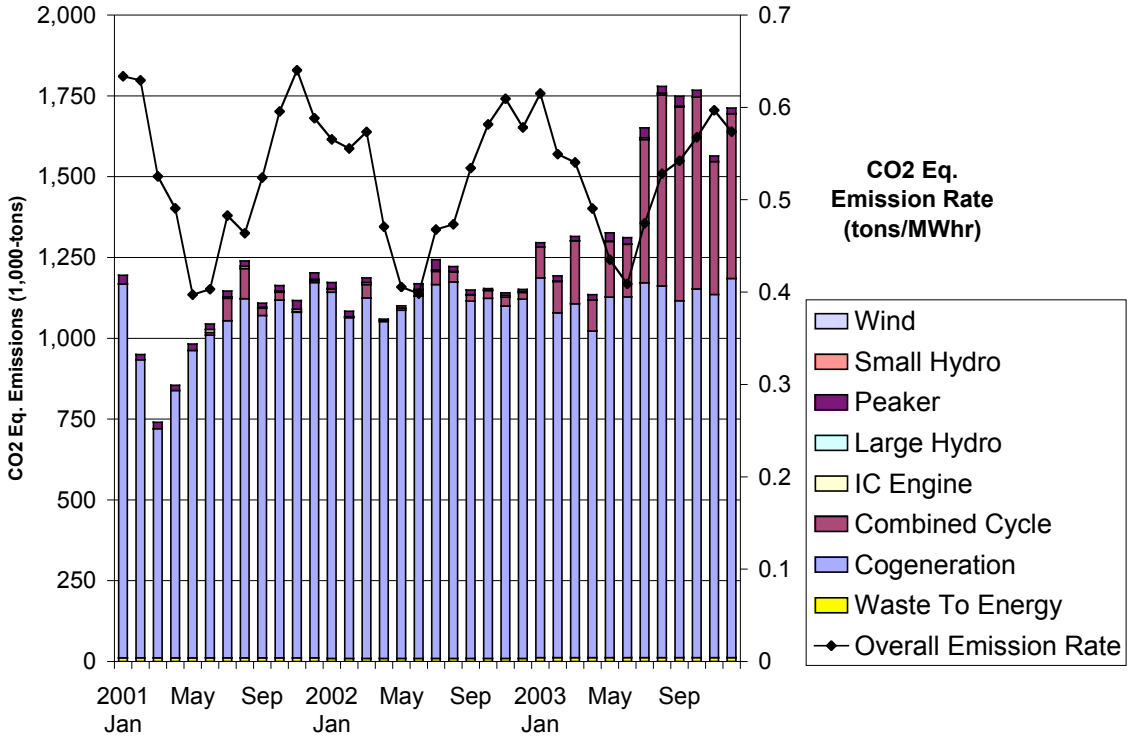


Figure 3-21 2001 to 2003 San Joaquin Valley Generation CO_2 (million tons per month) and Emission Factor (tons/MWh)

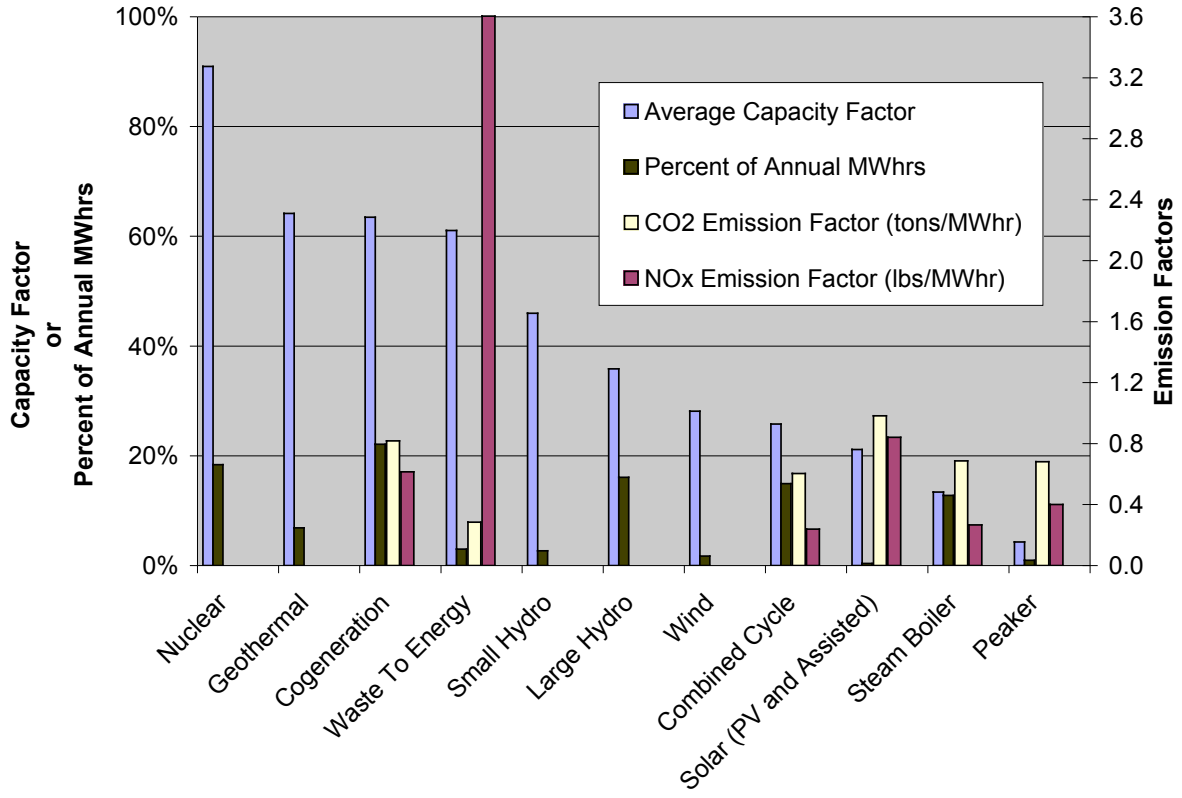


- **Regional Finding:** While the NOx emission factor is declining in the Bay Area, San Joaquin, and statewide, the trend is less clear in the South Coast region. However, NOx emissions are declining throughout California.
- **Regional Finding:** Cogeneration dominates PM10 emissions on a regional and statewide basis.
- **Regional Finding:** The CO_2-eq emission factors are similar for Bay Area and South Coast, but lower in San Joaquin due to more "emissionless" sources such as wind and hydroelectric.

Technology Comparisons and Dispatch Considerations

As shown in Table 3, emissions contributions from the generation sector total very small percentages of the state's emission inventory. The continuing addition of pollution control technologies through retrofit rules, stringent regulations and a diverse mix of resources combine to create a generation fleet of more than 61,000 MW (Table 1) with a very low emissions profile. However, there are some important differences in environmental performance between the fuel-fired portions of the fleet. Figure 22 provides a comparison of emission rates for NOx and CO_2-eq for 11 generation technologies used in California in 2003. The figures also show the varying capacity factors and the percentage contribution to total annual generation.

Figure 3-22 2003 Generation Capacity and Emissions Factors (NOx lbs/MWh and CO_2-eq t/MWh)



Waste to Energy has a much higher NOx emission factor on a per megawatt-hour basis compared to steam boilers, combined cycles and peakers, but its CO_2-eq emissions rate is much lower due to the use of renewable fuels such as biomass and landfill gas. Overall, the contribution to generation is very low, but its contribution to NOx emissions inventories is high. However, waste to energy generation may be environmentally preferable if compared to other means of disposing of the same waste material, such as burning or allowing to decay in

landfills. Such means of disposal may have more significant environmental effects than the air emissions generated through waste to energy or biomass generation.

Another category that appears to be a major contributor to air emissions is cogeneration. Without correcting for energy and emissions savings from the sequential cogeneration of electricity and useful thermal energy, this technology appears to have relatively high NOx and CO_2-eq emission factors. Cogeneration operates at very high capacity factors (i.e., baseload) and generates about 20 percent of our annual in-state generation. As shown on Figure 5, in August 2003, the almost 3,800 GWhrs of cogeneration generation emitted about one-third of all NOx emissions, or about 1,000 tons per month. In contrast, the nearly 8,900 GWhrs of combined cycle, steam boiler and single cycle turbine generation produced about the same total amount of NOx emissions during peak summer months. Figure 22 also shows that the cogeneration fleet accounted for about 22 percent of the total MWhrs in generation for 2003, while the combined cycle units, steam boilers and simple cycle turbines account for about 28 percent of total MWhrs for the same period. In summary, the cogeneration fleet produces as much or more total NOx emissions than the other natural gas-fired parts of the fleet because they operate more, even though they use mostly natural gas and are a much smaller portion of the state's generation capacity.

However, the effects on air emissions may be not discernable with the data used to generated the figure. The emission factors shown do not account for the benefits of cogeneration (i.e., the amount useful thermal energy delivered to a thermal host or process and the avoided emissions) and any self-generation at the facility. Even if the emission factors are 5 to 10 percent too high, cogeneration has higher emission factors than the steam boilers, the combined cycles, and the peakers.

The manner in which generation resources are dispatched is an important factor in assessing the relative emissions contributions from each of the main fuel and technology types. While the Must Take resources (e.g., nuclear, geothermal and cogeneration, and waste to energy) and Intermittent resources (wind, hydro, and solar) are not really dispatched, it is informative see their relative annual energy contribution and emissions factors, as appropriate.

Between 2001 and 2003, steam boilers reduced their dispatch and energy production while the new combined cycles increased their dispatch and energy production. The effect of the increased dispatch of the combined cycles can be seen in Figures 26 and 27. NOx and CO_2-eq combined cycle emissions increased while NOx and CO_2-eq steam boiler emissions have decreased. Overall, NOx emissions and the emission factor have decreased as the last few NOx control retrofits were implemented in the 2001 and 2002 timeframe on the steam boilers. CO_2 emissions and the emission factor have slightly decreased as new, more efficient combined cycles were added to the system.

Lastly, the peakers have improved their NOx and CO_2-eq emission factors from 2001 to 2003 as new peakers were added to the system. Still, the peakers operate very little and produce very little of the annual energy.

Does Displacing Steam Boilers Provide an Air Benefit?

In 2001 during the energy crisis, the state relied on steam boilers for over 35 percent of their in-state generation. By 2003, steam boilers were contributing less than 13 percent of annual in-state generation. In the same time period combined cycles increased their contribution from 4 to 15 percent. However, the NOx and CO_2-eq emission factors are not that different. Figures 23 through 26 compare the steam boilers and combined cycles from 2001 to 2003.

Figure 3-23 2001 to 2003 Natural Gas-Fired Steam Boilers NOx (tons per month) and Emission Factor (lbs/MWh)

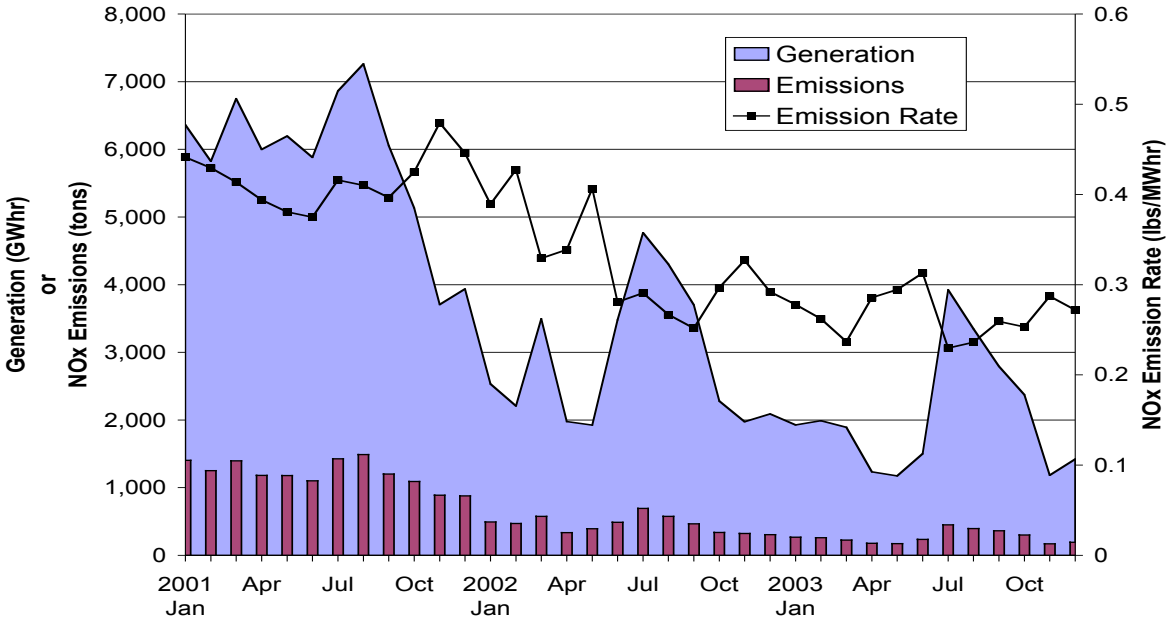


Figure 3-24 2001 to 2003 Natural Gas-Fired Steam Boilers CO_2 (million tons per month) and Emission Factor (tons/MWh)

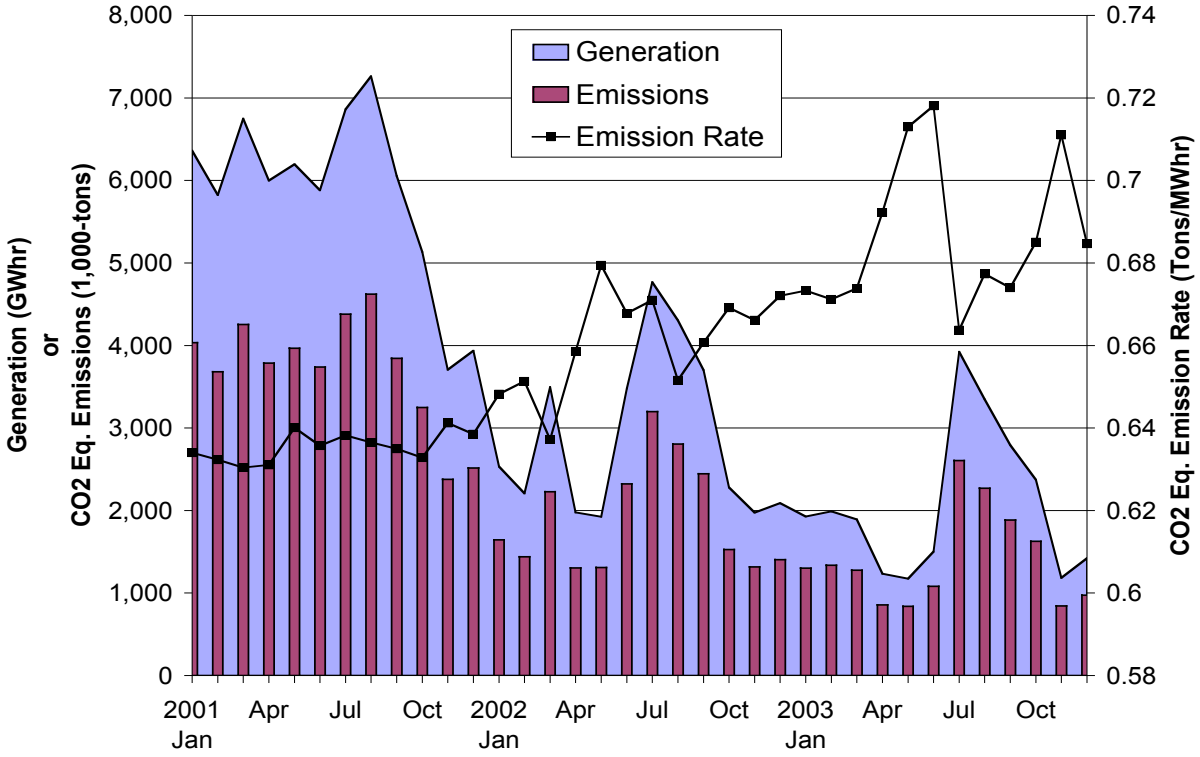


Figure 3-25 2001 to 2003 Combustion Turbine Combined Cycle NOx (tons per month) and Emission Factor (lbs/MWh)

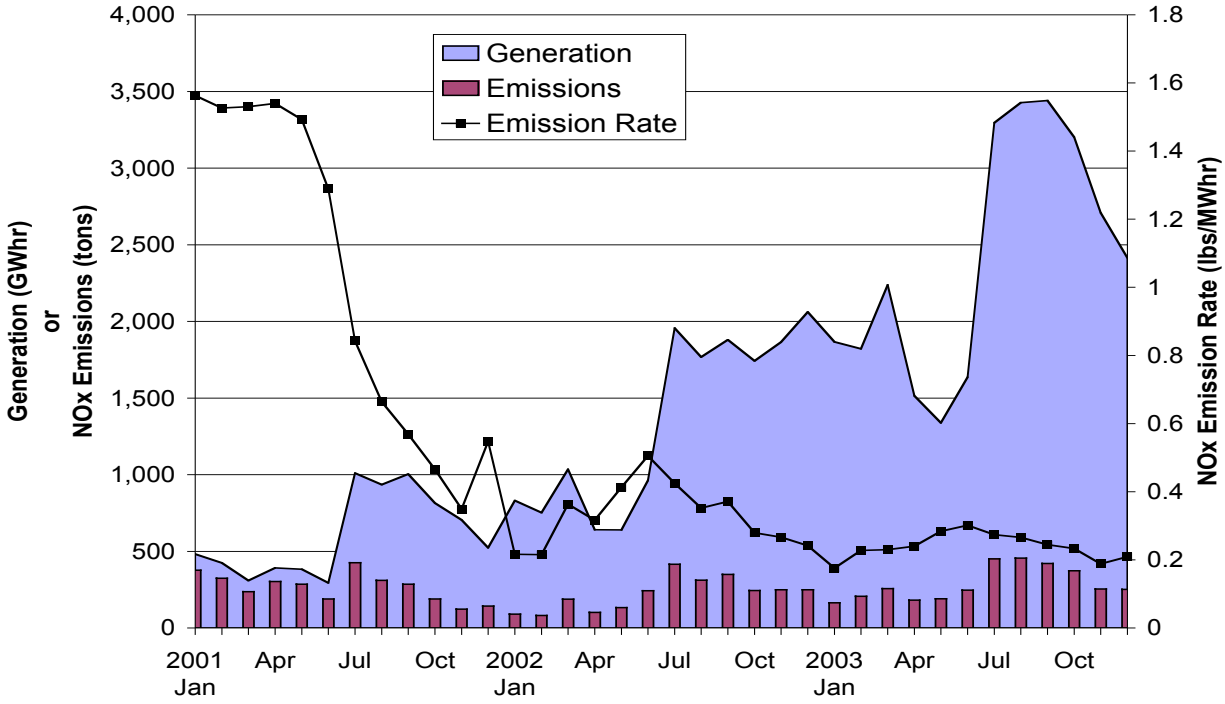
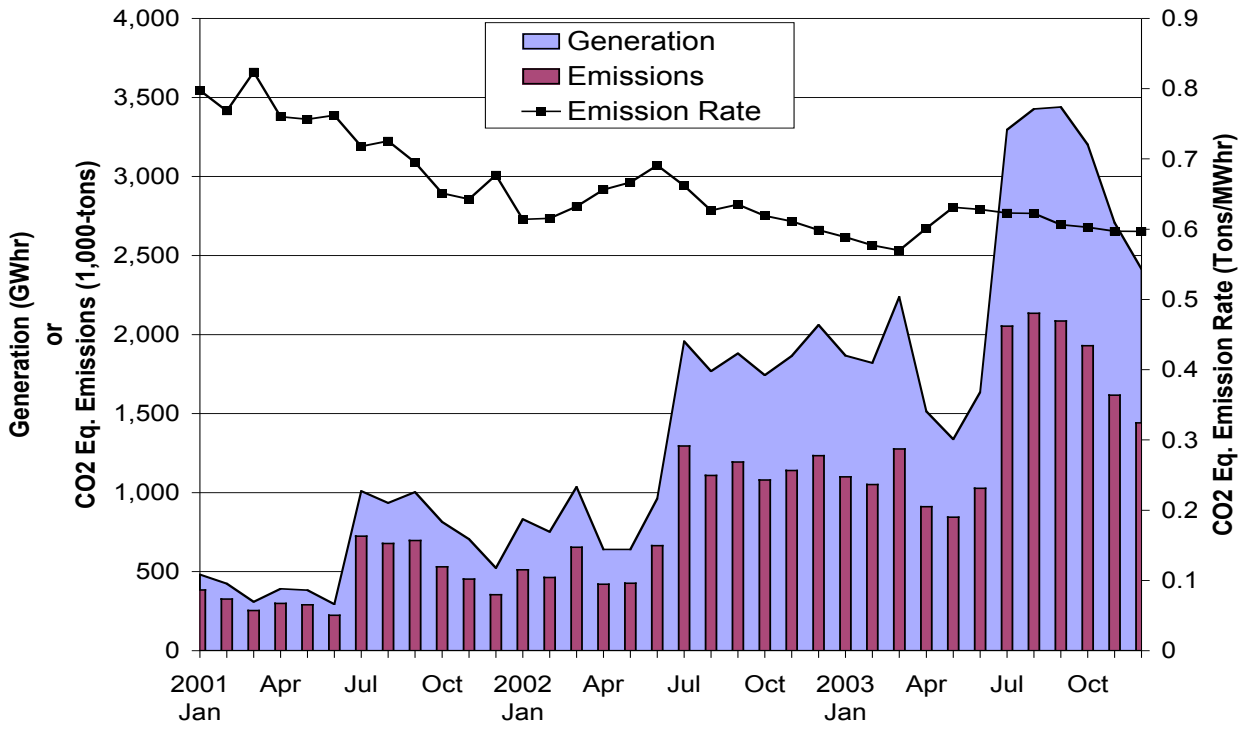


Figure 3-26 2001 to 2003 Combustion Turbine Combined Cycle CO_2 (million tons per month) and Emission Factor (tons/MWh)



The steam boiler CO_2-eq emission factor in 2001 when the boilers were frequently dispatched compares favorably to the combined cycle CO_2-eq emission factor in 2003 when the new combined cycles are included in the fleet averages. Similarly, the NOx emission factors in 2003 compare favorably when the final NOx retrofits on the steam boilers are weighted into the average. It appears that the fleet of combined cycles now operating in-state are only marginally better in terms of air emissions and efficiency (if CO_2-eq is used as a proxy for steam boilers or combined cycle efficiency).

Finding: New power plants appear to be displacing existing power plants without appreciable differences in emissions of oxides of nitrogen, particulate matter, or carbon dioxide equivalent.

Finding: The results and trends determined by the analysis of 2001 to 2003 monthly generation and air pollutant emissions reconfirm findings and trends of earlier environmental reports.

CHAPTER 4: BIOLOGICAL RESOURCES

Summary of Findings

Specific 2005 Biological Resources findings include:

- **Habitat Loss Impacts -** The 23 operational natural gas-fired power plants licensed by the Energy Commission between 1996 and April 2003 caused the permanent loss of 1,039 acres; 86 percent of the impacted acreage was natural habitat (895 acres) while 14 percent of the total (144 acres) was on existing industrial and agricultural land. Impacts to sensitive ecosystems were mitigated through permanent conservation of 2,229 acres of habitat. Sixty-five percent of the new power plants were constructed on agricultural or industrial land, however, new transmission lines and natural gas pipelines constructed in undisturbed desert ecosystems accounted for much of the acreage impacts in natural habitats.
- **Once-Through Cooling Impacts** - Twenty-one natural gas and nuclear power plants totaling 23,883 megawatts (MW) are located on the California coast or in bays or estuaries and use hundreds of millions of gallons of water a day for once-through cooling. Impacts to marine and estuarine ecosystems from the entrainment and impingement of aquatic organisms can be significant. Repowering proposals at five coastal power plants have included modern technologies that meet current air emissions standards, but rely on the continued use of 1950s era technologies that perpetuate impacts to aquatic ecosystems. A new Energy Commission report (Foster 2005) determines that more than two-thirds of the 21 power plants have not conducted the studies required by the Clean Water Act to adequately determine thermal discharge, impingement, and entrainment impacts. Recent changes in U.S. Environmental Protection Agency rules regarding once-through cooling intakes may require these systems to be substantially modified or replaced to reduce their effects on marine organisms.
- **Ocean Protection Council -** In 2004, Governor Schwarzenegger established the Ocean Protection Council in order to implement the recent California Ocean Protection Act and coordinate the work of state agencies related to the "protection and conservation of coastal waters and ocean ecosystems."
- **Hydroelectric Power Generation Impacts** - Development and operation of California's 14,000 MW hydroelectric system has created significant, on-going, under-mitigated impacts in rivers and streams. Riverine ecosystems are altered and degraded and can no longer support populations of wild salmon, steelhead, native trout, or amphibians. Fish passage for endangered migratory species like salmon and steelhead trout are generally lacking. Thirty-seven percent – 5,000 MW – of California's hydroelectric system is expected to be relicensed by Federal Energy Regulatory Commission between 2000 and 2015, presenting important opportunities to mitigate impacts and bring a large portion of the state's

energy infrastructure into conformance with modern science and regulatory standards.

- **Wind Power and Avian Mortality –**Wind farms, and the transmission lines needed to link them to the grid, are projected to expand in the next few years in order to help meet California's Renewable Portfolio Standard goals. Bird mortality from strikes with turbine blades continues to be the primary biological resource issue concerning wind energy. At the Altamont Pass Wind Resource Area in Alameda County, estimates of bird mortality range from 881 – 1,300 raptors and 1,766 – 4,721 total birds killed annually. Some turbine owners have agreed to implement measures to lessen the number of bird collisions, and a few high-risk turbines may be removed or shut down during the winter season when bird collisions are the highest. Additionally, new research funded by the Energy Commission Public Interest Energy Research Program (PIER) is attempting to determine if certain mitigation measures can effectively reduce impacts of wind turbines.

Introduction

The Biological Resources section of this Environmental Performance Report assesses impacts to California's natural environment from power plant development and operations, electric transmission lines and natural gas pipelines. The Biological Resources section is divided into two parts – Terrestrial Habitat Impacts and Aquatic Habitat Impacts. The Terrestrial Habitat section discusses trends of direct habitat loss from power plant development, habitat and species impacts associated with renewable energy development, new transmission lines, and new gas supply pipelines. We also discuss the impacts to protected species from increased nitrogen deposition in regions with nitrogen-deficient soils and protected species habitat. In the Aquatic Habitat Impacts section we describe the impacts of coastal power plants that use once-through cooling technology and hydroelectric generation and its impacts to rivers and streams.

The **2001** and **2003 Environmental Performance Reports** (CEC 2001, CEC 2003b) made several findings that are still relevant to this discussion:

- Most power plants and ancillary facilities were built before environmental regulations held them to any environmental standards. As a result, many unmitigated impacts have been perpetuated.
- While the majority of the original steam-powered plants were in coastal areas where once-through cooling using ocean or bay water was available, the majority of new combined-cycle plants are inland and do not use once-through cooling. The continuing use of once-through cooling at existing coastal and estuarine power plants will perpetuate impacts to the marine environment.
- Hydroelectric operations have resulted in significant, unmitigated impacts to aquatic ecosystems throughout California. Many hydroelectric facilities are due for relicensing in the next 15 years, creating opportunity for increased mitigation.

- The amount of habitat loss from the electric infrastructure has been low compared to that from other human impacts and land development. However, power plant development in the San Joaquin Valley has contributed to significant cumulative losses to endangered species habitats.
- Nitrogen deposition from new power plants and repower projects under Commission jurisdiction have potential cumulative impacts when the power plants are near nitrogen sensitive habitats, such as serpentine soil and desert plant communities.
- As the state expands renewable power to meet RPS goals, the biological resource impacts of additional wind power generation and associated transmission line additions and upgrades must be given careful consideration and mitigated. Avian mortality from birds striking wind turbines continues to be a major concern.
- New transmission line, natural gas pipeline, or water supply pipeline right-of-ways for new power plants under Energy Commission jurisdiction should, where possible, avoid federal or state wildlife refuges or preserves, public or private habitat mitigation banks, or other similar protected areas (unless they are within an approved utility corridor) because that perpetuates impacts to species which need protection from further habitat loss.

Terrestrial Habitat Impacts

California's Mediterranean climate and its varied topography interact to produce an amazing diversity of both landscapes and species. If you travel the length or breadth of the state, you will experience its species and habitat diversity as a progression of different environments with distinct plant species and climatic conditions. California is comprised of 11 bioregions containing an incredible mosaic of unique aquatic and terrestrial environments such as marshes, grasslands, woodlands, and forests. Each bioregion, represented by a specific habitat, community, or dominant plant species is characteristic of the region's natural history.

California is the most biologically diverse state of the conterminous United States, and many of our most sensitive species are quite rare and have very localized distributions. These rare and endangered species can be severely impacted by energy development if the power plant project, natural gas pipeline, or transmission line directly or indirectly affects the species and/or its habitat. While mitigation may reduce a local impact, the greatest concern for many state and federally protected species is the cumulative habitat loss due to urban development. By continuing to try to minimize the acreage impacted by energy development, efficient use of land for power production will reduce impacts to protected species.

Currently, California has 220 state and 185 state and federal protected native plants, and 79 state and 123 federal protected wildlife species. In the conterminous United States, California has the most federal protected species. When all the

states are considered, only Hawaii has more than California. The number of federally protected species in California has changed since the **2003 Environmental Performance Report** - two plant species were delisted and one was added, and one protected wildlife species was delisted and six new wildlife species were added to the federal list. No new plant or wildlife species have been added to the state protected species list since 2003.

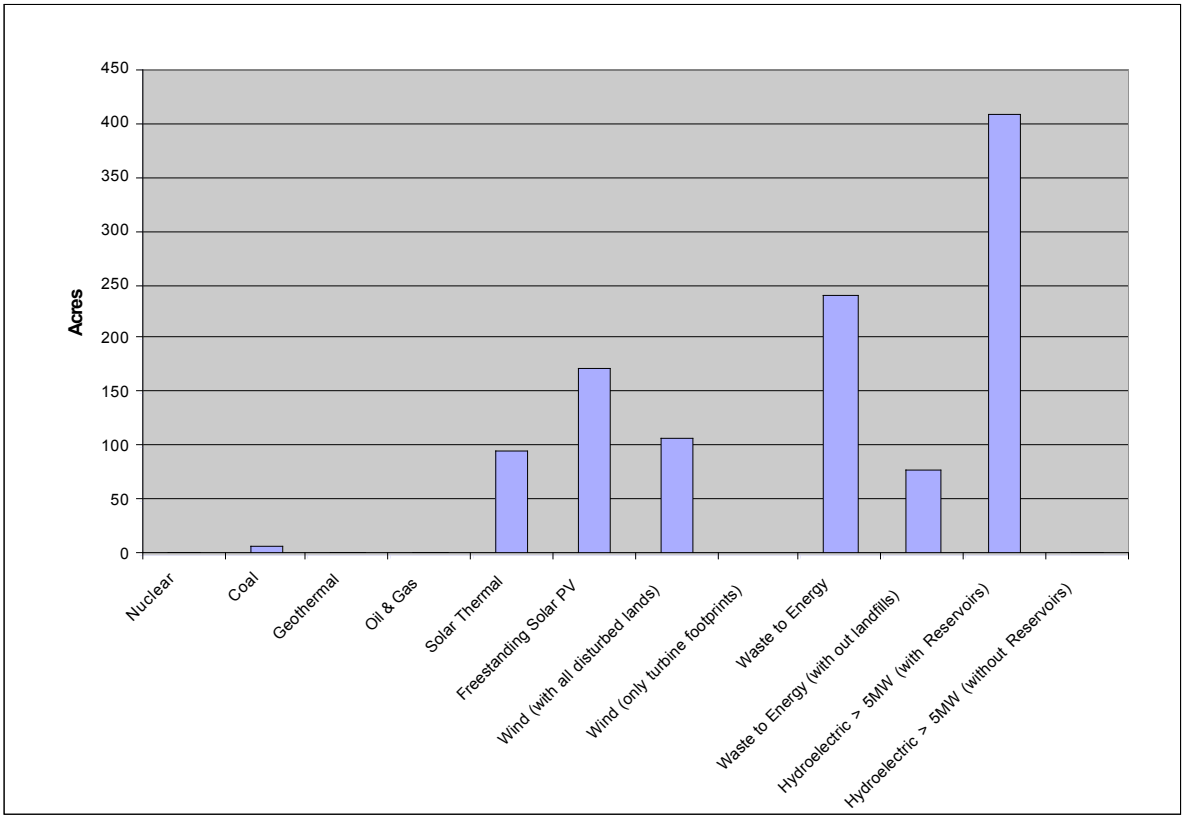
Direct Habitat Loss of Energy Development

It is estimated that 8.4 million acres of private land in California are developed. Estimates of losses to California's wetlands, coastal lands, and prime farmlands due to urban development have also been compiled (USDA 2000, CalEPA 2002). However, losses specific to the electricity generation sector have only recently been estimated. In 2002, about 10,500 acres of the state was estimated to be in direct electricity production, providing a total capacity of approximately 61,000 MW. Thus, electricity generation facilities account for only about 0.1 percent of urban development and have not resulted in large amounts of land converted from open space into industrial development. However, this calculation ignores large portions of the electrical generation system.

If the reservoirs behind dams are considered as fuel storage, then habitat losses from all power generation increases to over 275,000 acres. If the amount of land and roads surrounding the wind turbines at the wind resource areas is included as in use for power production, an additional 8,345 acres could be considered lost. The range of impacted acreage associated with energy production is therefore between 10,500 and 288,900 acres depending upon the method used in the calculation. If all energy-related reservoirs, landfills, and the open space between wind farm turbines are counted as an energy-related land use, almost 3.5 percent of urban development is being used in some manner for electricity production and this use of the land can result in minor or significant loss of habitat to local wildlife species.

Based on the amount of electric capacity per acre needed to produce 20 MW of electricity, the most efficient use of land (and the lowest amount of lost habitat) for central station power production is nuclear (1.5 acres, if the many thousands of buffer area acreage around the facilities are not included), natural gas (3.3 acres), and geothermal steam (3.4 acres). (Figure 3-1). If all energy technologies are considered, the least efficient use of acreage (habitat) to produce 20 MW are hydroelectric (409 acres, if reservoirs are included), solar thermal (98 acres) and

FIGURE 4-1 Amount of Acreage Needed to Produce 20 MW



photovoltaics (195 acres). Although hydroelectric reservoirs and bypass reaches eliminate large amounts of riverine, riparian, and terrestrial habitats, they can provide habitat for other species of fish and wildlife. Stand-alone solar photovoltaic and solar thermal facilities are an inefficient use of land, but when photovoltaics are located on the roof of a home or business no additional acreage is impacted. To produce 20 MW of electricity at a wind farm or a waste-to-energy facility associated with a landfill, 108 acres and 241 acres are required, respectively. However, these areas can still provide habitat for local wildlife species.

Since 1996, 23 power plant projects permitted by the Energy Commission have been constructed and are currently operating. During construction, 1,039 acres were either permanently impacted. Fifteen (65 percent) of these new power plants were constructed either on an existing industrial site or on agricultural land and impacted approximately 144 acres, a minimal amount of habitat. However, the remaining eight new facilities (including long linear facilities such as gas supply pipeline and new transmission lines) were constructed on natural lands containing at least some wildlife habitat. When the power plants and appurtenant facilities were constructed, approximately 895 acres were impacted, or 86 percent of the total acreage impacted since 1996.

The High Desert Power Plant Project in San Bernardino County is a notable example. The power plant site is located on the old George Air Force Base and no wildlife habitat existed where the power plant was constructed. However, the power plant required the construction of a new 25-mile gas supply pipeline which impacted more than 460 acres during its construction. Since the High Desert Project is located in the Mojave Desert, the home of the state and federal protected desert tortoise, the acreage impacts are considered permanent since habitat recovery following construction, even with habitat restoration efforts, is very slow and often unsuccessful.

> **TREND**: Since 1996, the majority of new power plants were constructed on industrial sites containing little or no wildlife habitat. However, significant wildlife habitat impacts continue to occur affecting state and federal protected species and their habitats.

Habitat Compensation

To offset habitat loss from power plant and appurtenant linear facilities development, habitat compensation and restoration is often required. The Energy Commission has required habitat compensation and suitable endowments to fully mitigate impacts to California's sensitive natural resources as part of its licensing review. Of the 23 new power plants permitted by the Energy Commission that are now operating (Table 3-1), construction of eight of these new facilities impacted a variety of habitats including desert scrub, grasslands, and wetlands. Since these

TABLE 4-1 Acreage Impacts of New Power Plants and Habitat Compensation Acreage

POWER PLANT NAME	SITE DESCRIPTION	P. PLANT ACRES IMPACTED	ACRES HABITAT COMP.	YEAR ONLINE	COUNTY	ONLINE MW
BLYTHE I	Desert scrub	76.00	77.15	2003	RIVERSIDE	520.00
KING CITY ENERGY CENTER	Brown Field	6.70	0.00	2002	MONTEREY	50.00
DELTA ENERGY CENTER	Brown Field	30.00	1.48	2002	CONTRA COSTA	861.00
PICO POWER PLANT	Industrial	0.00	0.00	2005	SANTA CLARA	147.00
ELK HILLS	Industrial & Natural	66.46	101.94	2003	KERN	500.00
GILROY ENERGY CENTER	Industrial & Ag	7.00	0.00	2002	SANTA CLARA	90.00
GWF HANFORD PEAKER	Industrial & Ag	6.10	27.40	2001	KINGS	95.00
GWF HENRIETTA	Industrial & Ag	20.00	9.30	2002	KINGS	96.00
GWF TRACY PEAKER	Ag	34.60	34.60	2003	SAN JOAQUIN	169.00
HIGH DESERT	Brown Field/Natural	461.20	859.02	2003	SAN BERNARDINO	750.00
HUNTINGTON BEACH 3 & 4	Industrial	0.00	0.00	2003	ORANGE	225.00
LA PALOMA	Saltbush Scrub	23.00	246.50	2003	KERN	1124.00
LOS ESTEROS	Industrial	18.00	40.00	2003	SANTA CLARA	180.00
LOS MEDANOS	Industrial	12.00	0.00	2001	CONTRA COSTA	555.00
MOSS LANDING	Industrial	0.00	183.00	2002	MONTEREY	1060.00
PASTORIA PHASE 1	Grasslands & Scrub	160.60	245.20	2005	KERN	250.00
SUNRISE II	Industrial	0*	237.40	2003	KERN	265.00
SUNRISE	Industrial & Natural	82.00	155.10	2001	KERN	320.00
SUTTER POWER PROJECT	Grasslands	16.00	11.00	2001	SUTTER	540.00
VALERO	Industrial	2.00	0.00	2002	SOLANO	51.00
WILDFLOWER - INDIGO	Scrub	10	0*	2001	RIVERSIDE	135.00
WILDFLOWER -LARKSPUR	Ag	8.00	0*	2001	SAN DIEGO	90.00
WOODLAND II - MID	Brown Field	0.00	0.00	2003	STANISLAUS	80.00
		1039.66	**2229.09**			**8153.00**
* SUNRISE II is on the SUNRISE site						
		Acres include ancillary facilities (evap ponds and/or linears)	Acres include ancillary facilities (evap ponds and/or linears)			

habitat types were often considered to be protected species habitat, habitat compensation was often sizable and expensive. As an example, the High Desert Power Plant Project (San Bernardino County) impacted more than 460 acres of desert tortoise habitat and provided compensation funds to the Desert Tortoise Preserve Committee to purchase approximately 860 acres of compensation habitat. Approximately $552,000 was provided for habitat compensation by the project owner, SoCal Gas and Kern River Gas.

For the Sunrise Combined Cycle Expansion Project (Kern County), the new power plant development impacted hundreds of acres of San Joaquin kit fox habitat (state and federal protected) during construction of a 20+-miles water supply pipeline, so habitat compensation funds were provided to the Center for Natural Lands Management to purchase more than 390 acres of habitat in the nearby Lokern Road Preserve.

TREND: Since 1996, the Energy Commission has licensed 23 new power plants that were constructed and are currently operating (~8,153MW). Several projects impacted sensitive species habitat and were required to provide habitat compensation. To date, approximately 2,229 acres of

compensation habitat has been protected to mitigate temporary and permanent habitat impacts. A suitable endowment, to fund perpetual protection of the mitigation habitat, was also required as part of the habitat compensation strategy.

Nitrogen Deposition Impacts on Biological Resources

Nitrogen deposition impacts to nitrogen sensitive habitats is an emerging biological resource issue in certain parts of California. Since 1999, impact analyses have determined that impacts are significant in parts of California which resulted in additional habitat compensation being provided by the project owners for several power plant projects. This habitat compensation is in addition to the habitat compensation that was required for direct habitat loss associated with power plant construction.

Since the U.S. Forest Service developed guidelines to assess the effects of air pollution on wilderness resources in 1992 (Peterson *et al.* 1992), the Energy Commission has seen an increased interest by federal agencies and land managers in the potential air pollution impacts from proposed power plants. The most common concern has been increases in nitrogen emissions (in the forms of NOx, NO_2, and ammonia), which can fall to the earth as either wet or dry deposition[10] In areas where nitrogen deposition is already high, federal land managers are particularly concerned about new power plant projects that could increase existing pollution levels. For example, Joshua Tree National Park staff has evaluated nitrogen deposition from two proposed power plants to be located within 50 miles of the park. Nitrogen deposition can also impact sensitive plant and animal communities in areas that contain nitrogen poor soils (e.g. serpentine) and federal protected species. The U. S. Fish and Wildlife Service has begun evaluating potential nitrogen deposition impacts for power plant siting cases to determine if additional air offsets and/or habitat compensation is necessary.

Nitrogen is the primary limiting factor for plant growth in nitrogen poor soils. Exposure to nitrogen can result in impacts from direct toxicity and changes in species composition among native and non-native plants. When introduced into these habitats through deposition, nitrogen acts as a fertilizer and facilitates the establishment of non-native, weedy species that often out-compete the native plant species. This can result in a loss of native plant and animal diversity in conifer forests, deserts, coastal sage scrub, mountain lakes, lichen communities, oak woodlands, vernal pools, sand dune areas and areas with serpentine soil (Fox *et al.* 1989; Blanchard *et al*. 1996, ESA 1999, Weiss 1999, Weiss 2005).

When a proposed power plant project is to be located near a nitrogen-stressed ecosystems (one where ambient conditions are high and soils are already nitrogen saturated or are naturally nitrogen limited), applicants to the Energy Commission licensing process have been required to model their potential impacts and then provide mitigation for cumulative nitrogen impacts. As an example, in Santa Clara County the federal endangered Bay checkerspot butterfly has been affected by

changes in the environment from nitrogen deposition on serpentine grasslands habitats (Weiss 1999). During the Metcalf Energy Center, Pico Power Plant, and Los Esteros Critical Energy Facility certification review, the applicants were required to provide modeling scenarios. The results showed that power plant emissions could potentially impact nearby Bay checkerspot butterfly habitat. Habitat compensation and funding for land management to improve the butterfly habitat were required in these cases.

The PIER program has also been researching the statewide nitrogen deposition risk to biodiversity in California (Tonnesen [draft] 2005, Weiss 2005). Forty-eight Forest Resource and Protection vegetation types were analyzed for their exposure to nitrogen deposition. The highest nitrogen deposition rates in California are in the South Coast Air Basin, with levels as high as 21.5 kg-N ha^{-1} $year^{-1}$ decreasing to 3-4 kg-N ha^{-1} $year^{-1}$ in the east. Of the 48 habitat types modeled, 40 have greater than 1 percent of their acres exposed to at least 5 kg-N ha^{-1} $year^{-1}$ of nitrogen deposition. For example, 50 percent of coastal sage scrub, perennial grasslands, freshwater emergent wetlands, valley foothill riparian, chamise redshank chaparral, and general conifer habitats are exposed to a level of 5 kg-N ha^{-1} $year^{-1}$ of nitrogen deposition (Weiss 2005).

> **TRENDS:** Since 1999, nitrogen emissions and impact assessments have become a significant emerging biological resource issue for power plant siting cases in the San Francisco Bay area and in Southern California. Staff expects new power plants proposed for air basins high in nitrogen to undergo increased scrutiny for potential impacts to protected species and their habitat. To better understand where nitrogen deposition may be a critical power plant siting issue, the Energy Commission PIER program has begun to inventory potentially nitrogen-limited and nitrogen-saturated habitats in the state to determine where nitrogen deposition from proposed new power plants will likely be a significant biological resource issue. The research results will be reported in the 2007 Environmental Performance Report.

Impacts of Renewable Energy Development on Terrestrial Biological Resources

California recently adopted a new Renewable Portfolio Standard that sets mandatory goals for investor-owned utilities to increase the amount of renewable energy technologies within their power mix (SB 1078). Renewable energy facilities, like non-renewables, have the potential to impact state and federal protected biological resources and sensitive ecosystems during construction and operation. In addition, transmission lines connecting renewable energy facilities to the grid can cause protected species habitat loss and fragmentation. This section addresses the biological resource impacts associated with renewable energy development for wind, geothermal, solar, and waste-to-energy. Hydroelectric development, and its biological resource issues, is discussed in the Aquatic Habitat Impacts section.

Most renewable energy (expect for hydroelectric development) is currently generated in the foothills of the central coast, in the Central Valley and in southwestern California. Future renewable expansion, based on Energy Commission Renewable energy auction results (CEC 2003), is expected to include:

- Wind development in Alameda, Kern, Los Angeles, Mono, Riverside, San Bernardino, San Diego, and Solano counties.
- Landfill gas (waste-to-energy) development in Alameda, Contra Costa, El Dorado, Fresno, Los Angeles, Monterey, Orange, Riverside, San Bernardino, San Diego, San Mateo, Santa Clara, Santa Cruz, and Tulare counties.
- Biomass, digester gas, and municipal solid waste development in Colusa, Imperial, Los Angeles, San Bernardino, San Francisco, and Yolo counties.
- Geothermal development in Imperial, Modoc, Mono, and Siskiyou counties.
- Solar thermal expansion in San Bernardino County.

Wind Energy

California is one of the leaders in wind energy generation in the United States. In descending order of megawatt capacity, the five major wind resource areas in California are Tehachapi Pass, San Gorgonio Pass, Altamont Pass, Montezuma Hills, and Pacheco Pass. California's wind resource areas cover approximately 106,400 acres and provides 1,822 MW of capacity. Currently, only 8,300 acres are developed for wind turbines and roads, or only eight percent of the total wind resource area acreage. Not all of the acreage designated as the wind resource areas are impacted by wind turbines because spacing between turbines can be one to three times the rotor diameter (about 50 to 600 feet), and spacing between turbine rows is typically eight to 12 rotor diameters (about 400 to 2,350 feet). Acres impacted by wind turbine pads and roads are estimated to be between five percent and 34 percent of the total available wind resource areas. Wind turbine pads accounted for a very small percentage of the total permanent habitat impact - cumulatively only about 45 acres (CEC 2001).

The most significant biological resource issue of wind power development is bird collisions with turbine blades (Estep 1989, Thelander and Rugge 2000). A white paper on Avian Mortalities From Collisions and Electrocutions has been created for the **2005 Environmental Performance Report**. A number of factors contribute to the higher number of bird fatalities in California (Sterner 2002). As an early leader in wind energy production, many of California's wind resource areas were constructed before there was an understanding of bird fatality risk and ways to avoid the impacts. There have been multiple studies of avian use and fatalities at Altamont Pass, Tehachapi Pass, San Gorgonio Pass, and Montezuma Hills (Orloff 1992a, 1992b and 1996, and Smallwood and Thelander 2004). New information on the bird risk in the Tehachapi Pass is now available, and a comprehensive study of San Gorgonio Pass as well as a companion document comparing the bird risk at both areas may soon be published (Anderson 2004 and 2005 [in press]).

The most comprehensive study at the Altamont Pass Wind Resource Area (APWRA), funded by the Energy Commission PIER program, focused on trying to better understand the causes of bird mortality (Smallwood and Thelander 2004). The study estimated that between 1,766 and 4,721 birds, including 881-1,300 raptors are killed annually at the APWRA. Although there are many factors that can co-contribute to bird collisions, the researchers found several factors that were associated with high collision risk and recommend mitigation measures that could be implemented at the existing turbines to reduce the mortality rates. The researchers estimated that bird mortality might be reduced by up to 40 percent depending on the species, if the mitigation measures act synergistically and are implemented for the entire Altamont area (Smallwood and Thelander 2004). The study also suggests that placing larger turbines with blade reaches at least 29 meters above ground may reduce collisions by avoiding the air space birds tend to fly most frequently. The mitigation measures developed for the Altamont Pass still needs research to determine their effectiveness. These mitigation measures are currently not implemented elsewhere since more information on bird behavior and risk is needed for other wind resource areas.

Using New Mitigation Measures to Site Turbines in the Altamont Pass

A current wind repowering project in the Altamont Pass Wind Resource Area, the Buena Vista Wind Energy Project, is using new best management practices (Smallwood and Thelander, Smallwood and Neher 2004) to help site wind turbines in a manner to reduce bird collisions with wind turbines. The project proposes to remove 179 existing turbines, and replace them with 38 larger 1 MW turbines. The project owner has proposed to not locate the new turbines on or immediately adjacent to the upwind side of a ridge crest where raptor use is often higher. To study the effects of the new turbines and the mitigation measures, a scientifically defensible monitoring program will be implemented for a minimum of three years. One of the potential follow up mitigation measures includes habitat compensation (Buena Vista DEIR, 2004).

Turbine owners in the Altamont Pass have also agreed to remove some of the high-risk turbines, or shut down a portion of the turbines for part of the winter season when documented raptor collisions are more frequent (Erickson and Strickland 2005).

TRENDS: The current trend in wind energy development is to repower or replace existing smaller, less efficient turbines with much larger, more efficient designs. In 1996 the total rotor swept area, a factor considered highly contributory to bird fatality risk, was approximately 3,900,000 square meters in California. By 2002, it had decreased to approximately 3,650,000 square meters. However, as more facilities repower, the total amount of rotor swept area may remain about the same or increase slightly with the correspondingly larger turbine blades (Sterner 2002). New mitigation measures are likely to

be implemented and their effectiveness monitored and updated in the 2007 Environmental Performance Report.

Geothermal Energy

Geothermal energy development is located primarily in Imperial, Inyo, Lassen, Mono, Mendocino, Lake, and Sonoma counties and was developed in the 1970s. In 2002, the state's 46 operating geothermal power plants produced about 2,561 MW, of which 19 facilities (1,977 MW) were sited under the Energy Commission's jurisdiction. Only two geothermal projects have been developed since 1996, both in the Salton Sea Known Geothermal Resource Area (KGRA). One facility was an expansion of an existing power plant, and the other was a new 49 MW power plant on a 20-acre agricultural parcel, but neither was under Energy Commission jurisdiction. A new 180 MW geothermal unit at the Salton Sea KGRA, on a 100-acre parcel, was approved by the Energy Commission in 2004, but has not been constructed. Air pollutants, avian collisions with new transmission lines, loss of habitat, and noise impacts to protected species were significant issues because the nearby Sonny Bono Salton Sea National Wildlife Refuge is a critical stop-over for migratory birds and habitat for several federally protected species.

New geothermal energy development in Siskiyou County within the Glass Mountain KGRA is expected. The Energy Commission has helped fund exploratory wells in this area and the Bureau of Land Management has approved two projects; Fourmile Hill Project was approved in May 2000 and Telephone Flat was approved in November 2002. The development in Glass Mountain KGRA will increase the number of federal protected species (northern spotted owl and marbled murrelet) impacted by geothermal power since the new development will occur in previously undisturbed habitat. Construction of appurtenant facilities, including new transmission lines and steam lines and roads, will result in permanent habitat loss for protected species.

TRENDS: Geothermal development is likely to increase in California as power developers try to meet the new Renewable Energy Portfolio standard. Protected species impacts are likely to occur in Siskiyou County if the Glass Mountain KGRA is developed. Continued geothermal development in the Salton Sea KGRA is likely to occur over the next few years as technologies to handle the geothermal brine have improved.

Solar Thermal Power

Solar thermal power plants are concentrated in San Bernardino County. Solar thermal power plants are often quite large and cover several hundred acres of desert habitat. Since these projects were greater than 50 MW and produce heat, they were permitted by the Energy Commission in the late 1980s and early 1990s. However, no new applications have been submitted since deregulation in 1996. Solar thermal power plants have only been developed in the western Mojave Desert where one state and federal protected species, the desert tortoise, was impacted.

TREND: No new solar thermal power plants have been proposed since 1996, and no new facilities have been constructed recently and none are anticipated at this time.

Waste-to-Energy Development

Waste-to-energy facilities burn discarded fuels or residues (such as wood or straw) or methane gas produced from decomposing waste. These two fuel types are typically found in urban areas, but wood fuel can also come from forest thinning or other forest management practices. The Energy Commission has not permitted these facilities, because so far all have been less than 50 MW. The biomass-to-energy industry categorizes biomass fuels as wood processing, in-forest, agricultural, and urban wood residues (IWMB 2001). In 1996, 28 out of 100 waste-to-energy facilities used biomass fuels, representing 62 percent of the total electrical generation from these facilities. The number of online biomass plants increased during the energy crisis of 2000 and 2001 (Morris 2002). As of June 2004, 32 of the state's 62 biomass facilities were in operation, most located in urban and agricultural areas. The Biomass Collaborative (of which the Commission is a partner) estimates there will continue to be biomass development in municipal solid waste, in-forest biomass, animal manures, landfill gas, orchard and vineyard residues, and field crop residues (PIER 2004).

When utilizing in-forest materials to create power, it is possible that certain forest dwelling protected species could be impacted by the forest thinning activities and the construction of roads necessary to get the fuel supply to the power plant. Under the National Fire Plan (NFP 2003), the U.S. Department of the Interior and U.S. Department of Agriculture have scheduled 143,673 acres of California forest land for hazardous fuels treatment to reduce the risk of fire. Although more information is needed on the numbers of acres to be treated by mechanical thinning versus controlled burns for fiscal year 2005 and beyond, it is likely that forest residue generated by National Fire Plan implementation activities could provide sources of fuel for biomass energy plants at a reasonable cost. Additional research is under way to better document the biological resource impacts of in-forest thinning.

Research has begun to determine the costs and benefits of forest thinning activities for waste-to-energy development and the anticipated impacts to protected species and their forest and shrub-dominated habitats. To support policy development in this area, the research branch of the USDA Forest Service is working with the Energy Commission; the University of California at Davis; energy, forestry, and environmental consultants; and several state and federal agencies to build a Life Cycle Assessment model. This model will identify and analyze the social, economic, and environmental costs and benefits of using forest biomass to generate electrical power. The Life Cycle Assessment project will be conducted in phases over a 3- to 5-year period. An update on the model development will be included in the 2007 Environmental Performance Report.

Terrestrial Biological Resource Impacts of New Natural Gas Pipelines and Transmission Lines

In California, there are approximately 31,720 miles of transmission lines, 200,000 miles of distribution lines, and 11,600 miles of major natural gas pipelines. Permanent and temporary impacts from construction of linear facilities such as natural gas pipelines and transmission lines can, depending upon location, impact protected species and their habitat. Linear facilities can fragment the local habitat by dividing continuous patches of habitat. When located in arid environments, the habitat is usually very slow to revegetate, and often the construction corridors contain weedy species. These non-native species may be of little value to the native wildlife species and some weedy species often out-compete the native vegetation which further degrades the habitat value.

Currently, most transmission line and natural gas right-of-ways are located in urban and agricultural areas. However, several major transmission lines and natural gas pipelines cross the Mojave Desert and a few major corridors traverse forested regions of northern and eastern California. A transmission line in forested areas represents a significant departure from the natural landscape and may result in greater habitat fragmentation and act as a barrier to wildlife movement. Transmission lines in shrub-dominated habitats and near bodies of water can increase the likelihood of avian collisions and increased predation.

Approximately 520 miles of new transmission lines have been built in California since 1996 (Table 3-2). These projects were not permitted under the Energy Commission jurisdiction. Three new transmission line projects (Nortech, Northeast San Jose Transmission Reinforcement and Tri-Valley Long Term Transmission) were constructed in the San Francisco Bay Area in an urban environment, so impacts to sensitive biological resources was minimal. Two additional new transmission lines, Path 15 Upgrade and Westley-Tracy, were constructed primarily within agricultural areas and pose minimal threat to wildlife. However, two new transmission lines, Mead-Adelanto and Alturas Intertie, are located in the Great Basin or the Mojave Desert and impacted more than 300 miles of natural habitat.

The vast majority of the 175+ miles of new natural gas pipelines constructed since 1996 in California were constructed in relatively undisturbed natural lands and undoubtedly affected the habitat of state and federal protected species. None of these projects fell under the authority of the Energy Commission. Most natural gas pipelines are buried, so permanent habitat loss can be minimal once construction is complete. However, if constructed in arid environments, like transmission line corridors, habitat recovery tends to be very slow, even if restoration is completed, and can take several decades to recover. Therefore, permitting agencies, such as the Energy Commission, and wildlife protection agencies such as the California Department of Fish and Game and the U. S. Fish and Wildlife Service, often determine natural gas pipeline construction impacts to be permanent habitat loss when construction occurs in arid environments such as the Mojave Desert.

TRENDS: Since 1996, several new major gas pipelines and transmission lines were constructed that stretch for hundreds of miles, and some of this development occurred in protected species habitat in the California deserts, forests, and coastal areas. Habitat compensation was required to address the project impacts; however, the impacts in the Mojave Desert and other arid environments are likely to further degrade the habitats along the routes. This trend is likely to continue as more natural gas is likely to be imported into California from neighboring states. In addition, transmission line system upgrades are needed to handle additional loads, and these projects are likely to further degrade the habitat associated with the transmission line routes. For future gas pipeline and transmission line development, the best strategy to help minimize the amount of habitat and species impacts is to utilize existing utility corridors and not create new ones, especially in arid environments such as the Mojave Desert.

Table 4-2
Natural Communities Associated with New Natural Gas Pipelines & Electrical Transmission Lines Constructed In California Since 1996

Project Name (Location)	Project Length	Natural Communities Within The Corridor (in order of dominance)
Natural Gas Pipeline		
Socal Gas Line 6900 (Southeastern California)	10 miles	Urban
North Baja Pipeline (Southern California)	80 miles	Desert scrub, desert wash woodland, croplands, Southern mixed chaparral, desert succulent scrub, coastal scrub, annual grassland, urban
Kern River High Desert Lateral (Eastern Kern County)	33 miles	Desert scrub, alkali desert scrub, urban
SoCal Gas Kramer Junction (Eastern Kern County)	32 miles	Desert scrub, alkali desert scrub
PG&E Redwood Path (Northeastern California)	14 miles	Sub-alpine conifer, ponderosa pine, foothill pine-oak woodland, eastside pine, Douglas fir forest, blue oak woodland
El Paso Line 1903 (Southeastern California)	6.4 miles	Desert scrub
Total	175.4 miles	
Electrical Transmission Lines		
Westley-Tracy (San Joaquin County)	30 miles	Annual grasslands, irrigated row and field crops
Mead-Adelanto (Mojave Desert)	202 miles	Desert scrub, cropland, alkali desert scrub, urban, riverine, desert riparian
Alturas Intertie (Great Basin)	163 miles	Sagebrush, pasture, juniper, lacustrine, low sage, perennial grassland, dryland grain crops, alkali desert scrub, freshwater emergent, urban, barren
Northeast San Jose Transmission Reinforcement (City of San Jose)	16 miles	Urban
Tri-Valley Long Term Transmission (E. Bay Area Coast Range)	2.5 miles overhead and 11.8 miles underground	Annual grasslands, cropland
Path 15 Upgrade (San Joaquin Valley)	84 miles	Primarily agriculture
Nortech (Northern Trimble, Santa Clara County)	7.3 miles	Urban
Total	516.6 miles	

Electrical Transmission and Distribution Lines and Bird Collisions and Electrocutions

Birds often die when they collide with transmission and distribution lines. Several factors (e.g. bird flight pattern, topography, darkness) can create high collision risk situations and evidence suggests that power line collision fatalities may be significant in California. High concentrations of waterfowl, frequent winter fog that reduces visibility, and the vast network of power lines can create the potential for considerable bird mortalities. In the Central Valley, there may be 800,000 breeding waterfowl depending upon the season. There are also approximately 600 miles of power lines that transect federal National Wildlife Refuges, state Wildlife Areas and other publicly owned high bird use areas.

Bird collisions with transmission lines and electrocutions cause costly power outages and kill many protected birds, particularly birds-of-prey, waterfowl, and wading birds. An Energy Commission PIER program report, "The Cost of Wildlife-caused Power Outages to California's Economy" (Energy and Environmental Economics 2005), concluded that the total annual cost of wildlife-caused outages for the state ranges from $32 million to $317 million depending on which customers are principally affected (residential versus industrial, for example). Because the cost estimate range is large, the accuracy could be improved with better information about which customers are affected, where these outages occur along the system and consistent value of service data for all electricity customers. However, the value of lost wildlife (e.g. value of individual) was not considered because this information is not available.

Due to concerns about impacts to protected bird species and costly power outages, staff has written a white paper on Avian Mortalities From Collisions and Electrocutions for the **2005 Environmental Performance Report**.

The risk of bird collision with power distribution lines in California has not been adequately assessed, nor has the fatality rate attributable to collisions been calculated. Nationwide bird fatality estimates range from tens of thousands to over 1.5 million annually (Erickson 2002). Bird collisions with transmission lines are most frequently documented concerning high voltage (greater than 69 kV) lines; however, recent evidence suggests that collisions with lower voltage distribution lines is a problem (Hunting 2002). Waterfowl and water birds appear to be most susceptible to power line collisions when wetlands are nearby, while raptors and passerines (song birds) appear to be more susceptible in upland habitats. Guidelines have been developed to aid in the design of transmission lines to reduce the probability of both collisions and electrocutions (APLIC 1994, APLIC 1996), however, no standards have been adopted.

Line placement and configuration, and the use of bird flight diverters can lower collisions. Bird flight diverters work on the premise that they make the line more visible to birds flying through the area. Biologists have documented that California

condors have died after colliding with a transmission line conductor. Due to these condor deaths, bird flight diverters have been installed as mitigation on new transmission lines permitted by the Energy Commission as part of the licensing of new power plant process in Kern County. Project owners of the La Paloma Generating Station and the Sunrise Power Project were required to install bird flight diverters on dozens of miles of new transmission lines, built as part of their power plants projects, to lessen the likelihood of the California condor (a state and federal endangered species) colliding with the new transmission lines. As of this report, no condors have collided with the new transmission lines in Kern County.

The owner of the Sutter Power Project (Sutter County) was also required to install bird flight diverters on their new transmission lines to help lessen the number of waterfowl collisions with their new transmission lines since the power plant is located near state and federal wildlife areas containing numerous wetlands and large numbers of migrating waterfowl.

The Energy Commission's PIER program, in collaboration with industry, utilities, universities, and conservation organizations, is sponsoring projects that develop and test new methods and technologies to make information more widely available, help determine the extent of the issues, and work with the utilities to reduce avian fatalities and electrical outages caused by avian electrocution and collisions with power structures. Current research trends focus on the development of tools, technologies, and protocols to evaluate, mitigate, and reduce avian interactions with electricity transmission and distribution structures in California and to evaluate the effectiveness of those measures. Current PIER research includes evaluating effectiveness and durability of visual diversion devices, assessing the most problematic distribution poles to help prioritize retrofitting to bird-safe designs, assessing the effectiveness of various accepted retrofitting procedures, developing standardized protocols and educational field guides and websites, and updating Avian Power Line Interaction Committee guidelines for reducing electrocution on distribution lines.

Birds with long wingspans, such as raptors, are the most susceptible to electrocution. Raptors use the transmission and distribution line poles as a vantage point to hunt from and as nest sites, especially in areas where power poles are the tallest feature in the landscape. Electrocutions have been reduced when power poles are fitted with raptor safe hardware. Utilities are now being required to develop Avian Protection Programs and retrofit power poles that cause electrocutions. These programs often require the utilities to report certain incidents to the U. S. Fish and Wildlife Service since protected species, such hawks and eagles, continue to be electrocuted.

TRENDS: Since 1996, the focus in California has been to sponsor research that can help better understand the avian collision and electrocution problems, educate the owners and operators of the threats to wildlife, and help develop ways to reduce avian impacts from collision and electrocution with utility

structures. Progress has been made to identify problem areas and retrofit these facilities so fewer electrocutions occur and power outages are less frequent. The Energy Commission intends to continue to sponsor research which can identify cost-effective mitigation to reduce wildlife interactions with distribution and transmission lines. Research results will be discussed in the 2007 Environmental Performance Report.

Aquatic Habitat Impacts of Electricity Generation

California has more than 1,100 miles of coastal shoreline and thousands of miles of rivers and streams. As with terrestrial ecosystems, the California near shore environment features tremendous biological diversity. The state's bays and estuaries are vitally important nursery and foraging habitats for fishes and waterfowl, and serve as migratory pathways for ocean-going salmonids. Nearshore coastal environments have been significantly impacted by residential development, recreational and commercial use, point and nonpoint source pollution, flood control projects, and energy development. Coastal wetlands and estuaries are vital to many invertebrates, fishes, birds, mammals, and plants and represent an important part of our coastal environment and play an important role in our state's economy. However, these areas are becoming increasingly scarce. Ninety percent of California's coastal wetlands are diked, paved, developed, or otherwise destroyed; only five percent of California's coastal wetlands are intact (Thelander 1994). And, there are 21 coastal power plants in California that crop billions of organisms when they withdraw coastal water from our nearshore ecosystems to cool the power plant and produce electricity.

Our rivers and streams represent many things to many people; they are an important source of drinking and irrigation water, and they are an integral part of our outdoor recreation and food production. And, many of our rivers and streams are an integral part of our hydroelectric power system. Hydropower development has significantly reduced habitat for several native salmon and trout species, which has resulted in state and federal determinations that these fish species need state and federal endangered species protection. Significant impacts to these species and new requirements to protect our river and stream habitats, makes relicensing of these facilities a difficult, time-consuming, and expensive process.

Once-Through Cooling Impacts

California's coastal water is habitat, and coastal power plants that withdraw water for once-through cooling from the nearshore environment can have dramatic affects on the local coastal ecosystems. Power plants that use once-through cooling withdraw cooling water from a river, stream, lake, reservoir, estuary, ocean, or other water body and return the heated water to the source. The withdrawal of large volumes of cooling water (up to 2.5 billion gallons per day at the Diablo Canyon Nuclear Power Plant) affects large quantities of aquatic organisms annually through impingement and entrainment[11]. Species impacted include phytoplankton (tiny, free-floating photosynthetic organisms suspended in the water column),

zooplankton (small aquatic animals, including fish eggs and larvae that consume phytoplankton and other zooplankton), fish, crustaceans, shellfish, and many other forms of aquatic life.

Recent reports by The Pew Charitable Trusts (POC 2003) and the U. S. Commission on Ocean Policy (USCOP 2004) have concluded that use of our oceans and coastal resources have come with significant costs – up to 30 percent of fish stocks are overexploited, the size and water quality of estuaries have been greatly reduced, toxins are common constituents of the oceans, harmful algal blooms are more common, invasive species are on the rise, and nutrient-rich runoff has created ocean dead zones. Coastal fishery declines in California are now a well known fact. Declining fisheries and the understanding of the ecological relationships between fisheries and the concern over the degraded condition of our coastal ecosystems led to the development of the California's Marine Life Management Act (1998), Marine Life Protection Act (1999) and the Ocean Protection Act (2004).

A single power plant can have significant impacts. For example, at Diablo Canyon, the proportions of larva lost for five selected nearshore fish ranges from 10 to 30 percent (California Regional Water Board 2000) as recent, in-depth scientific analyses have shown. These impacts can have dramatic effects on the local coastal environment.

Cooling Water Withdrawal

Currently, California has 21 operating power plants that utilize once-through cooling and all but one is permitted to pump hundreds of millions of gallons of water for cooling each day. Of these, more than half are located along the Southern California coast; nearly three-quarters have shoreline intakes and/or outfalls; only about one-third have offshore intakes and outfalls; and more than half have their intakes and/or outfalls located within a closed or somewhat closed ecological system such as a harbor, bay, cove, river or estuary (Table 3-3). Intakes in these protected environments can be very detrimental to the bay and estuarine species since these areas offer a more protective environment and are therefore places where many species reproduce in great numbers. Overall, intakes located in an estuary or a bay are more likely to have significant entrainment impacts than similar intakes located in deeper water in an open system such as the Pacific Ocean. However, offshore intakes in deeper water can have significant impingement and entrainment impacts if the nearby environment includes rock outcrops or kelp forest, or if it has been determined that the intake affects a significant portion (length) of shoreline.

Table 3-3
Location of Intake and Outfall Structures
at Once-Through Cooling Facilities

	MW Capacity	Intake Location*	Outfall Location	Permitted Water Volume (mgd)
North Coast				
Contra Costa	680	Shoreline*, San Joaquin River delta	Shoreline river	341
Humboldt Bay Thermal	135	Shoreline, Humboldt Bay	Shoreline bay	78.3
Hunters Point	215	Shoreline, San Francisco Bay	Shoreline bay	412.3
Pittsburg	2,029	Shoreline, San Joaquin Riverdelta	Shoreline river	1,000
Potrero	362	Shoreline, San Francisco Bay	Shoreline bay	111.1
Central Coast				
Diablo Canyon Nuclear	2200	Shoreline cove	Shoreline cove	2,540
Mandalay Bay	570	Shoreline, Channel Islands Harbor	Shoreline canal	255.3
Morro Bay	1,056	Shoreline, Morro Bay Harbor	Shoreline canal	725
Moss Landing	2,538	Shoreline, Moss Landing Harbor	Offshore[6]	1,224
Ormond Beach	1,500	Offshore	Offshore	688.2
South Coast				
Alamitos	2,083	Shoreline, Alamitos Bay channel	Shoreline, flood channel	1,283
El Segundo	1,020	Offshore	Offshore	607
Encina	1,000	Shoreline, Agua Hedionda Lagoon	Shoreline channel	863
Haynes	1,570	Shoreline, Long Beach Marina	Shoreline, San Gabriel River	1,014
Huntington Beach	788	Offshore	Offshore	516
Long Beach	577	Shoreline, Long Beach Harbor	Shoreline, Long Beach Harbor	265
Los Angeles Harbor	472	Shoreline, Los Angeles Harbor	Shoreline, Los Angeles Harbor	170
Redondo Beach	1,310	Offshore	Offshore, King Harbor	898
San Onofre Nuclear	2,254	Offshore	Offshore	2,605.5
Scattergood	818	Offshore	Offshore	496
South Bay	706	Shoreline, San Diego Bay	Shoreline, San Diego Bay	602
Totals	**23,883 MW**			**16,694.7 mgd**

mgd = million gallons per day

* A "Shoreline" intake or outfall is located in shallow water of the Pacific Ocean shoreline or the shoreline of a harbor, channel, bay, lagoon, cove, river, or canal. An "Offshore" intake or outfall is located hundreds or thousands of feet offshore in deeper water of a bay or the Pacific Ocean.

Development Trends

No new once-through cooling power plants have been built in new locations in California since the 1970s. However, since 1999 the Energy Commission has reviewed five Applications for Certifications (AFC) for coastal power plants already using once-through cooling that wanted a license for repowering or modernization project.

Some once-through cooled power plants may be closed in the near future. PG&E has determined that the Hunters Point Power Plant and Humboldt Bay Power Plant are likely to be closed in the near future. And, the Long Beach Generating Station, located in Long Beach Harbor, recently stopped operation and may not be restarted (Hemig pers. comm. 2005).

The current trend is for applicants to propose the replacement of turbines and other land facilities, but retain the use of existing once-through cooling intakes and outfalls. Four of the five once-through cooling power plant projects that filed an AFC with the Energy Commission since 1996 were licensed, and two were constructed and are operating (Moss Landing and Huntington Beach). Four projects have completed, or are in the process of completing impingement/entrainment impact studies. Since facilities that use once-through cooling can have significant environmental impacts, staff often completes a cooling alternatives analysis to explore the feasibility of using some other cooling method that avoids the impacts. Commission staff did not complete a cooling alternative analysis for the Huntington Beach Retool project because the Commission license process was concluded very quickly (~2 months) under a Governor's Emergency Order due to the anticipated energy crisis for the summer of 2001.

Impact Analyses

A thorough impingement and entrainment impacts analysis can take more than a year to complete. A recent draft report (Foster 2005) completed for the Energy Commission, determined that 60 percent of the impingement impact studies and 68 percent of the entrainment impact studies were seriously deficient or totally lacking. Consequently, determining project impacts lacks precision.

Recent and comprehensive impingement and entrainment impact analyses have not been completed for most coastal power plants. Current impingement and entrainment impact studies have been completed for four coastal power plants (Morro Bay, Moss Landing, Potrero Unit 7, and Huntington Beach) during the Energy Commission power plant licensing process. Staff determined that significant cumulative entrainment impacts are occurring at the Morro Bay and Moss Landing facilities. The Huntington Beach impacts analyses has only recently been completed, and the significance of the impacts has yet to be determined. The Potrero Unit 7 impacts analysis was begun in 2001; however, it was only recently completed and staff has not seen the impacts analyses. One other comprehensive impact study was completed in 2004, but not under the Energy Commission

permitting authority, for the South Bay Power Plant located at the southern end of San Diego Bay.

Intake and Discharge Permitting

Water use and discharge in California is administered by Regional Water Quality Control Boards in accordance with Section 316(a) and (b) of the federal Clean Water Act. The Regional Boards issue a National Pollutant Discharge and Elimination System (NPDES) permit to applicants (dischargers). The NPDES permit, renewed every five years, sets discharge temperature, water volume and pollution limits for each intake/discharge. The U.S. Environmental Protection Agency, which administers Section 316(b) to address impingement and entrainment issues, has developed new federal regulations due to legal challenges related to impacts of cooling water intakes and associated impacts to local fisheries and fresh and ocean environments. New federal regulations for existing intakes were adopted in September 2004 and will affect thousands of facilities across the United States. Overall, the trend in Section 316(b) regulations for new intakes is to establish national intake design and velocity requirements as well as technology options to help reduce impingement and entrainment impacts on aquatic organisms.

The new federal regulations significantly change the process by which cooling water intakes are evaluated and ultimately may require facilities to operate differently to meet new standards to minimize impacts to nearby aquatic ecosystem. As an example, for cooling water intakes in tidal rivers, estuaries and the ocean, the new regulations set performance standards for impingement and entrainment impacts reduction of 80 to 95 percent and 60 to 90 percent, respectively. To meet these new standards, the project owners are likely to have to complete various studies to determine their impingement and entrainment impacts and then work with the appropriate Regional Board to determine what, if any, changes need to be made to their intake and/or how they must operate to meet the new standards.

Fourteen of the 21 coastal power plants have NPDES permits up for renewal in 2004 to 2006, so project owners are beginning to determine what information needs to be collected and what their overall strategy will be to comply with the new federal regulations. The new regulations allow project owners up to 3½ years to file the required information, and then the Regional Boards will determine what each facility owner must do to comply with the new Clean Water Act Section 316(b) regulations. As of this report, no changes to the power plant cooling water intakes or how they operate have been required by the various Regional Boards.

The California Coastal Commission also administers water use for coastal power plants. The California Coastal Act includes polices requiring maintenance, enhancement, and restoration of marine organisms, and the minimization of the adverse effects associated with entrainment. For upgrades to power plants of 50 MW or greater, the Energy Commission review must incorporate the findings and recommendations of the Coastal Commission unless the Energy Commission determines they are infeasible or would cause greater adverse environmental harm.

For power plants less than 50 MW, the Coastal Commission retains independent review and permit authority. In several recent reviews of proposed upgrades of coastal power plants greater than 50 MW, the California Coastal Commission has determined that continued use of the once-through cooling system does not conform to Coastal Act policies.

TRENDS: California could have fewer once-through cooled power plants within the next five years if some of the older, less efficient power plants retire. However, currently all 21 are still operational and there is no certainty as to when any of these coastal power plants will actually cease operations and cooling water withdrawals.

As the project owners move through the lengthy and difficult NPDES permit renewal process to comply with the federal Clean Water Act 316(b) regulations, we may see a trend in operational changes or technology retrofits required by the various Regional Boards to comply with more stringent impact minimization standards. Staff will report in the 2007 Environmental Performance Report on what, if any, changes these existing facilities have been required to make to meet the new impingement and entrainment impact minimization standards.

Some coastal power plant owners have indicated an interest in the addition of one or more simple-cycle peaking units which may fall under Energy Commission jurisdiction. However, simple-cycle peaking units are nearly always air-cooled and therefore would not require any cooling water from the intake associated with the existing coastal power plant.

Thermal Discharges

Once the power plant withdraws the cooling water from the nearby bay, estuary, or nearshore environment, the water goes through the power plant's cooling system and is heated and then discharged back to the cooling water source. California has more power plants discharging into salt and brackish water than any other state (Leef et al 2001). Permitted cooling water discharges often result in the release of water that is 30ºF or more above that of the receiving water. Impacts from heated water discharges can vary depending upon the species present and location of the discharge structure. Heated discharges have the greatest impact on environments that do not normally experience wide temperature fluctuations like open, coastal waters. When the heated water is discharged into a coastal environment that normally does not experience wide temperature fluctuations, the thermal discharges can result in decreased species diversity and density of species in the region of the discharge.

Thermal Impacts on Biological Resources: Ocean Warming Causes a Comprehensive Change in Organisms Living in the Sea

Recent studies have questioned if heated cooling water discharges from a coastal power plant could elevate sea water temperatures and change the species composition of the coastal ecosystem in the area of the discharge. An 18-year research study explored the ecological consequences of thermal discharges to Diablo Cove from the cooling water discharge by the Diablo Canyon Nuclear Power Plant. The research showed that over 10 years, a 3.5°C rise in seawater temperature, induced by the thermal discharge of the nearby power plant resulted in significant community-wide changes to 150 species of marine algae and invertebrates relative to adjacent control areas experiencing natural temperature changes. Contrary to predictions by biogeographic models, there was no trend to toward warm water species. Instead, several key species, in particular habitat-forming subtidal kelp and intertidal red algae, are experiencing significant shifts in abundance and entire communities changed in character.

Source: David Schiel, John Steinback, and Michael Foster. Ten Years of Induced Ocean Warming Cause Comprehensive Changes in Marine Benthic Communities. *Ecology* 85(7): 1833-1839. July 2004.

Thermal impacts to sensitive species and species in decline are of particular concern to resource agencies trying to protect these species. Thermal discharges in the nearshore environment can also impact large areas of our state's shoreline. For example, Diablo Canyon's discharge continuously affects 1.4 miles of shoreline and occasionally affects an additional three-quarters of a mile of shoreline, in addition to impacting adjacent kelp beds (Tenera 1997 and 2002).

Coastal power plants that use once-through cooling also discharge heated water that contain chemicals added to the cooling water stream to prevent bio-fouling and corrosion and these chemicals are also discharged in the bay, estuary, or near-shore environment.

Foster (2005) also reports that nearly two-thirds of the thermal impact studies are not of sufficient quality to determine the thermal impacts to the local environment of the thermal discharge.

Availability of Power Plant Cooling Alternatives

Because the impacts of once-through cooling are a concern and can be significant, Energy Commission staff completed detailed power plant cooling alternative analyses for four once-through cooling power plant siting cases to determine if impact avoidance was feasible. Staff determined for each project that one or more alternative cooling methods (*e.g.* dry cooling, use of reclaimed water, hybrid wet/dry cooling) were technically feasible and, if implemented, would eliminate the impacts

associated with the continued use of once-through cooling. However, the project applicants disputed staff's findings. Increased costs to install the new technology, lack of space, noise, visual concerns, lack of a contract with a nearby wastewater treatment entity, and reduced power capacity were given as reasons for not replacing the existing once-through cooling system with some an alternative cooling technology. The use of ocean water cooling continues to be the most economically attractive option for the power plant owners since there is no charge to use the coastal water and the only cost involved is the cost of running the existing intake pumps. This may change if, during the NPDES permit renewal process, the Regional Board determines that expensive retrofits, habitat restoration, and/or operational changes are required to comply with the new Clean Water Act regulations.

New Desalinization Facilities at Coastal Power Plants Using Once-through Cooling–An Emerging Issue

Co-locating new desalination facilities at existing coastal power plants to take advantage of an existing cooling water intake is an emerging issue with biological resource impact implications. Two coastal power plants (Haynes and Encina) already have small pilot desalination facilities to take advantage of the power plant intake and outfall, and the California Coastal Commission reports that desalination facilities are being considered at the Moss Landing, Ormond Beach, Scattergood, El Segundo, Huntington Beach, and San Onofre power plants. The concern is that if desalination facilities are built adjacent to existing coastal power plants to take advantage of the existing intake and discharge structures, that current impacts will exacerbated and/or continued.

> **TREND:** Construction of one or more desalination facilities are likely to be co-located at one or more of California's coastal power plants in the next few years. Staff will continue to monitor how many new desalination facilities are constructed and provide an update in the 2007 Environmental Performance Report.

Hydroelectric Impacts to Biological Resources

Nearly all of California's major waterways have hydroelectric facilities on them. As described in the ***2001 and 2003 Environmental Performance Reports***, and the 2003 staff report, ***California Hydropower System: Energy and Environment***, hydroelectric power generation can cause significant impacts to aquatic ecosystems in rivers and streams by changing natural river flows, dewatering river sections, changing water temperatures and water chemistry, changing channel structures and rates of sediment transport, and blocking passage of ocean-going fish such as salmon and steelhead trout, and resident trout populations. Thousands of miles of rivers and streams can no longer support wild populations of native salmon, trout, or amphibians.

For 2005, Energy Commission staff reports on two major trends; Federal Energy Regulatory Commission (FERC) relicensing and selective decommissioning. This section briefly describes plans for a broader environmental assessment of hydropower facilities in California, and summarizes the permanent conservation of PG&E's watershed lands as a result of their bankruptcy settlement with the CPUC.

FERC's Relicensing of California Hydropower Facilities

California's 119 FERC-licensed hydropower facilities are undergoing a major period of relicensing; 44 projects totaling about 5,000 MW are scheduled for relicensing by 2015. On a capacity basis, this is 37 percent of the state's entire hydropower system. Many of the large projects owned by PG&E and Southern California Edison will be relicensed during this period. Historically, FERC hydro licenses were issued for 30 to 50-year time periods and did not contain adaptive management measures. The science and mitigation extant at the time of the license prevailed for the duration of the license period, often creating significant lags between modern scientific and regulatory standards, and the older license conditions. Relicensing provides important opportunities – once in a generation opportunities – to bring older licenses and facilities into conformance with modern scientific and regulatory standards.

California state agencies like the State Water Resources Control Board and the Department of Fish and Game are dedicating substantial staff resources to the large number of relicensing cases underway throughout the state. No systematic assessment on the success of these state agency efforts to obtain modern mitigation during this current round of FERC relicensing has yet been done. Following is a brief list of recently relicensed projects along with short summaries of the new mitigation.

Pit 3, 4 & 5

Pit 3, 4 & 5 is one of the many large hydroelectric projects owned by PG&E on the Pit River in Shasta and Lassen Counties. It is a 317 MW capacity project on a spring-fed river with an 1,800 cubic feet per second (cfs) unimpaired base flow. Key species for which the Department of Fish and Game has sought improved habitat conditions include wild trout, rough sculpin, hardhead, and yellow legged frogs. There is also an important population of bald eagles in the Pit River drainage.

Fish and Game staff believe that "the Pit River is an example of a resource area that is currently in decent shape and one that we believe will become even better with the new license conditions." Staff's main goal in the relicensing proceeding was to restore more of the naturally varying hydrograph, and eliminate the current "flat line" management approach in which instream flows were held constant throughout the year. Fish and Game staff achieved this goal during the settlement negotiations, as shown on Table 4-4; flows increase overall, and contain seasonal variability. "We believe the proposed "natural shape" flow regime will be an improvement in that it increases aquatic habitat and reestablishes fundamental hydrologic and geomorphic processes." (Department of Fish and Game 2005)

Table 4-4 Changes in Pit 3, 4 & 5 Instream Flows Resulting from the New FERC License Settlement Agreement

Pit River Bypass Reach	Current Annual Instream Flows (cfs)	Future Annual Instream Flows (cubic feet per second - cfs)			
		Summer	Fall	Winter (Wet)	Winter (Dry)
Pit 3	150	300	280	350	300
Pit 4	150	375	350	450	375
Pit 5	100	400	350	450	400

Big Creek No. 4

On December 4, 2003, the Federal Energy Regulatory Commission issued a new major license for Southern California Edison's Big Creek No. 4 project. The project is located on the San Joaquin River in Fresno, Madera, and Tulare counties. The 98 MW Big Creek 4 Project is the lower-most of Southern California Edison's large, approximately 1,000 MW integrated "Big Creek System" on the San Joaquin River. The San Joaquin and its tributaries are highly developed for hydropower, water supply and flood control. The Bureau of Reclamation operates the Friant Dam at lowest portion of the watershed.

The State Water Resources Control Board's (SWB) Section 401 Clean Water Act Certification included many provisions that will increase instream flows and provide for long term management and monitoring, including an Adaptive Management Plan for River Flows and a Native Aquatic Species Management Plan. New instream flows below the project will range from 15 to 20 cfs in the summer months (Department of Fish and Game 2005b).

Lower Tule River Project

On September 3, 2004 FERC issued a new major license for Southern California Edison's Lower Tule River Hydroelectric Project. The project is located in the western foothills of the Sierra Nevada, on the Middle Fork of the Tule River and its tributaries in Tulare County. It is a small 2.5 MW run of the river project with two small diversion dams (Department of Fish and Game 2005b).

The key elements of the SWB's Section 401 Clean Water Act Certification include:

- Maintenance of a minimum flow of 5 to 10 cfs below the project, depending on the time of year
- A Native Aquatic Species Management Plan
- Requirement for development of a plan for the design, construction, and maintenance of a fish return structure at the project intake as well as related monitoring
- No pollution of project-affected waters by the licensee

Proposals for Selective Decommissioning of Low Power – High Impact Hydro Projects

As reported in the ***2003 California Hydropower System: Energy and Environment*** staff report, in some instances it makes more economic sense to decommission a facility with an older FERC license rather than to spend the funds necessary to bring it into conformance with current regulatory and scientific standards. This is especially true for low power – high impact projects that directly affect rivers and streams that provide habitat for endangered winter and fall run Chinook salmon, Coho salmon, and steelhead trout. The Department of Fish and Game and State Water Resources Control Board are increasingly asking Energy Commission staff to help assess energy and environment issues on such projects. The Battle Creek, South Yuba, and Trinity River Division cases were described in 2003. Following are brief descriptions of two additional cases.

Kilarc–Cow Creek Project

PG&E announced in the summer of 2004 that it would not renew its license to operate the small 4.6 MW run of river Kilarc – Cow Creek project in Shasta County. The Kilarc and Cow Creek streams provide spawning habitat for fall run Chinook salmon and steelhead trout. The streams are tributary to the Sacramento River, which contains the largest remaining salmonid habitat areas in California. The Department of Fish and Game is planning salmonid habitat restoration work in the Kilarc and Cow Creek watersheds.

Energy Commission staff assessed the potential effects of losing the project's energy resources in order to restore salmon habitat. Staff found that the 4.6 MW hydropower project had no peaking reserve capacity due to its run of river operation and provided only 1.5 MW in dependable capacity during the summer, which is when hydropower can help to meet peak summer demands. "While the powerhouses provided important contributions to electricity supplies when built nearly 100 years ago, as did many other hydropower projects of the era, in the current era, the environmental benefits of removing this small facility outweigh its electricity generation benefits." (Energy Commission 2004)

Klamath Relicensing

The Klamath River is a major salmonid river in Northern California that once supported the third largest salmon runs on the West Coast. PacifiCorp and the US Bureau of Reclamation operate a system of water supply dams and powerhouses that includes the 161 MW Klamath Hydroelectric Project, which PacifiCorp is relicensing before FERC. Water allocation, supply and water quality problems are severe. In autumn 2002 over 30,000 adult salmon returning to spawn were killed in the lower river reaches as a result of low river flows from the project, elevated water temperatures, crowding of fish due to a large return-year class, and ultimately an outbreak of bacterial pathogens (DFG 2003). The lower project dams (Iron Gate

and Copco) block fish passage to upper reaches of the main stem river and a series of tributary streams which contain an estimated 300 linear miles of spawning habitat.

As part of the FERC relicensing process, the Resources Agency, California Department of Fish and Game and the State Water Resources Control Board requested that Energy Commission staff review the energy effects of full or partial decommissioning. Energy Commission staff determined that loss of the Klamath's hydroelectric generation would not have an appreciable effect on electric resource adequacy or on PacifiCorp's ability to meet customer energy demands. (Energy Commission 2003, 2004). All state of California agencies have determined that decommissioning is a viable project option under the National Environmental Policy Act, and have urged FERC to evaluate this option during its relicensing process.

Permanent Conservation for PG&E's Watershed Lands

On December 3, 2003, PG&E and the Public Utilities Commission signed a settlement agreement that resolved PG&E's bankruptcy claim in Federal court. A conservation condition of the settlement will be permanent protection for approximately 140,000 acres of watershed lands associated with PG&E's vast hydropower system in the Sierra Nevada and Southern Cascade mountain ranges. The settlement culminated an eight-year effort by state agencies to protect the public's interest in the watershed lands from the threats of sale or rapid development associated with energy market deregulation. Staff from the Energy Commission played key supporting roles for the Resources Agency during three gubernatorial administrations over the eight-year saga.

The watershed lands tend to have three vegetation types with comparatively high biodiversity values; mature forests, lakefront wetlands, and dense riparian habitats along streams and rivers. Much of watershed lands are proximate to PG&E's 99 reservoirs and 16 major rivers and streams. The California Department of Forestry and Fire Protection conducted a preliminary inventory of the watershed lands and found that approximately 24,000 acres have mature forest characteristics, as defined by the Wildlife Habitat Relationships scoring system. Forest with these characteristics support some of the highest diversity of any forest types in California.

The settlement agreement also created the Pacific Forest Stewardship Council as the management entity to oversee development of a resource inventory and management strategy for the watershed lands. The Council includes 17 board members from PG&E, state agencies, environmental organizations, local government and landowners, and tribes. The Council has a $70 million management fund to use for stewardship and habitat enhancement.

Summary and Recommendations

Temporary and permanent loss of natural habitat, power plants withdrawing cooling water from our sensitive coastal bays and estuaries, wind power development affecting protected birds, hydropower development continuing significant under-mitigated impacts to our rivers and streams, and power plant air emissions that contribute to the degradation of sensitive species' habitats, all represent significant stressors to California's biological resources. To help minimize these impacts by California's electricity production infrastructure, staff believes consideration should be given by the Commission to the following:

Temporary and Permanent Habitat Loss

For projects under Energy Commission jurisdiction, staff believes that the Energy Commission should continue to urge power plant developers to utilize existing industrial sites or similar areas wherever possible to minimize natural lands and wildlife habitat. For proposed linear facility development such as new natural gas pipelines and new transmission lines, the Energy Commission should continue to discourage the development of new utility corridors, especially in the Mojave Desert, and utilize existing corridors whenever possible to minimize additional habitat degradation and permanent impacts of protected species and their habitat.

Hydropower Development

Staff recommends:

- Energy Commission continue ongoing efforts to expand the level of understanding of environmental damage from hydropower to allow for a broader understanding of the energy – environment balance for this important energy resource. Additional assessments and PIER-sponsored research are needed.
- Energy Commission continue providing technical support on energy and energy cost issues to state environmental and resource agencies with regulatory authority on water and fisheries issues as they participate in Federal Energy Regulatory Commission relicensings, or as they evaluate potential decommissioning of low power – high impact projects.
- Energy Commission encourage the state to provide sufficient staffing and funding levels for environmental and resource agencies so that they can successfully participate in relicensing proceedings. Hydropower relicensing requires large amounts of staff time and data. The current boom in relicensing of hydropower facilities offers a once-in-a-generation opportunity to bring these critical parts of the state's energy infrastructure into conformance with modern science and regulatory standards.

Coastal Power Plants Using Once-Through Cooling

For coastal power plant projects that fall within Energy Commission jurisdiction and currently use or plan to use once-through cooling, staff believes the Energy

Commission may want to consider various policy options that are included in the **2005 Environmental Performance Report** white paper entitled *Issues and Environmental Impacts Associated with Once-through Cooling at California's Coastal Power Plants.*

Bird Collisions with Wind Turbines

To help lessen the avian impacts of wind turbines, staff believes the Energy Commission may want to consider various policy options that are included in the **2005 Environmental Performance Report** white paper entitled *Assessment of Avian Mortality from Collisions and Recommendations.*

CHAPTER 5: WATER RESOURCES

Summary of Findings

- **Increasing Demands for Fresh Water:** Competition for the state's limited fresh water supplies is increasing as a result of rapid population growth and economic development; in some years contractual obligations to supply water cannot be met. Competition for limited water supplies is greatest in Southern California where water historically used for agriculture is being displaced for municipal purposes.
- **Power Plants Are Using Fresh Water More Efficiently**: Power plants developed since 1996 are using fresh water more efficiently due to increasing uses of recycled water for cooling, more efficient cooling technologies, and zero-liquid discharge systems. Between 1996 and 2004, 22 percent of the new electric capacity brought on-line used recycled water for cooling, while 52 percent of the electric capacity currently under construction, permitted, or in licensing review will use recycled water. In response to concerns about the use of fresh water for power plant cooling, the Energy Commission adopted a Water Policy in the ***2003 Integrated Energy Policy Report*** that requires power plant developers to use alternative water supply sources and alternative cooling technologies unless they prove to be environmentally undesirable or economically unsound.
- **Alternative Cooling Technologies Are Increasingly Viable:** Water conservation through use of more efficient dry and hybrid cooling systems is gradually increasing in regions with limited water supplies. Two projects using dry or air-cooling became operational between 1996 and 2002, and a third project is under construction. Water spray enhancement of air-cooled condensers is an emerging technology that is low-cost and improves cooling efficiency while using only 10 to 15 percent of the water required for wet cooling.
- **Waste Water Discharges Are Decreasing:** Water quality impacts from wastewater discharge to surface water bodies, groundwater, and land are being reduced or eliminated altogether through use of zero liquid discharge systems. The use of zero liquid discharge has increased from 35 percent of the 7,554 MW of new capacity brought online between 1996 and 2004 to 46 percent of the projects currently under licensing review at the Energy Commission or under construction. The 2003 Water Policy also requires power plant developers to use zero liquid discharge systems unless they prove to be environmentally undesirable or economically unsound.
- **Few Hydropower Projects Meet California Water Quality Standards:** Only twenty percent (2,407 MW) of California's regulated (non-federal) hydropower capacity has already undergone licensing to improve environmental conditions. By 2020, only fifty percent (5,241 MW) will have completed relicensing, indicating a limited rate of progress for mitigating some of the most significant impacts to water quality and the aquatic environment.

Policy Issues

- **Create Water Use Guidelines for Smaller Power Plants:** To help broaden opportunities for conserving the state's fresh water supplies, the Energy Commission could develop and provide power plant siting review guidelines to local agencies for the permitting of power plants less than 50 MW. The guidelines would establish a more consistent practice for conserving local water supplies and help local government officials understand power plant water conservation technologies.
- **Identify Alternative Water Supplies for All Power Plants**: Evaluation of water conservation opportunities of existing power plants currently relying on fresh water would offer the plant owners and local water districts a basis to consider opportunities to use recycled water and water-conserving cooling methods.
- **More Research Can Increase Commercial Viability of Air Cooling:** Continuing research and development of water spray enhancement for air-cooled condensers to improve water spray distribution and recovery will lead to more rapid commercial application to accomplish improved steam turbine-generator performance in air cooling applications.

Introduction

Assuring sufficient, high-quality water supplies for California over the next several decades will be a great challenge for water resource managers. The demand for water is expected to increase in response to population and economic growth, and to meet current and future ecosystem restoration objectives. Climate change will further complicate the ability to plan and prioritize competing demands for water. Meeting increasing demand will be particularly challenging as additional supplies will be costly and the vital agricultural sector will continue to require most of the State's water supply for food and fiber production. At this time industrial use of water compared to other uses is small and that of power plants is even less. However, efficient water use will be essential to help conserve limited supplies, and all users should strive for efficiency. The Energy Commission, as the regulatory agency permitting most of the power plants in the state, is in the unique position to review water use by the power industry and make recommendations and policies for conserving our state's waters and for improving the environment.

The state is at a critical juncture in water supply as evidenced by several indicators. First, if drought conditions similar to 1977 were to repeat, California Department of Water Resources (Water Resources) predicts deliveries from the State Water Project could be cut to 20 percent of the primary contractual supply. Under average water conditions, the State Water Project is expected to supply about 75 percent of the primary contractual supply (DWR 2002). Second, in April 2005, Water Resources circulated its Draft 2005 California Water Plan Update. While the results and recommendations are preliminary, the Water Plan Update stressed that our challenges are significant. Third, there has been a recent cutback in California's supply from the Colorado River, after nearly 50 years of reliance on up to 1 million

acre-feet per year in excess of California's normal year entitlement of 4.4 million acre-feet per year. These factors are leading to a growing reliance on water sources of lesser quality and higher cost such as desalinized seawater, and/or sources having serious long-term consequences such as transferring water derived from fallowing once-productive agricultural lands. The challenge is to find mutually viable options for California that meet the state's energy needs, and preserve limited water supplies for the most fundamental and beneficial uses, while maintaining economic growth and environmentally sound practices.

As noted in the *2001 and 2003 Environmental Performance Reports*, there has been a shift to build power plants in the inland areas and this trend has necessitated the use of new cooling water supplies and cooling technologies. As both reports stated, there is an increased supply of reclaimed water and there are viable and commercially available alternative cooling methods that can reduce or eliminate the need for fresh water (e.g. dry cooling and hybrid cooling). To reduce the amount of wastewater discharge, both reports discussed the positive trend towards zero liquid discharge systems at power plants. As part of the *2003 Integrated Energy Policy Report*, the conservation of fresh water and zero liquid discharge were developed into policy, which is referred to in this report as the 2003 IEPR Water Conservation Policy. The Energy Commission's policy states that it will not approve use of fresh water at power plants and will require wastewater reuse through zero-liquid discharge technologies unless such technologies are shown to be "environmentally undesirable" or "economically unsound".

Environmental Trends in Water Use: 1996–2004

Water Demands as Related to Cooling Technology

Although older power plant designs require more water than modern, thermally efficient designs, all power plant designs (other than wind and solar-photovoltaic) require at least some water to operate. Power plant designs that are in common use today are listed below in order of greater to lesser water requirements:

- once-through cooling
- wet (evaporative) cooling tower
- wet-air cooled condenser hybrid (plume abated) tower
- wet-air cooled condenser parallel cooling towers
- air cooled condenser cooling

Examples of typical power plant water use as a function of energy resource, plant type and cooling method are as shown in Table 5-1.

Table 5-1 Cooling Water Withdrawal and Consumption in Gallons/MWh Representative of Power Plants in the Western States

Energy Resource, Plant Type, & Cooling System[1]*	Withdrawal (Cooling & Process) Gallons/MWhr	Consumption (Cooling) Gallons/MWhr	Consumption for 20 MW Plant [2] Gallons/year	Consumption for 500 MW Plant [2] Gallons/year
Fossil Energy Resources				
Steam Cycle,				
Once-through	20,000-50,000	~300	47 million	1,183 million
Re-circulating	300-800	240-640	69 million	1,735 million
Dry cooling	40	0	0	0
Combined Cycle,				
Natural Gas-Once-through	7,500-20,000	~100	15.6 million	394 million
Natural Gas-Re-circulating	~230	~180	28 million	704 million
Natural Gas-Dry cooling	~40	0	0	0
Steam Cycle, Coal-Re-circulating	~380[3]	~200	31 million	782 million
Integrated Gasification Combined Cycle (Clean Coal), Coal–Re-circulating				
Coal–Dry Cooling	Not Available	Not Available	Not Available	104 million (DOE 1994)
Renewable Energy Resources				
Wind	~1	0	0	0
Solar - Photovoltaic	~4	0	0	0
Solar – Parabolic Trough	~830	~760	120 million	2,996 million
Geothermal	107,000-130,000	2,700-4,500	568 million[4]	14,191 million[4]
Biomass,				
Steam Once-through	23,000-55,000	~350	55 million	1,378 million
Steam Re-circulating	350-900	350-900	91 million	2,266 million
Steam Dry cooling	50	0	0	0

Source: Hewett 2003, DOE 1994

[1] Once-Through Cooling = Open loop cooling where water only passes once through a condenser to absorb heat; Re-circulating = Closed loop cooling to reduce heat in steam, can include wet-cooling towers or inlet sprays; Dry Cooling = use of air instead of water to cool the steam

[2] Note: Calculated by staff. Assumes a 90 percent capacity factor and uses the median of water use for each fuel type

[3] Includes gasification process water

[4] Although some geothermal plants cool using condensed steam, cooling water is typically obtained from another water supply as reflected in the table.

Water use typically describes the direct impact of a cooling system on a water source, for example groundwater withdrawal. Water consumption describes the loss of water from a water source, primarily through evaporation. Once-through cooling systems have a large withdrawal, but since all the water is returned to the source, they have very low consumptive use. Recirculating wet systems have lower water use requirements, but consumptive losses through direct evaporation can be relatively high.

Since 1996, the majority of large power plants (greater than 50 MW) licensed in California have been natural gas-fired simple or combined-cycle power plants. No new sites have been approved for once-through cooled plants. However, the trend for existing coastal power plants is to modernize while maintaining their once-through cooling processes. Currently, coastal power plants that have recently completed or are seeking modernization with once-through cooling include Moss Landing and Huntington Beach which have been constructed and are operational, El Segundo which has been certified, Morro Bay which is awaiting approval of its NPDES permit from the Regional Board, and Potrero Whose licensing review is currently in suspension.

As for fresh water use associated with the newer gas-fired power plants, only 58 percent of the capacity added between 1996 and 2004 was licensed to use fresh surface waters or groundwater for cooling, while 31 percent of the capacity that is proposed, or is currently under construction, may use those sources (Figure 3-13). This trend away from the use of fresh water for plant cooling is attributable to state water policy/statutory guidance and the Energy Commission's 2003 IEPR Water Conservation Policy, encouraging fresh water conservation through use of recycled water, hybrid or dry cooling, and reuse of wastewater.

Case Study – San Diego County Water Authority's Adaptations to Meet Future Water Supplies

As an example of the adaptations in water use that will be needed to meet growing demands over the next 20 years in Southern California, we can look to San Diego County Water Authority. In reviewing the San Diego County Water Authority's quantities of water supply projected through 2025 compared to existing supplies in 2005, we observe trends that show the following: 1) A growing reliance on water transfers leading to fallowing of agricultural lands; 2) Implementation of projects to recover water losses in the conveyance system; 3) Increases in production/distribution of recycled water signaling an increasing reliance on new fresh water resources; and 4) For the first time, development of seawater desalinization, which is considered to be the most costly resource to treat to potable water standards, and indicating an overall lack of alternative fresh water supplies.

While water districts like the entities within the San Diego County Water Authority appear to be pursuing new supplies to meet their projected water demands over the next 20 years, in decades to follow the opportunities for securing additional water transfers and developing new supplies (except for the most costly supplies derived from seawater desalinization) are expected to be limited. Committing water resources for power plant cooling can be a 30 to 50 year decision; whereas, normal water supply planning horizons conducted by water districts are typically for 20 years, which may not anticipate the potential competing needs for water supplies between power plant cooling and municipal uses.

There has been a large increase in the number of power plants reviewed since the *2003 Environmental Performance Report.* Most of these plants will use recycled or degraded water as their supply source (Table 5-2). but some are not proposing the use of recycled water or dry cooling even where feasible (See the Tesla Power Plant Case Study). However, the 2003 IEPR Water Conservation Policy has established the Energy Commission's position to promote conservation of fresh water supplies, and to independently evaluate alternative water supply and cooling options where appropriate. As of April 2004, there were still seven power plants under construction that will be on-line before the next reporting cycle (Table 5-3) and eleven that have been approved for construction, but are delayed due to financing or other permitting problems (Table 5-4). The Energy Commission is reviewing five power plants, two of which propose continued use of once-through cooling (Table 5-5).

Table 5-2 Water Use at Thermal Generation Plants On-Line Between 1996 and 2004

County	Name of Facility/ Fuel Type/Generator Type	MW Capacity	Cooling Water Source	Volume of Water (acre-feet per year)
ONCE THROUGH COOLED (FOR STEAM CONDENSATION)				
Los Angeles	El Segundo/ NG (CC)	48.2 (additional capacity added in 1996)	Ocean or Estuary	231,800
Monterey	Moss Landing/ NG (CC)	1060	Ocean or Estuary	403,200
Orange	Huntington Beach/ NG (CC)	225	Ocean or Estuary	283,800
WATER COOLED (FOR STEAM CONDENSATION OR INLET COOLING*) OR HYBRID COOLED				
Contra Costa	Los Medanos Energy Center/ NG (Cogen)	555	Recycled or degraded water	4,000
	Delta Energy Center/ NG (CC)	887	Recycled or degraded water	5,900
Kern	Elk Hills/ NG(CC)	500	Groundwater from off-site wells	3,200
	La Paloma/ NG(CC)	1124	Water transfer from freshwater source	6,000
	Sunrise/ NG (SM)	320	Owner-owned groundwater	18
Kings	GWF Henrietta/ NG (SM)	96	Water transfer from freshwater source	160
	GWF Hanford Peaker/ NG(CC)	95	Owner-owned groundwater	800
Riverside	Blythe Energy Project/ NG(CC)	520	Owner-owned groundwater	3,000
Sacramento	Procter & Gamble (SMUD)/ NG (Cogen)	117	Other	1,806
San Bernardino	High Desert/ NG (CC)	830	Groundwater from off-site wells	4,000
Santa Clara	Los Esteros Critical Energy Facility/ NG (SM)	180	Recycled or degraded water	560

Solano	Valero Unit 1/ NG (Cogen)	51	Reclaimed based on conservation within the industrial facility	314
Stanislaus	Woodland II Combined Cycle / NG (CC)	80	Water transfer from freshwater supply	470

(*Simple cycle power plants may use wet cooling towers for gas turbine inlet cooling, and combined cycle plants will use wet cooling towers to condense steam from their heat recovery system and possibly for gas turbine inlet cooling.)

GAS TURBINE INLET COOLING WITHOUT COOLING TOWERS				
Fresno	Kings River Conservation District Peaker/ NG (SM)	97	Groundwater from offsite wells	75
Riverside	Riverside Energy Resources Center/ NG (SM)	96	Recycled or degraded water	247
San Bernardino	Drews/ NG (SM)	40	Municipal potable water supply	32
San Diego	CalPeak Border/ NG (SM)	49.5	Municipal potable water supply	16
	Calpeak Escondido/ NG (SM)	49.5	Municipal potable water supply	3
San Joaquin	Tracy Peaker/ NG (SM)	169	Water transfer from freshwater supply	30
Santa Clara	Gilroy Peaker Units 1,2, & 3/ NG (SM)	135	Owner-owned groundwater	745

DRY COOLING				
Sutter	Sutter Power Project/ NG (CC)	540	Owner-owned groundwater	230

(NG = Natural Gas Fired, CC = Combined Cycle, SM = Simple Cycle)

Table 5-3 Expected Water Use at Thermal Generation Plants > 50 MW In Construction in 2004 and early 2005

County	Fuel Type	MW Capacity	Cooling Water Source	Volume of Water (acre-feet per year)
Los Angeles	Malberg - City Of Vernon Combined Cycle/ NG (CC)	134	Recycled or degraded water	1,500
	Magnolia/ NG (CC)	328	Recycled or degraded water	5,100
Sacramento	SMUD Consumnes Combined Cycle Phase 1 / NG (CC)	500	Water transfer from freshwater source	8,000
San Bernardino	Mountainview Units 1 & 2 - / NG (CC)	528	Recycled or degraded water	7,500
San Diego	Otay Mesa/ NG (CC)	590	Dry Cooling with a Municipal water supply	400
	Palomar/ NG (CC)	546	Recycled or degraded water	3,600
Santa Clara	Metcalf Energy Center/ NG (CC)	600	Recycled or degraded water	3,900
	Don Van Raesfeld (Pico)/ NG (CC)	147	Recycled or degraded water	1,182

Table 5-4 Expected Water Use at Thermal Generation Plants > 50 MW Approved but Not Under Construction

County	Fuel Type	MW Capacity	Cooling Water Source	Volume of Water (acre-feet per year)
Alameda	Tesla Combined Cycle/ NG (CC)	1,120	Recycled or degraded water	5,100
	East Altamont / NG (CC)	1,100	Recycled or degraded water	4,600
	Russell City/ NG (CC)	600	Recycled or degraded water	3,700
Contra Costa	Contra Costa – Mirant/ NG (CC)	530	Water transfer from freshwater source	8,200
Fresno	San Joaquin Valley Energy Center/ NG (CC)	1,087	Recycled or degraded water	5,340
Imperial	Salton Sea Unit #6/ Geothermal	185	Steam Condensate - Fresh Water	230
Kern	Western Midway-Sunset – Mission/ NG (CC)	500	Owner-owned groundwater	3,300
Los Angeles	El Segundo/ NG (CC)	630	Ocean or estuary	231,800 (shares water with El Segundo facility in Table 3-13)
Riverside	Inland Empire Energy Center/ NG (CC)	670	Recycled or degraded water	4,200
San Luis Obispo	Morro Bay/ NG (CC)	1,200	Ocean or estuary	532,000
Shasta	Three Mountain/ NG (CC)	500	Owner-owned groundwater	890

Table 5-5 Expected Water Use at Thermal Generation Plants > 50 MW Still Under Review at the Energy Commission in early 2005

County	Fuel Type	MW Capacity	Cooling Water Source	Volume of Water (acre-feet per year)
Kings	Avenal/ NG (CC)	600	Water transfer from freshwater source	2250
Riverside	Blythe Energy Project Phase 2/ NG (CC)	520	Owner-owned groundwater *	3,300
Santa Clara	Los Esteros Critical Energy Facility Phase 2/ NG (CC)	140 (in addition to operational simple cycle facility)	Recycled or degraded water	910 (additional)
San Francisco	San Francisco Electric Reliability Project/ NG (SM)	145	Recycled or degraded water	132
	Portero Unit 7/ NG (CC)	540	Ocean or estuary	255,000

* Energy Commission staff is recommending use of degraded agricultural drain water or dry cooling rather than groundwater as proposed by the applicant.

Use of Degraded Cooling Water Increasing

Of the 7,054 MW of new capacity brought on-line between 1996 and 2004 for which data is available, 1,622 MW (23 percent of total capacity) are cooled using recycled or degraded water as shown in Figure 3-13. Of the 14,563 megawatts currently under construction, permitted but delayed, or in licensing review, an additional 7,606 MW (52 percent of total planned capacity) will be cooled by recycled or otherwise degraded water as shown in Figure 3-14. This marks a significant increase in the use of recycled water for power plant cooling compared to the number of power plants that were licensed and became operational between 1996 and 2004. Relative to new power plants increasing their utilization of recycled water is the overall availability statewide of recycled water as 55 of 58 counties in California have large-scale facilities for treating and recycling wastewater.

Treated wastewater is readily available in most areas of the state, and is an increasingly viable alternative to using fresh water for cooling. One of the factors contributing to the marked increase in utilization of recycled water by power plants is the 2003 IEPR Water Conservation Policy. In two recent Alameda County siting cases, accounting for 2,220 MW of new capacity combined, the Energy Commission was successful in guiding the applicants to accept conditions of certification requiring the use of recycled water when it was determined to be economically feasible and environmentally sound, as an alternative to the proposed use of fresh water. (Please refer to the Tesla Power Plant Case Study for a description of one such project).

Power Plant Effects on Local Water Supplies

The most significant effects on fresh water resources by power plants are on the current and future users of local fresh water supplies and aquatic resources. A modern 500 MW combined-cycle power plant will require approximately three million gallons per day, almost entirely for cooling purposes. This is an amount of water sufficient to support 12,000 people, a community about the size of the City of Auburn. Unlike water demands from agriculture and domestic uses, power plants can drastically reduce their freshwater demand through the use of degraded cooling water sources or water conserving cooling technologies such as hybrid or dry cooling. It is also important to recognize regional distinctions in recycled water availability. In Southern California, recycled water is becoming critical for meeting non-potable needs in residences, parks and golf courses, and the overall reduction of water demand for power plants is a responsible strategy. Maximum water conservation can be achieved by employing dry cooling and zero liquid discharge systems for treatment and reuse of wastewater.

Key Water Permitting Issues for New Power Plants

- Reduce the use of fresh surface water and groundwater for power plant cooling. Power plants can be cooled with degraded water from reclaimed and recycled sources, and by alternative technologies such as dry cooling.

- Reduce wastewater discharges to land, groundwater or surface water bodies through use of zero liquid discharge systems.
- Assess and mitigate long-term impacts to aquatic ecosystems in marine and estuarine environments resulting from the use of once-through cooling by power plants in the coastal zones, including considerations of the use, when feasible, of cooling systems that use less water, such as dry cooling or hybrid wet-dry systems.

The availability of fresh water can be a major constraint for new projects. Ways to reduce water use and environmental impacts include the use of recycled water, alternative cooling technologies, dry cooling, and zero-liquid discharge of wastewater. All these items are discussed in detail below.

Figure 5-1 Cooling Medium for the 7,054.2 Megawatts That Came On-line from 1996-2004 as a Percent of Installed Capacity

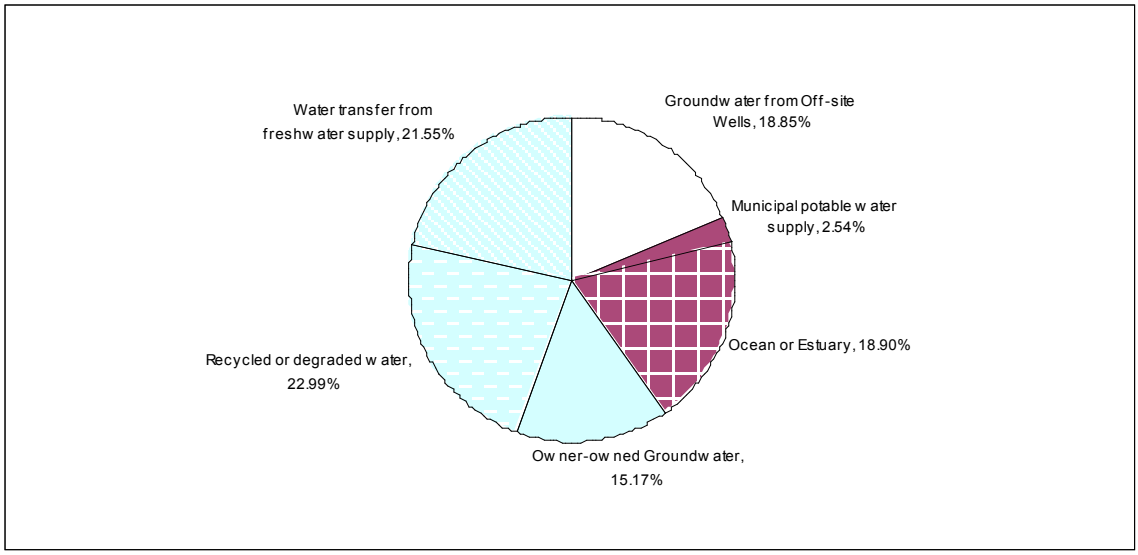
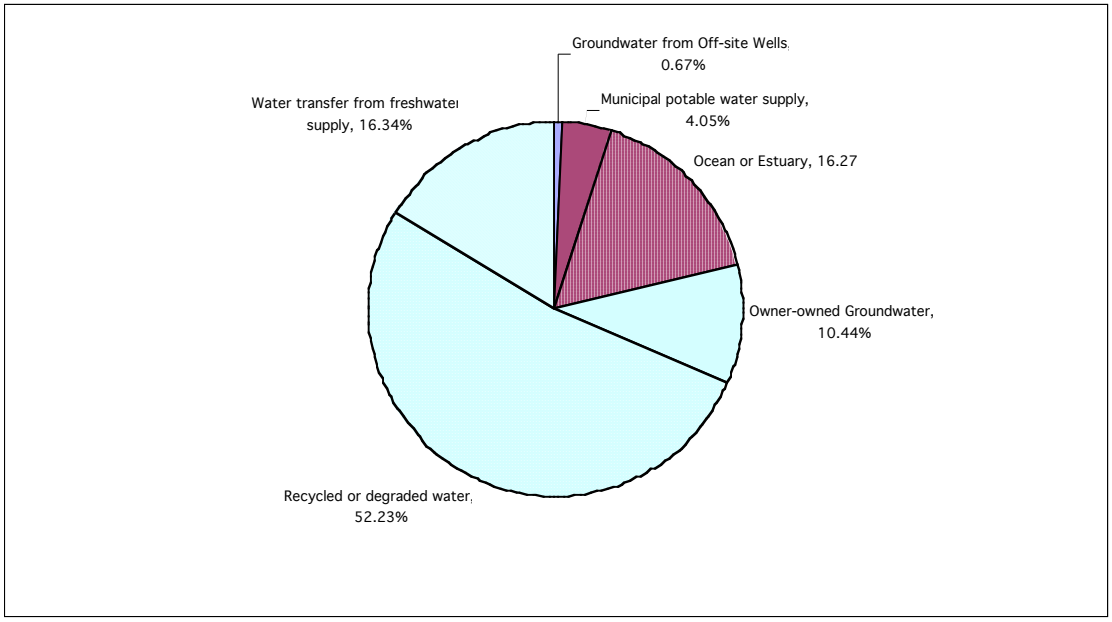


Figure 5-2 Proposed Cooling Medium for the 14,563 Megawatts Currently Under Construction, Permitted but Delayed, or In Review as a Percent of Installed Capacity



Viable Alternatives for Conserving Water

Recycled Water Law and Its Impact on the Siting Process

The Recycled Water Act of 1991 and related sections of the California Water Code and Constitution have had perhaps the greatest impact on the siting process from the water resources perspective. These provisions outline the benefits of using recycled water and deem the use of potable water for non-potable uses to be a waste or unreasonable use of fresh water if recycled water is available with no significant financial burden or adverse environmental impact. The use of recycled water for non-potable power plant requirements such as for cooling, process and landscape irrigation is a benefit to state's water supply. Determining if a power plant must use recycled water under the law is based on an evaluation of the quality needed for power plant use (or can be reasonably treated), public health effects, effects to downstream water rights or to plants, fish and wildlife, or degradation to water quality. The use of reclaimed water does not significantly impact the owner's ability to sell its power in California's competitive market.

Recycled Water Use - Tesla Case Study
In 2003, the Energy Commission approved the 1,120 MW Tesla Power Plant, a gas-fired combined cycle facility proposed in Alameda County. The project as initially proposed would have used fresh water obtained under an exchange agreement and delivered from the State Water Project averaging about 5,100 acre-feet per year, and up to a maximum of 5,900 acre-feet per year. During the course of reviewing the project application, the Energy Commission identified that the Tesla Power Plant could utilize disinfected tertiary-treated recycled water. The Energy Commission was able to demonstrate costs for the life of the project were comparable, showing for fresh water that a 1.7-mile pipeline and higher annual purchase costs were reasonably the same as for using recycled water with an 11-mile long pipeline and lower annual purchase costs. The Energy Commission was successful in fostering a relationship with the applicant and City of Tracy for the Tesla Power Plant to use a recycled water supply, utilizing degraded rather than fresh water consistent with state regulations and policies.

Emergence of Alternative Cooling Technologies

Technologies that reduce or avoid the use of fresh or recycled water for cooling have seen substantial increases in quality and decreases in cost. Dry cooling is an entirely feasible method for cooling a combined-cycle gas-fired power plant, even in the hottest climates of California. Since 1996, California has added two facilities (Crockett and Sutter) which generate power using dry cooling technology, and a third will be added when construction of Otay Mesa is completed, for a total of 1,290 MW of dry cooled-generation. In the U.S., there are approximately 60 dry-cooled power plants, the earliest becoming operational in 1968

It is widely recognized that dry cooling (the use of an air cooled condenser) can accomplish the maximum conservation of water supplies associated with both gas turbine inlet cooling and steam condensation for the steam turbine, conserving up to 90 to 95 percent of the water needed for a similar wet cooled power plant. However, the major drawbacks to the use of dry cooling are the heat rate and capacity penalties during the hottest hours of the year, which usually coincide with when power is most needed. These penalties occur when less efficient cooling during hot ambient temperatures causes an increase in back pressure on the steam turbine, and thus reduced capacity for about one third of the total capacity of the combined cycle power plant.

Case Study of the Otay Mesa Power Plant

The Otay Mesa Power Plant is a project licensed by the Energy Commission in 2001 and currently under construction as a 510 MW combined-cycle dry-cooled power plant. The project is located about 15 miles southeast of San Diego and 1.5 miles north of the California-Mexico border in a warm and arid region. The proposed project would use only about 400 AFY for process and domestic needs provided by the Otay Water District, compared to about 3,500 AFY if the project were configured with a wet cooling technology. The higher water usage associated with wet cooling is primarily attributable to about 90 percent water loss in evaporation, drift and blowdown from the wet cooling towers. Energy Commission staff has evaluated dry cooling as an alternative to several other proposed projects and has concluded that the average annual cost of energy production for a project configured with dry cooling is comparable in some cases to a project using wet cooling. In essence, the additional capital cost for dry cooling is offset by the reduction in annual water acquisition costs (including payments to farmers for land fallowing) and water/wastewater treatment costs. Even when accounting for a reduction in peaking capacity associated with dry cooling as would occur during periods of hot ambient temperatures, the cost of production is typically expected to increase only about 0.5 to 3.5 percent compared to a project with wet cooling. The slight increase in cost of production would not affect the owner's ability to market its power, as it is within the range of its competitors.

Spray Enhancement of Air Cooled Condensers

In looking forward to technological advancements that may reduce water demand and water quality effects to one of the most fuel efficient production technologies, combined cycle gas turbines, spray enhancement of air cooled condensers shows a high level of promise for the future. A collaborative pilot study by the Electric Power Research Institute (EPRI) and the Energy Commission, in cooperation with the Crockett Cogeneration Plant, demonstrated power plants can increase their electrical output with limited amounts of water use and with a payback period for a capital investment expected to be less than two years.

While additional study is needed to optimize the type and positioning of water spray nozzles around the air cooled condenser, and to find efficient ways to capture and return water droplets that do not vaporize and instead accumulate at the base of the condenser, resolution of these issues appears readily achievable. The significance of this study is to realize that for a minor tradeoff in conservation of water use for today's most efficient gas-fired combined cycle power plants, spray enhancement of an air cooled condenser can reduce generating capacity penalties by over 50 percent during hotter days. Spray enhancement would not be needed during cooler days. The net water use for a 500 MW combined cycle power plant would therefore be on the order of 100 to 150 acre-feet/year for dry cooling, 400 to 750 acre-

feet/year for dry cooling with spray enhancement, and 3,000 to 4,000 acre-feet/year for wet cooling. The slight increase in water use associated with a spray enhanced air cooled condenser would likely be a negligible effect to water resources in most locations considering the benefits to higher steam turbine generating capacity on hot days.

Water Quality

Thermal power plants produce wastewater during numerous parts of the electric generation cycle and from stormwater runoff at the plant site. Wastewater streams from thermal power plants may degrade surface and groundwater supplies, which may adversely affect drinking water supplies and other beneficial uses, including those related to biological resources. Disposal methods include discharge of the effluent to land (evaporation ponds), rivers or other surface water bodies, local sewer systems or by injection underground. The regulations for appropriate disposal of wastewater streams are enforced by local municipalities and regional water quality control boards through the issuance of waste discharge requirements and industrial waste discharger permits.

For once-through cooling facilities, chemical constituents are added to the cooling water stream to prevent biofouling and corrosion. These chemicals are then discharged to the ocean, bay or estuary. However, unlike cooling tower systems where wastes are concentrated, wastes in a once through cooling system are diluted with the large volumes of intake cooling waters. The discharge of heated waste water back to the source waters also creates environmental effects. Wastewater temperatures may be 20 degrees F or more above the receiving water temperature. Depending on location and other specifics, these thermal discharges can result in significant impacts, primarily to aquatic habitat and resources. For more discussion of these impacts, please refer to the Biological Resources section.

Water quality can be impacted by power plants due to:
• effluent and thermal discharge from power plants;
• spills from petroleum transport tankers or pipelines;
• dams and impoundments for hydropower, which alter natural river flows and affect
ecological systems;
• construction and maintenance of transmission lines and natural gas pipelines that traverse water bodies;
• deposition in water bodies of nutrients, toxins, and salts from power plant emissions; and
• storm-water runoff (petroleum products and heavy metals) from power plants sites.

Recycling Process Wastewater through Zero Liquid Discharge Systems

Advancements in water and wastewater treatment systems have made it cost-effective to employ zero liquid discharge (ZLD) systems, accomplishing separation of solids and recovery of water for reuse in power plants. Typical components of zero liquid discharge systems include brine concentrators, crystallizers and evaporators. Zero liquid discharge systems achieve a reduction of overall water consumption of about 10 percent to 15 percent, which normally amounts to conserving water on the order of about 300 to 600 acre-feet/year. Some of the environmental benefits are avoiding degradation of surface or groundwater where treated wastewater would have otherwise been returned to a water source, and avoiding potential health effects to wildlife where highly concentrated wastewater would otherwise be discharged to an evaporation pond. The adoption of the 2003 IEPR Water Conservation Policy requires power plants being reviewed for licensing to include zero liquid discharge systems for recovery and reuse of wastewater unless shown to be environmentally undesirable or economically unsound. As a reflection of the 2003 IEPR Water Conservation Policy, Figures 3-14 and 3-15 illustrate utilization of zero liquid discharge expressed as a percent of installed capacity. This is shown in the figures to be increasing from about 35 percent between 1996 and 2004 to about 46 percent presently.

Figure 3-14 Disposal Method for the 7,559 Megawatts That Came On-line from 1996-2004 as a Percent of Installed Capacity

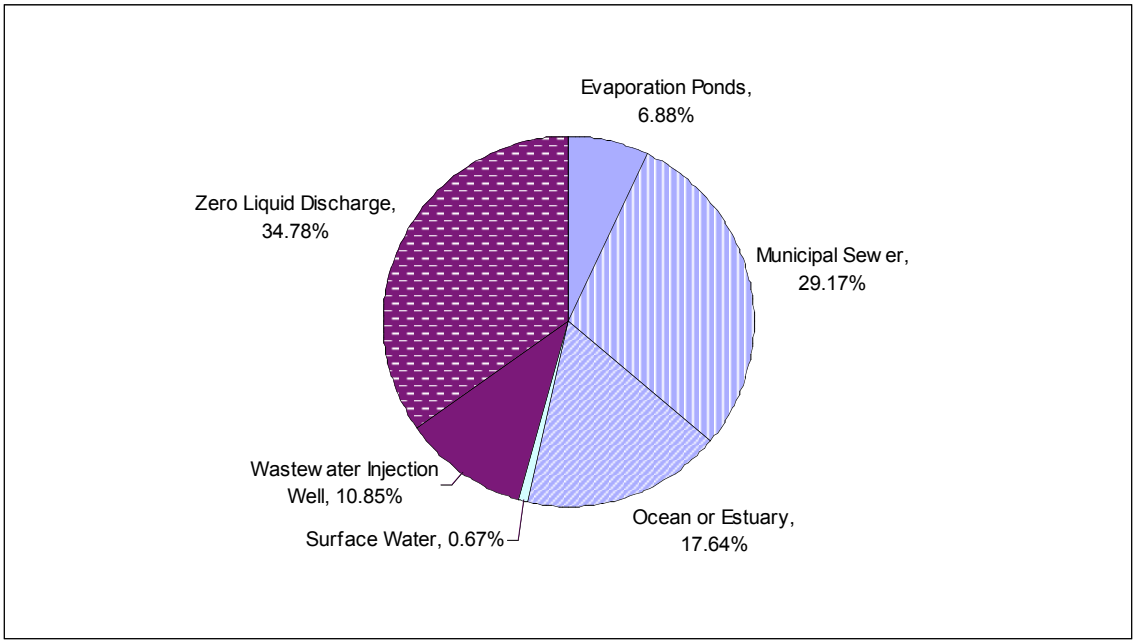
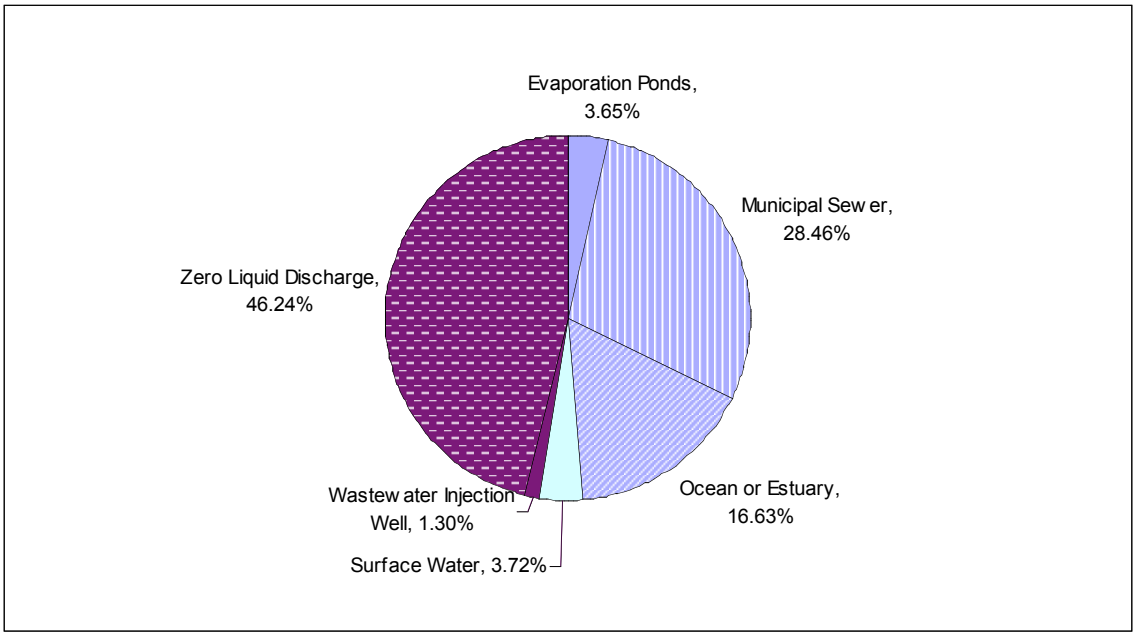


Figure 3-15 Disposal Method for the 14,248 Megawatts Currently Under Construction, Permitted but Delayed, or in Review as a Percent of Installed Capacity



Alternatives to Once-Through Cooling

Continued use of once-through cooling (OTC) at existing and repowered power plants perpetuates impacts to aquatic resources in coastal zone, bays, and estuaries. While no power plants using OTC have been proposed for new California coastal sites in the last two decades, proposals to repower existing generation units at these sites are expected to propose the continued use of OTC. There are alternative cooling technologies that are proven and used extensively. In fact, 95 percent of the power plants licensed in California since 1996 have used cooling technology other than OTC such as wet cooling towers or dry cooling. Facilities proposing to use OTC could be required to use an alternative cooling technology unless they can show why they must use OTC.

Once-through cooling can be destructive to coastal and bay biological resources; this contributes to the deterioration of California's already compromised near shore and estuarine ecosystems. Please see the Biological Resources Section for more information on environmental effects of once-through cooling and a policy discussion.

Mitigating Adverse Impacts to Water Supply and Quality

Renewable Energy Resources

Some renewable energy resources such as wind and solar–photovoltaic use little or no water and produce little or no wastewater, and thus provide the opportunity to reduce existing and future demands on water supply and effects to water quality attributable to power generation. Other renewables with high capacity development potential such as biomass could accomplish water conservation through use of recycled water and/or dry cooling. Renewable energy has applications as either distributed generation (serving a particular home or business) or commercial generation, and some resources like solar or wind can produce power in either setting. Several programs facilitated by the Energy Commission are promoting renewable energy resource development. Projections for potential renewable energy development in California, and associated water use issues and benefits, are summarized in Table 3-17.

Table 5-6 Renewables in California-Existing Development, Potential for Growth and Associated Water Use

Renewable Type - Fuel Source & Process	Approximate MW On-Line / MW of Additional Potential	Water Use at Power Plant/ Water Use for Fuel Source	Opportunities in Relation to Water Use
Biomass Energy - use of agricultural, forest or municipal organic wastes or feedstock grown for the purpose of providing fuel;	600 MW; an additional 122 MW are idle	Relatively high water use at power plants using direct combustion for producing steam & using wet cooling; Water use to grow feedstock may be high.	For direct combustion technology, water could be conserved using hybrid or dry cooling. (CBEA 2005)
Digester Gas- - biodegradable organic matter is broken down by bacteria into biogas, consisting of methane, carbon dioxide and other gases	<1 MW from animal waste; 40 MW from wastewater treatment. Potential of over 105 MW from animal waste & about 36 MW from wastewater treatment	Water use is similar to natural gas fueled production technologies, which depend on cooling method.	Water could be conserved using hybrid or dry cooling. (CEC 2005a).
Landfill gas - decomposition of the organic matter in municipal solid wastes that are disposed underground.	200 MW Potential for about 100 MW	Water use is similar to natural gas fueled production technologies, which depend on cooling method.	Water could be conserved using hybrid or dry cooling. (CEC 2005b).

Renewable Type - Fuel Source & Process	Approximate MW On-Line / MW of Additional Potential	Water Use at Power Plant/ Water Use for Fuel Source	Opportunities in Relation to Water Use
Geothermal - utilization of underground resources of steam in a steam turbine generator	2,225 MW Potential for about 1,700 MW today & for an additional 1,300 MW when economical later	Water use can be high if not derived from condensed steam.	Water could be conserved if cooling water is derived from condensed steam
Small Hydro < 30 MW - harnesses the potential energy of falling water;	1,300 MW Potential to develop about 1,300 MW primarily from upgrading existing units or adding new units to existing dams and water conveyance facilities	No consumptive water use except in the construction phase.	Environmental improvements occur primarily during licensing by the Federal Energy Regulatory Commission & certifications by the State Water Resources Control Board
Wind	1,700 MW Potential for about 5,000 MW	No consumptive water use except in the construction phase.	Avoids water use that would be necessary for other technologies (CWEC, 2005)
Solar – Photo voltaic Energy - Solar cells or modules use semiconductor material to directly convert sunlight into electricity	Developed primarily as distributed generation for residences & businesses. Some 1-MW systems are being installed by municipalities.	No consumptive water use except in the construction phase.	Development of this renewable would result in increased MW with little or no increase in water use. (CEC, 2002)

Under the Renewable Portfolio Standard Program, investor owned utilities have discretion as to how they choose to meet the standard for increasing their procurement of eligible renewable energy resources by at least one percent per year so that 20 percent of their retail sales are procured from eligible renewable energy resources by 2017. In general, their strategy is to procure those resources that are incrementally the least cost, which is in the best interest of the utility's ratepayers. However, the least cost renewable resources may not necessarily coincide with the most environmentally friendly or technologies that have the least effect to water supply and quality. Overall, the viability of renewable energy resources is primarily driven by market conditions, and the ability of a particular generation sector to compete among other production technologies.

Typical water use by production technology is as shown in Table 3-12. The promotion of higher cost production technologies that are more environmentally

friendly and do not have any appreciable demand for water supply, such as promoting solar – photovoltaic energy to a commercial level, accomplishes both avoided air emissions and avoided water use for power plant cooling. If 500 MW of renewable energy resources such as solar – photovoltaic energy or wind energy were to be developed, it would avoid water demands on the order of 3,500 to 4,000 acre-feet per year for an equivalent combined cycled plant with wet cooling. Likewise, directing biomass energy to use either direct combustion or gasification coupled with dry cooling, so as to become less water-intensive as well as improving air emission controls, may require revenue mechanisms that recognize and account for its additional societal benefits. Considering the abundant availability of fuel for both solar and biomass energy, these renewable resources along with wind energy have the greatest potential for providing new generating capacity with the least impact to the state's water supplies.

Regulatory Trends

Clean Water Act 316(b) Regulations

Cooling water intake structures can cause injury or death to fish or other aquatic organisms by entrainment and impingement. Section 316(b) of the Clean Water Act requires EPA to ensure that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impacts. Implementation of new provisions and performance standards that went into effect September 7, 2004 under Section 316(b) of the Clean Water Act will help reduce and mitigate detrimental effects to aquatic life from cooling water intake structures of larger existing power plants using more than 50 million gallons per day (mgd) of cooling water. The revised regulation is expected to be applicable to all 21 power plants in California utilizing OTC, and requires the project owner to demonstrate compliance with these requirements by no later than January 7, 2008. Implementing regulations under Section 316(a) of the Clean Water Act will help reduce and mitigate thermal effects of cooling water discharge. These facility and operating improvements are normally addressed in the renewal of the Waste Discharge Requirements for the power plants as facilitated by the Regional Water Quality Control Board every five years. The details concerning how these regulations are implemented may influence plans to modernize existing coastal power plant projects in California.

California Hydropower and Water Quality Impacts

California has 386 existing hydroelectric plants, each with one or more generating units making up an installed capacity of 14,116 MW. The capacity of a hydroelectric project can vary significantly from less than 0.1 MW to over 1,212 MW at PG&E's Helms Pumped Storage Project, and even greater outside California, such as Grand Coulee Powerhouse on the Columbia River rated at 6,809 MW.

California hydropower provides about 15 percent of the state's electricity in a normal water year. While generally considered a clean technology due to the lack of criteria

pollutants emissions and greenhouse gas emissions, hydropower operations impact the ecosystems of rivers and streams and diminish the water quality characteristics needed for fish and other aquatic biota. These impacts include altered river systems resulting from the change to natural river flows, altering aquatic habitats, dewatering sections of streams, blocking the migration of fish, changing water temperatures and flooding land and adjoining upland riparian areas.

The key water quality parameters for hydropower are temperature, flow volume, suspended solids and dissolved oxygen levels. Cold water fish such as trout and salmon require the right balance of temperature, flow volume and oxygen to maintain viable habitat conditions. Cold water fish require water temperatures of 20 degrees Centigrade (68 degrees Fahrenheit) for most life stages. Water temperatures in bypass reaches often exceed those levels and are lethal to cold water fishes. Sediment and gravel transport are factors in maintaining the physical suitability of channels and stream bottoms for spawning and foraging. Water that passes through hydroelectric turbines is classified as a “waste discharge” under the federal Clean Water Act. The California SWRCB regulates such waste discharges through Section 401 of the act, and sets water quality standards to protect the beneficial uses of water in California.

FERC licenses and regulates 119 projects in California, totaling 11,930 MW. Twelve power plants representing 2,186 MW are federally-owned projects which are not subject to FERC licensing, but benefit from improvements from programs such as the Central Valley Project Improvement Act and Cal-Fed.

FERC hydropower licenses are issued for 30 to 50 years. The original licenses generally contained no provisions to monitor water quality and aquatic biological conditions and had no provision to change operational practices in response to new scientific understandings of impacts. Rivers were treated as linear water conveyance systems, as opposed to complex, dynamic ecological and physical systems. In accordance with the scientific thinking from the mid-20th century, FERC generally set instream flow levels and release schedules at low, static levels intended to optimize power production from each stream and river segment (SWRCB 2003a).

Under the Federal Power Act, a FERC project license incorporates the regulatory standards that were in place when the license was issued. This means that the many older California hydropower projects conform with the Federal Power Act, but do not conform to current state regulatory standards or to current federal Clean Water Act or Endangered Species Act standards. As of 2003, only a small portion of California’s hydropower system meets current state water quality standards**.** Eleven of the 119 FERC-licensed projects have 401 certifications under the Clean Water Act from the State Water Board, and eleven more will be completed by 2007. In addition, seven other hydroelectric projects have environmental protection conditions established under proceedings for appropriation of water rights. These twenty-nine projects total about 2,407 MW, representing only 20 percent of the total regulated (non-federal) hydroelectric installed capacity in California. The relicensing of

California's hydroelectric system creates opportunities to bring a key part of California's energy sector into conformance with current state and federal environmental law. However, the rate of progress to implement relicensing is slow. By 2020, only 58 projects representing 5,985 MW (50 percent of California's hydropower capacity) will have completed environmental review through FERC relicensing and SWRCB Section 401 Water Quality Certification. Relicensing provides the opportunity to improve environmental protection measures and initiate adaptive management principles, a trend for continuous and progressive environmental improvements to hydro facilities.

Modern FERC relicensing conditions include a host of protection, mitigation and enhancement measures addressing goals, objectives and strategies tailored for management of the individual ecosystems. Below are examples of the types of environmental goals and objectives managed under the adaptive methods established in these relicensing agreements.

Fisheries – Establishing criteria such as fish population, species and densities in pounds per mile or pounds per acre, age classes, average size caught, average catch rate in number of fish per hour, macro-invertebrate indices (as available food for fish);

Natural hydrograph and stream environment – Establishing flow rates below powerhouses or in bypassed reaches of streams to better mimic natural conditions, maintaining natural fluvial processes and riparian habitat, and to prevent unnatural fluctuations that could affect biota or public safety; and

Other beneficial uses – Providing stream flows that provide broad recreation opportunities where applicable, and that maintain the economic viability, reliability and flexibility needed for effective power production.

Please see the **Biological Resources** section for additional discussion of hydropower issues. Energy Commission staff will also publish a white paper on hydropower issues as part of the Integrated Energy Policy Report.

Results from 2004 Survey of Power Plant Owners

The Energy Commission's 2005 survey of power plant owners targeted water use and discharge data from a representative cross-section of power plants rated at a capacity of 20 MW or more and which were operating in 2003. Over 100 responses were returned from fossil-fueled, nuclear, geothermal, biomass, and cogeneration facilities. For many of these facilities the Energy Commission had little or no data, so the survey has significantly increased our knowledge base about the power plants that generate less than 50 MW and the cogeneration sector.

There are a number of factors that can cause water use and wastewater discharge characteristics to be unique, even when grouping by fuel type or energy production technology. These factors include the type of associated cooling method, quality of

water supply (affecting how many times it may be reused before being diluted), extent of process wastewater treatment/reuse, and climate conditions. As a result, since it is difficult to interpret specific patterns of water use from the 2005 survey, the analysis performed thus far is limited to observing more general patterns and trends.

The power plants operating in our state have varying sources for water (Table 3-18). Based on the data collected during the Energy Commission's 2005 survey, we can observe the most intensive water use occurs with power plants drawing water from the ocean, a bay or an estuary which is associated with once-through-cooling of the coastal plants. The total combined use for primarily cooling purposes is 1,345,085 acre-feet per year with an average annual water use of 269,000 acre-feet per year among the 5 plants surveyed. Recycled or degraded water accounts for a combined use of 12,944 acre-feet per year and an average annual water use of 1,618 acre-feet per year among the 8 plants surveyed. The average annual plant use of recycled water is likely higher due to more extensive cooling water demands associated with a combined cycle power plant. Among the three sources of water supply that are likely suitable for municipal supplies once treated, including municipal water, groundwater and water transfer supply, the total is 40,526 acre-feet per year, which among the inland water supplies represents 72 percent of the total.

Table 5-7 Total and Average Water Use by Source of Power Plants Currently Operating

Source of Cooling Supply Water	Count of all reporting plants	Sum of reporting power plant's annual water use (Acre Feet)	Average annual water use (Acre Feet)
Municipal potable water supply	43	18,883	439
Recycled or degraded water	8	12,944	1,618
Groundwater from onsite wells	27	15,975	591
Groundwater from offsite wells	14	3,587	256
Owner-operated surface water	0	0.00	0.00
Water transfer from freshwater supply	15	2,081	138
Ocean or estuarine water	5	1,345,085	269,017
Other	3	2,784	928

Source: Energy Commission's 2005 survey of power plants

In the 2005 survey of power plants, the majority of respondents both large and small used municipal water supplies as their source of cooling water, followed by on-site wells (Table 3-19, Appendix E-1). In addition, 82 of 95 (or 86 percent of the) power plants operating in 2003 used a water source capable of serving as potable water

supply after treatment, including municipal water, groundwater and untreated fresh water.

In disposing of their wastewater, most facilities responded that they use municipal sewers, but much of the data still needs to be verified because a large portion of the data is only classified as "other" which may require follow-up by staff (Table 3-32, Appendix E-1). Prior to 1996, wastewater discharge from power plants was commonly returned to surface water off-site and several re-injected water back into a saline aquifer formation, typically in association with oil fields in Kern County. Newer facilities have the option of using specialized wastewater lines that have been built by interagency groups. An example is the Mountainview Power Plant in San Bernardino County that uses a specialized brine line for disposal of its wastewater. Or, power plants can place a zero-liquid discharge unit onto the end of their water cycle to dispose of waste in solid form and return the water to the power plant's operations.

Table 5-8 Power Plant Facilities Cooling Water Supply Source and Discharge Method by Type

	Operating Power Plants as of 1996		Additional Power Plants post-1996		Total Count of Facilities with data
Cooling Water Medium	**20-50 MW**	**>= 50 MW**	**20-50 MW**	**>= 50 MW**	
Municipal potable water supply	19	18	2	4	43
Recycled or degraded water	3	2	1	2	8
Groundwater from on-site wells	9	11	4	3	27
Groundwater from off-site wells	6	6	2	0	14
Owner-operated surface fresh water diversion	0	0	0	0	0
Water transfer from freshwater supply	4	9	1	1	15
Ocean or estuarine water	0	5	0	0	5
Other	0	3	0	0	3
Total	**41**	**54**	**10**	**10**	**115**
Wastewater Disposal Method					
	20-50 MW	**>= 50 MW**	**20-50 MW**	**>= 50 MW**	**Total**
To Municipal Sewer	22	14	5	6	47
To Surface Water	1	2	0	1	4
Wastewater Injection Well	8	3	0	1	12
To Ocean or Estuary	0	10	0	4	14
To Evaporation Ponds	7	4	0	0	11
Zero Liquid Discharge	6	3	2	2	13
Other	6	25	4	0	35
Total	**50**	**61**	**11**	**14**	**136**

Source: Energy Commission 2005 Survey of power plants

Summary and Conclusions

Water use by power plants since 1996 has been trending towards improved fresh water conservation through the use of recycled water, more efficient cooling and zero-liquid discharge systems. The 2003 IEPR Water Conservation Policy is expected to continue to positively influence power plant applicants to achieve maximum water conservation of fresh inland water supplies related to power plant use for the highest beneficial purposes, including domestic and irrigation. With concern for the environmental impacts from once-through cooling that could perpetuate as the coastal power plants seek to modernize, staff believes consideration should be given to adopting a policy to support more environmentally friendly cooling methods as presented in the Biological Resources Section.

Water demands for supporting future power generation will be a function of the production and cooling technology, and the effect of policies encouraging no or low-water use technologies for cooling and recycling power plant process wastewater. In general, water use by the electricity sector can be reduced if Energy Commission policies can increase the amount of megawatts produced with the same amount of water use. This goal can best be accomplished by encouraging development of the renewable energy resources in utility portfolios that best conserve water such as wind and solar-photovoltaic, increasing use of recycled water, and encouraging use of dry or hybrid cooling where water supplies are limited. Continuing to encourage the use of zero-liquid discharge systems will accomplish water conservation by treating wastewater and recycling water within power plants and will avoid water quality impacts.

To help broaden opportunities for conserving the state's fresh water supplies, the Energy Commission could develop and provide power plant siting review guidelines to local agencies for the permitting of power plants less than 50 MW. The guidelines could include water conservation policy recommendations to encourage a more consistent practice for conserving local water supplies and helping local government officials understand water conservation technologies associated with power plants. In addition, Energy Commission staff could evaluate water conservation opportunities of existing licensed power plants greater than 50 MW. Many power plants were developed prior to recycled water programs becoming available. For power plants found to meet initial criterion for having potential to conserve fresh water, staff could offer the plant owner and local water district a more detailed alternatives analysis evaluating opportunities for use of recycled water and water-conserving cooling methods.

Appendix E: Data Tables for Water Resources

(Two Excel files that are published separately)

CHAPTER 6: PUBLIC HEALTH

Summary of Findings

- Toxic air pollutant emissions from the normal operation of electric generation facilities are not major contributors to regional public health risk.
- There are no significant localized cancer or noncancer risks associated with the normal operation of any individual electric generation facility.
- Mobile source emissions, especially diesel particulate matter, dominate regional air quality and public health risks in most areas of the state.

Introduction

Toxic air pollutants cause or may cause a variety of adverse public health effects, including cancer or other serious health effects, such as reproductive effects or birth defects. This section examines the degree to which toxic air pollutant emissions from the electric generation sector contribute to public health impacts on a regional and local basis. It presents information on the quantities of toxic emissions from the electric generating sector as well as a discussion of health risks both regionally and from individual facilities.

Please refer to the Air Quality section of the 2005 Electricity Environmental Performance Report for a discussion of criteria air pollutants, including inhalable particulate matter. Particulate matter from all sources is of great concern to the public and regulatory agencies because of its potential health effects. Many epidemiological studies have shown that exposure to particulate matter can induce a variety of health effects, including premature death, aggravation of respiratory and cardiovascular disease, changes in lung function and increases in existing respiratory symptoms, effects on lung tissue structure, and impacts on the body's respiratory defense mechanisms. Exposure to particulate matter may also exacerbate asthma symptoms and lung development in children. Although the contribution from the electricity generation sector to particulate matter levels in the air is very small (generally on the order of one-half to one percent in various air districts), the public and agencies are still concerned if individual power plant particulate emissions may influence local conditions.

Regulatory Framework

Federal

The Clean Air Act directs the U.S. Environmental Protection Agency (U.S. EPA) to establish national standards for ambient air quality for criteria air pollutants. The Clean Air Act also requires the U.S. EPA and the states to implement, maintain, and enforce these standards. The U.S. EPA regulates emissions of toxic air pollutants from a published list of industrial sources referred to as "source categories." The

U.S. EPA has developed a list of source categories that must meet control technology requirements for these toxic air pollutants.

State

California has two primary statutes affecting the control of toxic air pollutant emissions: the Toxic Air Contaminant Identification and Control Act (AB 1807, Tanner 1983) and the Air Toxics "Hot Spots" Information and Assessment Act (AB 2588, Connelly 1987).

Assembly Bill 1807 created California's program to reduce exposure to toxic air contaminants. Under AB 1807, the California Air Resources Board (Air Board) identifies and controls toxic air pollutant emissions by determining if a substance should be formally identified as a toxic air contaminant and if an Air Toxic Control Measure is necessary to reduce the associated risk. As discussed further below, the Air Board adopted an Air Toxic Control Measure for stationary diesel engines on February 26, 2004.

Assembly Bill 2588, the Air Toxics "Hot Spots" Information and Assessment Act, supplements the Assembly Bill 1807 program by requiring a statewide toxic air pollutant emissions inventory, notification of people exposed to a significant health risk, and facility risk management plans.

Local

In California, local air districts have the primary responsibility for issuing air quality permits. Permitting includes New Source Review for areas that are not in attainment of state or federal ambient air quality standards (nonattainment areas) and Prevention of Significant Deterioration in attainment areas. Rules and regulations, which can include specific stationary source toxic air pollutant emissions control measures, are adopted by individual districts.

Local air districts prioritize facilities based on their routine toxic air pollutant emissions. The air districts typically rank facilities in the “high” priority category if the cancer risk exceeds 10 in one million. Similarly, most districts rank facilities in the “high” priority category if the acute or chronic hazard index (which is a measure of noncancer health impacts) exceeds 1.0 (although the Bay area district has chosen 10). If risk is less than 10 in one million and hazard indices are less than 1.0, the facility is considered to emit toxic air pollutants at levels below those which would cause adverse health effects.

Toxic Air Pollutant Risks

Criteria air pollutants are those for which air quality standards have been established to protect public health. When a pollutant exceeds its standard, the air is unhealthy to breathe. Toxic air pollutant emissions have no associated ambient air quality standards, so other health measures must be used to determine their potential

health impacts. The three measures used are: acute health effects (short-term), chronic noncancer health effects (long-term), and cancer risk (also long-term).

Acute health effects result from short-term (1-hour) exposure to relatively high concentrations of pollutants. Acute effects are temporary in nature, and include symptoms such as irritation of the eyes, skin, and respiratory tract. Chronic health effects result from exposure over many years to lower concentrations of pollutants. Chronic health effects include diseases such as reduced lung function and heart disease. Acute and noncancer chronic health impacts are measured by a hazard index, which is the ratio of the exposure concentration of the facility's reported emissions to a concentration considered safe for people. A hazard index less than 1.0 indicates that the exposure is not likely to result in adverse health impacts.

Cancer risk is the probability that a person may contract cancer over a lifetime of 70 years as a result of breathing toxic air pollutants. For example, a ten in one million risk level represents ten additional chances in one million of developing cancer over a person's lifetime. Cancer risk assessments assume that any exposure to a carcinogen, no matter how small, may lead to developing the disease.

Cancer risk is a more sensitive measure of potential health effects than noncancer effects because of the assumption that any exposure to a carcinogen may cause cancer. Therefore, the public health discussion in this section focuses exclusively on cancer risk rather than noncancer health effects.

One characteristic of toxic air pollutant emissions, which distinguishes them from most criteria pollutants, is that their impact tends to be highest in close proximity to sources and drops off with distance.[12] Impacts may be greatly reduced at distances ranging from hundreds to thousands of feet, depending on the source.

Background Cancer Risk

Cancer is the second leading cause of death for Californians behind heart disease.[13] Smoking, diet, inactivity, and obesity have been identified as major cancer risk factors, and may account for about two-thirds of all cancer deaths. Exposure to environmental pollution only accounts for an estimated two percent of cancer cases. Given the multiple factors that contribute to the risk of cancer, the long latency times between exposure to the onset of cancer, and the low levels at which chemicals usually occur in the ambient environment, associating cancer with specific environmental exposures is difficult.

Cancer risks from exposure to toxic air pollutants (expressed as chances per million) are discussed below for electric generation facilities as well as the average risk from breathing ambient air. To provide some perspective regarding the magnitude of such risks, we note that the National Cancer Institute registries on cancer incidence and mortality show that, on average, a person has approximately a 21 percent chance of developing cancer of any type by age 70.[14] This means that when expressed as a probability, the average risk of developing cancer over a lifetime is about 210,000 in

one million. Thus, when a facility risk of 10 in one million is included, the total risk to the average person would be 210,010 in one million, an increase of five thousandths (0.005) of one percent.

Relative Contribution of Power Sector Emissions

Table 1 lists the ten toxic air pollutants that pose the most substantial inhalation health risks in California and the sectors from which they originate. Inhalation risk is driven by a small number of compounds, the top three (diesel particulate matter, 1,3-butadiene and benzene) accounting for over 88 percent of total risk. Diesel particulate matter from transportation is especially significant, accounting for over 70 percent (about 540 in one million) of the average person's inhalation cancer risk of 758 in one million, as well as contributing to noncancer health effects, such as chronic bronchitis and reductions in pulmonary function.

The mobile sector is the dominant source of the top three toxic air pollutants, contributing over 80 percent of the emissions of each. Consequently, transportation-related emissions are the overwhelming determinant of regional ambient toxic air pollutant trends and associated potential public health effects in urban areas.

The stationary source sector is an important source of benzene, carbon tetrachloride, hexavalent chromium, formaldehyde, methylene chloride, and perchloroethylene, as discussed in Attachment A. Most of these toxics (carbon tetrachloride, hexavalent chromium, methylene chloride, and perchloroethylene) are not emitted by natural gas-fired power plants, which comprise 91 percent of California's in-state fired generation capacity.[15] They are emitted, however, by facilities fueled by landfill gas, coal, coke, wood, and agricultural waste, which comprise about 5 percent of in-state fired generation capacity. Benzene, acetaldehyde, and formaldehyde are emitted as byproducts of natural gas combustion.

Table 2 presents the toxic air pollutant inhalation cancer risk from all sources for the state's most populous air basins, and shows that risks (both with and without diesel particulate matter) in each air basin have decreased consistently over the past decade. This improvement in air quality within the air basins is due in large part to advances in clean transportation fuels and technologies.

Table 6-1 Highest Risk Toxic Air Contaminants and Their Sources (Statewide by Sector)

Toxic Air Contaminant	Cancer Risk (chances per million)	Contribution to Total Cancer Risk[1] (percent)	Percent of Toxic from Stationary Sources[2,3]	Percent of Toxic from Areawide Sources[2,4]	Percent of Toxic from Mobile Sources[2]
Diesel particulate matter	540	71.2	5	0	95
1,3-Butadiene[5]	74	9.8	1	13	83
Benzene	57	7.5	15	1	84
Carbon Tetrachloride	30	4.0	100	0	0
Formaldehyde	19	2.5	14	1	76
Chromium (hexavalent)	17	2.2	48	52	0
para-Dichlorobenzene	9	1.2	1	99	0
Acetaldehyde	5	0.7	3	23	74
Perchloroethylene	5	0.7	68	32	0
Methylene Chloride	2	0.3	52	48	0
TOTAL RISK	758	100	n/a	n/a	n/a

[1] California Air Resources Board. Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles, October 2000, Table 7

[2] California Air Resources Board. The California Almanac of Emissions and Air Quality, Chapter 5

[3] Stationary sources of air pollution include non-mobile sources such as power plants, refineries, and manufacturing facilities.

[4] Areawide sources of pollution are those where the emissions are spread over a wide area, such as consumer products, fireplaces, road dust, and farming operations.

[5] Totals 97 percent due to 3 percent contribution from natural sources which is not shown

Table 6-2Toxic Air Contaminant Cancer Risk[1] by Air Basin (with and without diesel particulate matter-DPM)

Air Basin	1990		1995		2000		2003
	without DPM	with DPM	without DPM	with DPM	without DPM	with DPM	without DPM[2]
San Francisco Bay Area	403	1153	314	884	179	659	150
San Joaquin Valley	450	1230	305	815	196	586	158
San Diego	399	1269	273	843	187	607	148
Sacramento Valley	385	1135	225	705	160	520	148
South Coast	616	1696	505	1315	285	1005	225

[1] Risk represents the number of excess cancer cases per million people based on a lifetime (70-year) exposure to the annual average concentration.

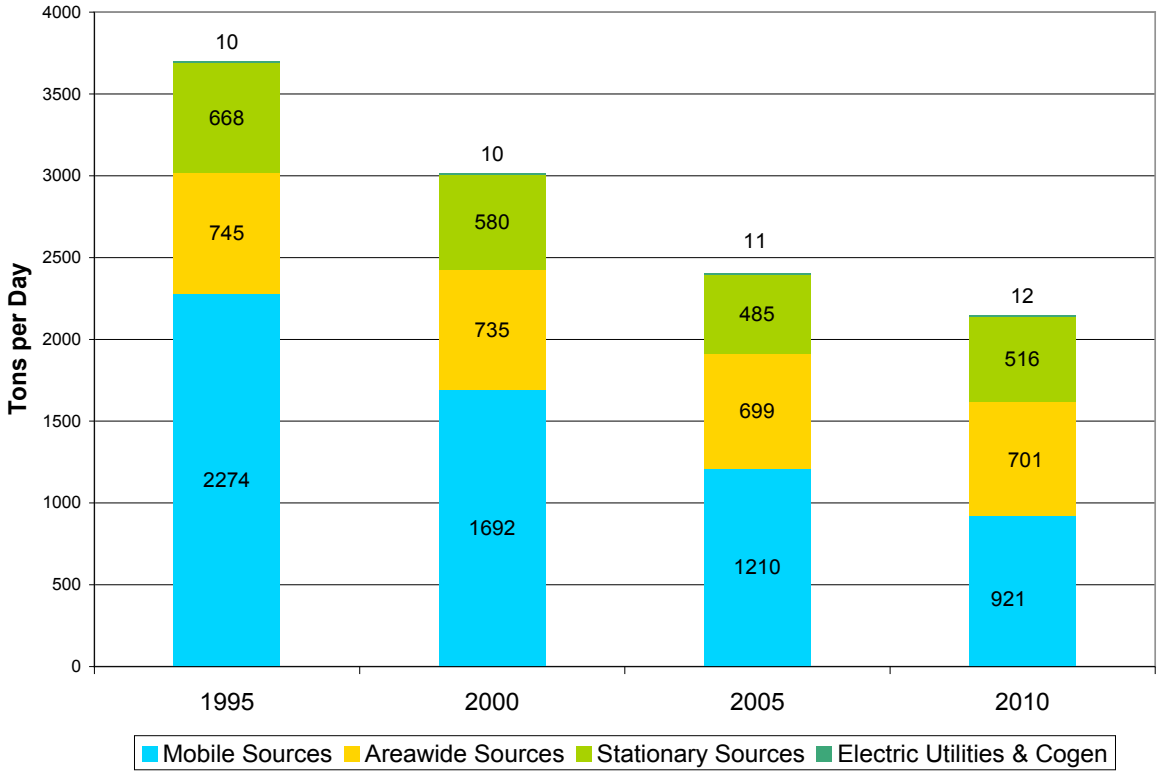
[2] Diesel particulate matter risk data not available for 2003

source: California Air Resources Board. The California Almanac of Emissions and Air Quality, 2005, Chapter 5 Appendix C

Figure 1 presents the statewide contributions in tons per day from the electric utility and cogeneration sectors over the period 1995 to 2010. Since quantitative trend data are not available for individual toxic air emissions, Air Resources Board trend data for Reactive Organic Gases are used instead. Reactive Organic Gases comprise a broad category of gaseous carbon compound pollutants and includes the air toxics listed above, with the exception of diesel particulate matter, hexavalent chromium, methylene chloride, and perchloroethylene.

Figure 1 shows that Reactive Organic Gases emissions from the electric generation and cogeneration sectors contribute only 0.5 percent or less to statewide emissions from 1995 to 2010. Projected emissions from these two sectors stay fairly constant over the period, but the percentage contribution increases slightly due to emission decreases in other sectors. Although there is a slight decrease in Reactive Organic Gases emissions from areawide and stationary sources, most of the improvement during the period is due to a significant decrease in transportation sector emissions. Figures B-1 through B-5 in Attachment B show similar Reactive Organic Gases emissions trends for the five most populous air districts in the state.

Figure 6-1 Reactive Organic Gases Emissions by Sector (Statewide)



From Figure 6-1, it can be seen that electrical and cogeneration facilities contribute a small fraction (about two percent) to stationary source Reactive Organic Gases emissions. Assuming that electrical and cogeneration facilities contribute to benzene, formaldehyde, and acetaldehyde emissions at the same ratio, such facilities would account for only about 0.3 percent of statewide benzene and formaldehyde emissions and 0.6 percent of statewide acetaldehyde emissions. Similar trends occur in each of the state's major air districts.

Individual Facility Risk

As discussed above, electric generation facilities contribute only a minor fraction of total toxic air pollutant emissions in the state's major air districts. They also do not contribute significantly to average regional health risk from inhalation of toxic air pollutants. This section discusses potential health impacts from individual electric generation facilities based on risk assessments required under Assembly Bill 2588.

Facilities that do not meet the screening thresholds for preparing risk assessments are categorized as low-risk. Risk assessments consider the quantity and toxicity of all of the toxic air pollutants emitted by the facility as well as the proximity of persons who live or work nearby. The risk assessments must comply with state-approved protocols and are designed to provide conservative (health protective) estimates of potential risks to persons exposed to toxic air pollutant emissions. Real risks are expected to be lower, and sometimes much lower, than estimated risks.

Table 3 summarizes health risks for electric generation facilities in each of the state's five most populous air districts. Since only facilities that exceed the air districts' screening thresholds are required to perform risk assessments, the number of facilities that have submitted risk assessments is significantly less than the approximately 1000 existing generating facilities.

Table 6-3 AB2588 Health Risk Assessment Results for Electric Generation Facilities[1]

Air District	Number of Facilities Required to Report	Cancer Risk	Number of Significant Risk[2] Facilities
Bay Area	25	<10	0
Sacramento	4	<1	0
San Diego	10	<1 - 2	0
San Joaquin	36	<1 - 5	0
South Coast	32	0.02 - 4.98	0

[1] from air district AB2588 data
[2] greater than or equal to a cancer risk of 10 in one million

Table 6-3 shows that no electric generation facility poses a significant cancer risk to any member of the public. Similarly, AB 2588 risk assessments for chronic and acute noncancer hazards show insignificant risks from electric generators.

Emergency Diesel Generators

The AB 2588 risk assessment program (and the above discussion) does not include stand-alone stationary diesel engines, such as those used for emergency backup purposes during power outages. As discussed above, diesel particulate matter is a significant driver of inhalation health risk, and even a single diesel engine may result in relatively high health risks to nearby people. For example, operation of an

uncontrolled one megawatt diesel engine for 250 hours per year would increase cancer risk to nearby residents (within one city block) by 250 in a million.[16]

In 2001, statewide there were 4,097 backup generators over 300 kilowatts in size with a combined capacity of 3,233 megawatts.[17] By 2004, the number of backup generators had increased to 4,906 with a total capacity of 3,880 megawatts.[18] About 93 percent of the 2001 inventory were diesel-fueled engines. In 2001, it was estimated that if all backup generators were to operate for four hours in a day, the amount of particulate matter emitted from their operation would result in a noticeable increase in the daily particulate matter inventory of most air districts (e.g., ranging from 0.2 to 7.0 percent).

As part of the Air Resources Board's Diesel Risk Reduction Plan, the Air Resources Board adopted an Air Toxic Control Measure for stationary diesel engines on February 26, 2004.[19] The Air Toxic Control Measure includes emergency standby engines such as those used when normal power or natural gas service fails or when needed for fire suppression or flood control purposes. The Air Toxic Control Measure includes operating requirements and particulate matter emission standards as well as a compliance schedule. The regulation requires engine owners and operators to submit engine information and plans outlining how each facility will comply with the Air Toxic Control Measure to air districts by July 1, 2005. The first required compliance date is January 1, 2006.

Geothermal Power Plants

California has about 1900 megawatts of geothermal installed capacity, generating approximately 5 percent of the state's energy on an annual basis. Major geothermal resource areas are located at the Geysers in Sonoma and Lake Counties, the Imperial Valley area east of San Diego, and the Coso Hot Springs area east of Bakersfield.

Geothermal steam and liquids contain a wide variety of constituents that are emitted into the atmosphere during facility operation. These include metals (e.g., arsenic, beryllium, cadmium, chromium, copper, lead, manganese, mercury, nickel, phosphorus, selenium, zinc), organic compounds (e.g., benzene, toluene, xylenes), bromine, hydrogen sulfide, ammonia, and radionuclides (e.g., radon). Attachment C presents the annual noncriteria pollutant emissions from four selected geothermal facilities to show the variety of emissions and annual quantities. Typically, ammonia and hydrogen sulfide are emitted in the greatest quantities (on the order of tens to hundreds of tons annually) with other constituent quantities ranging from trace amounts to hundreds of pounds.

Like other stationary sources, geothermal facilities are subject to AB 2588 reporting requirements and must prepare health risk assessments if warranted. As with the electric generation facilities discussed above, no geothermal facility risk assessment reported significant health risks from exposure to toxic air emissions as a result of the plant's operation.

In-State Coal

California has 8 coal-fired units that provide about 390 megawatts of installed capacity. These units are mostly cogenerators that are base-loaded and therefore operate at high capacity factors. Most burn western low sulfur coal and co-fire gas or petroleum coke. Almost all the in-state coal is burned in circulating fluid bed combustors or cement kilns, which result in lower mercury emissions than out of state pulverized coal. Total mercury emissions in 2000 from these units was approximately eight pounds.

Out-of-State Coal

California entities own various percentages of and import electricity from six conventional pulverized coal power plants (Reid Gardner, Intermountain Power Project, Mohave, Navajo, Four Corners, and San Juan) located in nearby states. The California ownership of these six coal plants totals 4,744 MW. Please see Appendix A, A Preliminary Environmental Profile of California's Imported Electricity, for a public health discussion of coal-related emissions.

Conclusions

Toxic air pollutant emissions from the normal operation of electric generation facilities are not major contributors to public health risk on a regional basis. Individual facility risk assessments required by Assembly Bill 2588 also show no significant localized cancer or noncancer risks associated with the normal operation of any individual facility, regardless of fuel type. Mobile source emissions dominate regional air quality and public health risks in most areas of the state. Nevertheless, continuing reductions of toxic air pollutant emissions from the generation sector will contribute to the air agencies' goal of reducing the public health risk from exposure to toxic air pollutants. Such reductions will be based on measures determined to be technologically and economically feasible as part of requirements promulgated by air districts and the U.S. EPA.

Attachment A – Stationary Sources of Selected Air Toxics

Benzene

The primary stationary sources of benzene emissions are crude petroleum and natural gas mining, petroleum refining, and electric generation. Benzene is a byproduct from the combustion of fossil fuels.

Carbon Tetrachloride

The primary stationary sources of carbon tetrachloride include chemical and allied product manufacturers and petroleum refineries. It is emitted from electric generating facilities when coal and landfill gas are combusted as fuel.

Hexavalent Chromium

In the past, compounds containing hexavalent chromium were added to cooling tower water to control corrosion. In 1989, the ARB adopted a statewide airborne toxic control measure prohibiting the use of hexavalent chromium in cooling towers. Primary sources of hexavalent chromium currently include industrial operations such as chrome plating and metal finishing. Hexavalent chromium is emitted from the combustion of wood, ag waste, coke, and fuel oil in electric generating facilities.

Formaldehyde

An important stationary source of formaldehyde includes wood product manufacturing. Areawide sources include residential wood burning. Since the mobile sector is the largest source, future outdoor levels are expected to decline as low emission regulations continue to take effect. Indoor concentrations are generally higher than outdoors due to formaldehyde emissions from building materials and indoor combustion sources. Power plants emit formaldehyde from the combustion of all fuels.

Methylene Chloride

Methylene chloride is used as a solvent, in the manufacture of polyurethane foam and plastic, and as a paint remover. Stationary sources include plastic, aircraft parts, and synthetic materials manufacturers. It is also emitted from the combustion of landfill gas when it is used as a fuel.

Perchloroethylene

Perchloroethylene is used as a solvent in degreasing operations, paints and coatings, adhesives, aerosols and other manufacturing operations. Stationary sources include dry cleaning plants, aircraft part and equipment manufacturers, and fabricated metal product manufacturers. Perchloroethylene is also a combustion byproduct of landfill gas-fired powerplants.

Figure B-1 Reactive Organic Gases Emissions by Sector (Bay Area)

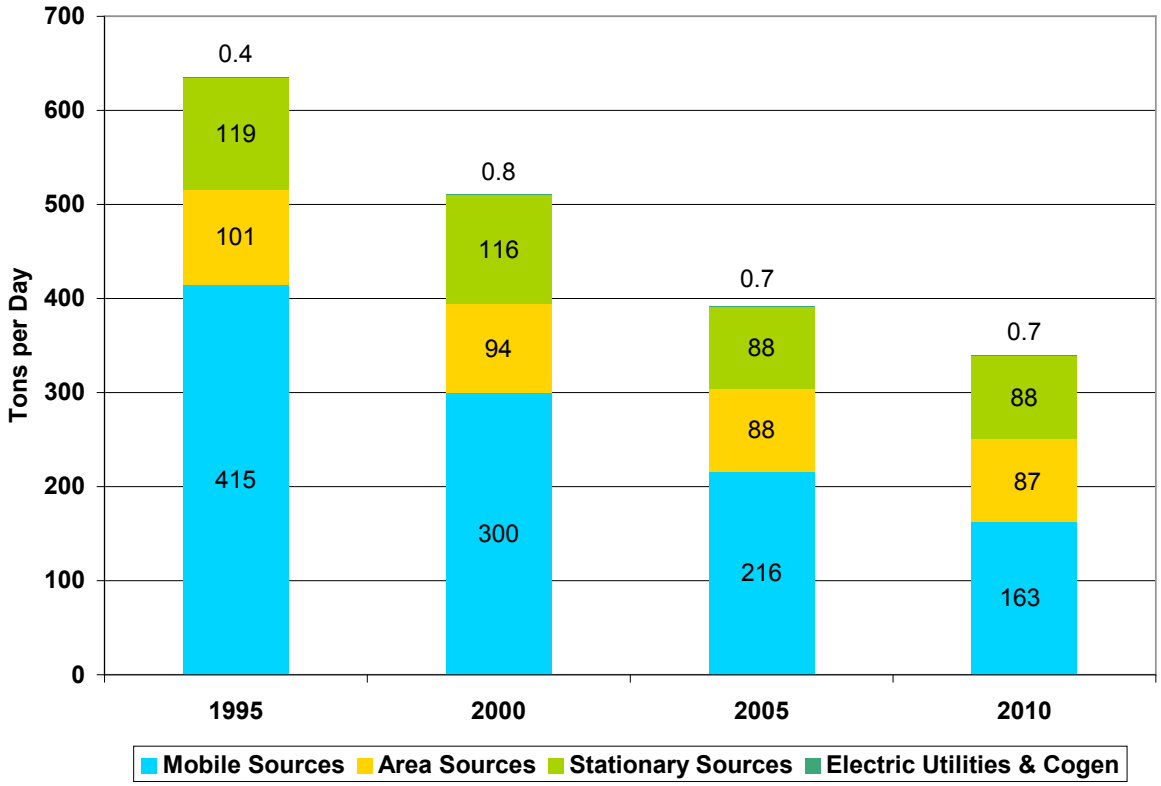


Figure B-2 Reactive Organic Gases Emissions by Sector (Sacramento Metro)

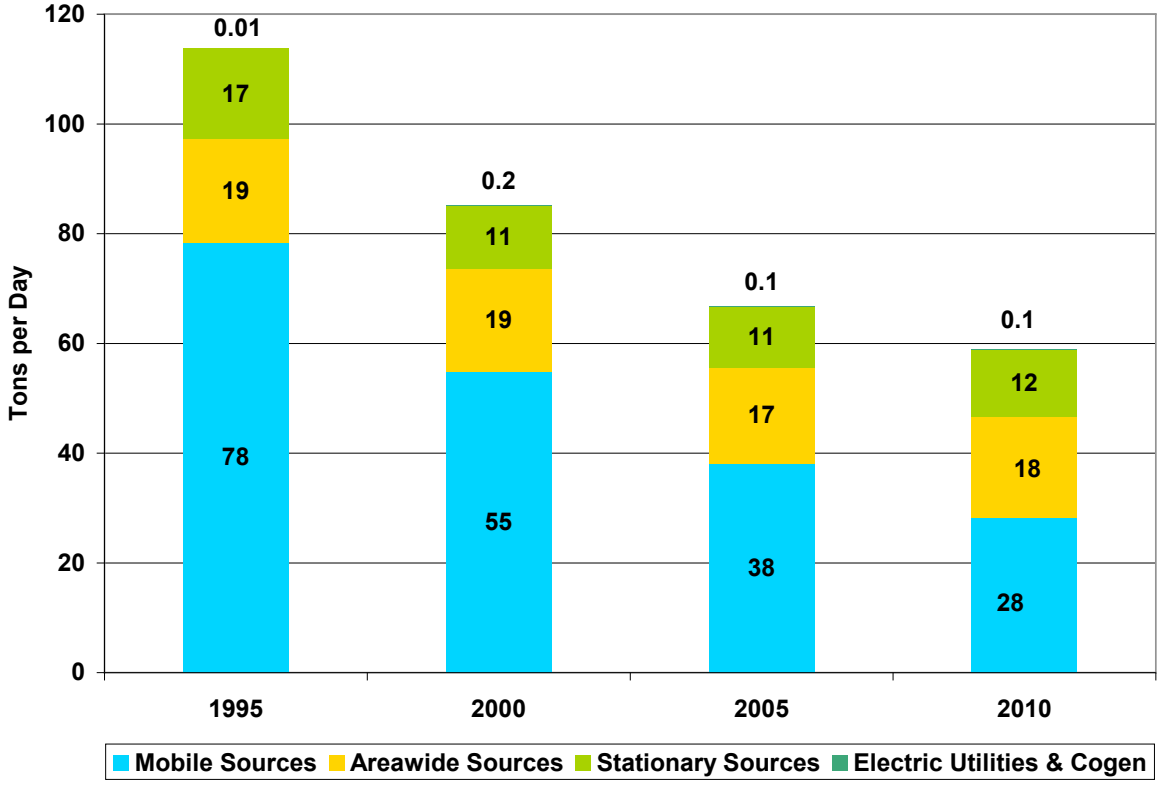


Figure B-3 Reactive Organic Gases Emissions by Sector (San Diego County)

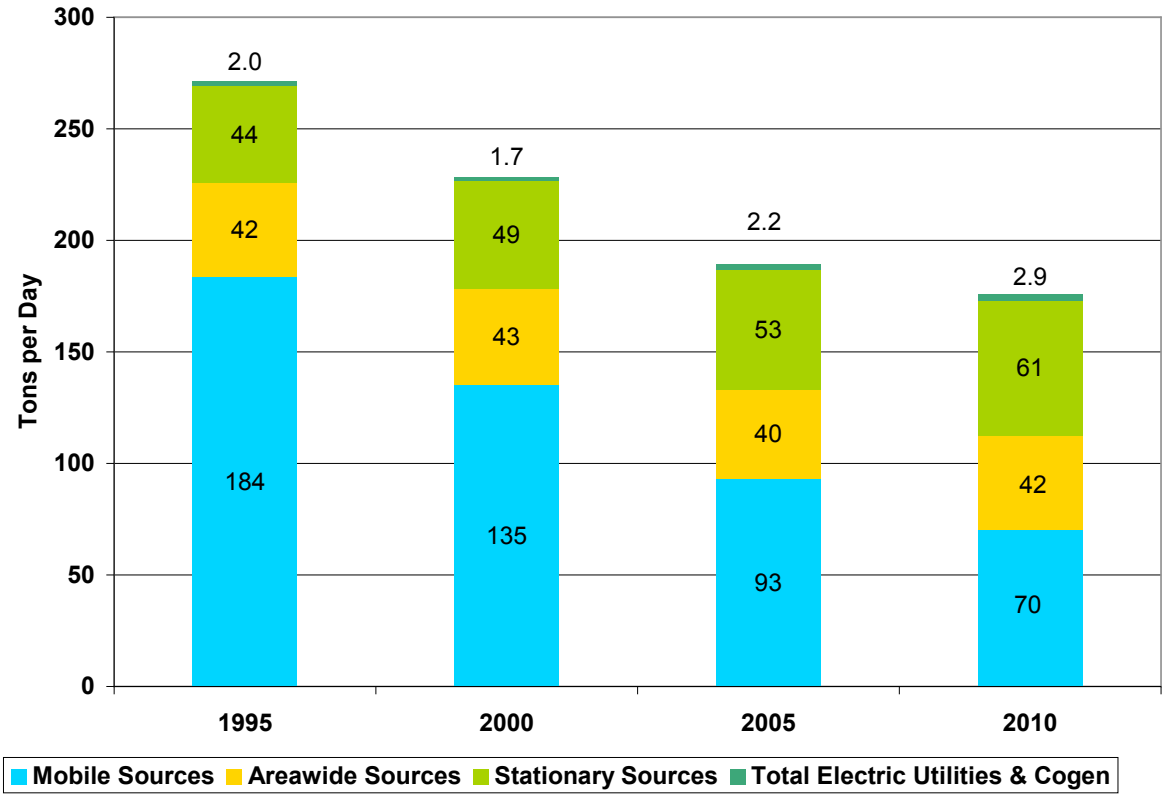


Figure B-4 Reactive Organic Gases Emissions by Sector (San Joaquin Valley)

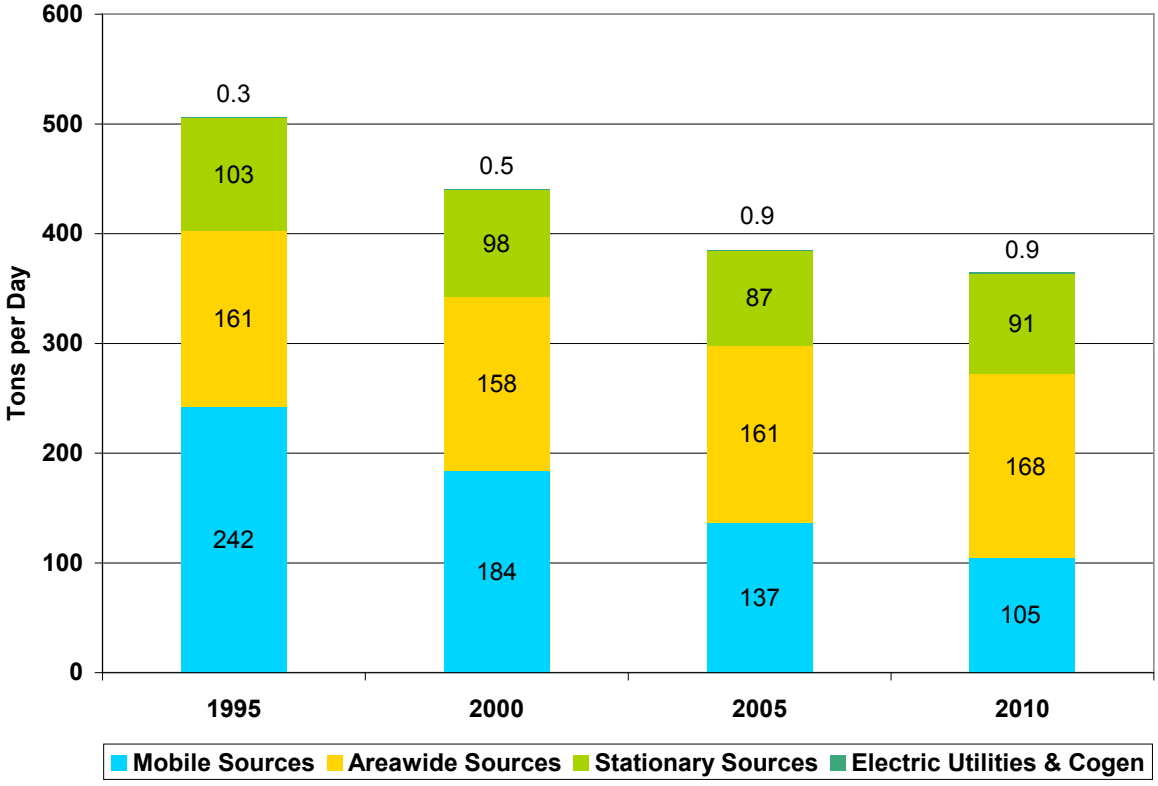
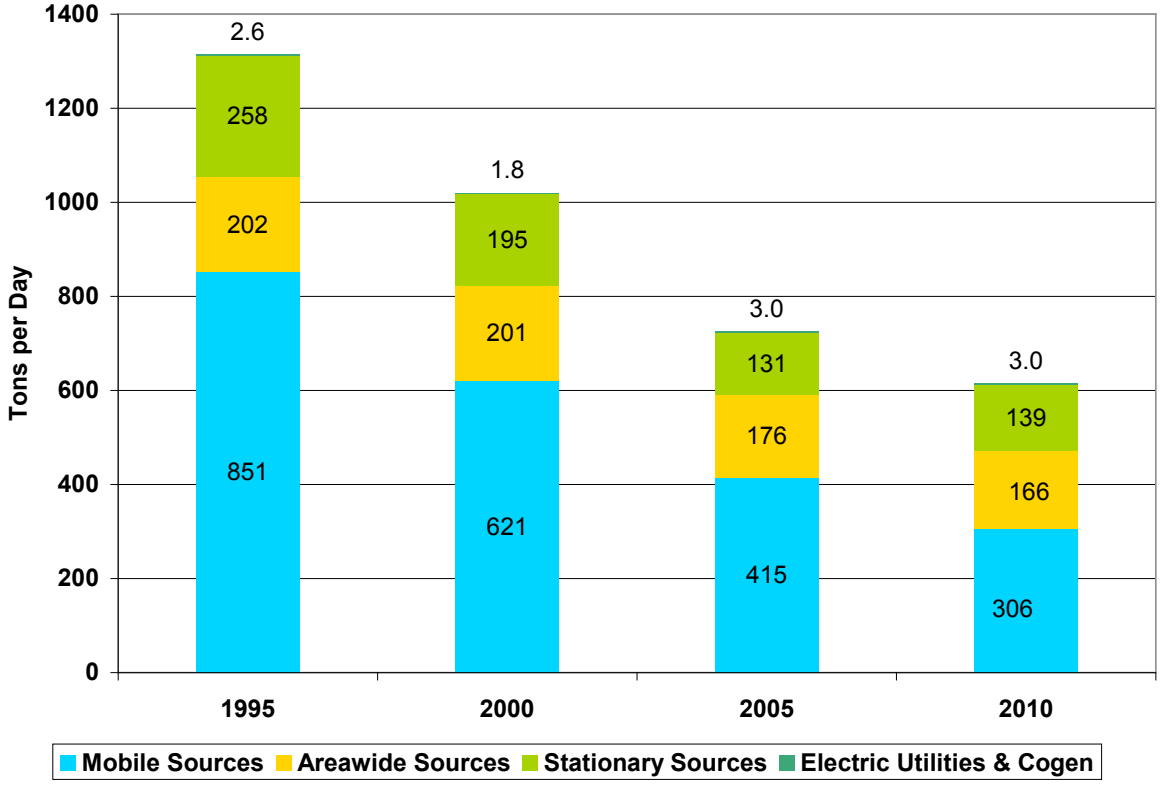


Figure B-5 Reactive Organic Gases Emissions by Sector (South Coast)



Attachment B – Reactive Organic Gases Emissions

Attachment C –Geothermal Facility Emissions (Selected Facilities)

Table C-1 Geothermal Facility Emissions (lbs/yr except radionuclides in curies/yr)

	Geysers 18	Geysers 14	Geysers 6	Salton Sea	NCPA 4
Arsenic	6.080	4.200	1.900	0.051	1.077
Benzene	41.600	120.600	38.400	6015.160	2680.925
Beryllium	6.620	3.480	2.350		
Bromine				0.078	
Cadmium	3.180	2.500	0.430		0.123
Chromium	0.048	0.042	0.770		
Cr(VI)					0.220
Copper	739.920	547.800	185.800		0.352
EthylenThiourea				0.164	
H2S	38973.400	42657.500	46055.900	18.500	59182.984
Lead	652.330	47.050	20.230		0.042
Manganese	89.270	568.800	1276.000	0.002	0.126
Mercury	20.930	16.227	16.030	0.020	235.727
NH3	50895.230	32410.930	72593.500	1837006.280	749090.100
Nickel	6.370	4.900	0.300		0.387
Phosphorus	0.022	0.017			
Propylene					159.549
Radionuclides	34.000	89.900	101.000		
Radon				0.028	0.000
Selenium	446.830	175.000	127.670		0.002
Silica, Crystln					6.882
Toluene	29.200	50.400	10.770	998.000	517.459
Xylenes	5.000	18.400	2.500	0.024	107.378
Zinc	1841.300	696.900	531.800	0.001	0.410

CHAPTER 7: LAND RESOURCES

Summary of Findings

- **Regional and State-Level Energy Infrastructure Is Often Not Incorporated into Local Land Use Planning:** Local land use planning is mainly focused on addressing the needs and development of local government, and is limited in addressing regional and state energy generation and transmission needs. Local agencies sometimes overlook the need for new power generation facilities and transmission lines in the context of their respective general plans.
- **Brownfield Sites Can Be Good Locations for New Power Plants:** Existing brownfield sites often have available infrastructure (e.g., natural gas and water supply pipelines, electrical transmission facilities, roads) and frequently are designated in local government land use plans for industrial development, and may be excellent opportunities for new power plants.
- **Urban Sites for New Power Plants Can Create Community Concerns:** In urban areas, development of new energy infrastructure and upgrades to existing facilities often occurs close to residential areas, schools, and recreation areas. This can lead to potential environmental and public health concerns, intense controversy, and a lengthy licensing process while potential impacts are analyzed and mitigation is developed.
- **Impacts to Agricultural Lands:** Seven power plant projects approved in 2003 and 2004 by the California Energy Commission (Energy Commission) resulted in the permanent conversion of approximately 261 acres of agricultural land. The Energy Commission found the impacts on agriculture to be significant in four of these licensing cases, and required mitigation for the loss of 186 acres of farmland.
- **Repowering Coastal Power Plants Can Cause Community Concerns:** Modernization and expansion of existing coastal power plants have often been controversial because the coast is viewed as a visual, recreational, and ecological resource. The two modernizations of existing coastal power plants approved by the Energy Commission in 2004 were required to implement measures to enhance the degraded visual quality of the project setting caused by the existing generation facilities, and to improve the public's access to coastal recreation areas.
- **Assistance to Local Government:** Staff suggests that the IEPR Committee consider proposing a new program at the Energy Commission that would provide technical assistance to local agencies in preparing energy elements in their general plans that address the need for reserving lands for new power generation facilities and transmission lines to serve new development.

Introduction

Local land use planning is primarily focused on addressing the needs and development of local government, and is limited in addressing regional and state energy generation and transmission needs. Power plants and electric transmission lines are sometimes overlooked in local land use planning activities, such as updating a general plan, a zoning revision, or the formulation of specific plans for residential and school developments. The lack of local or regional long-range planning for facilities such as power plants, and the difficulty of coordinating any statewide energy facility planning process with local land use planning processes, has been a factor in some protracted and controversial licensing proceedings before the Energy Commission. Because major energy facilities are at times not considered when local long-range development plans are updated, community concern over the potential effects of these facilities is generally voiced when specific projects are proposed, rather than in the general plan update process.

The direct impact of energy facilities in terms of acres of land converted is relatively small on a state-wide basis. However, in some cases, new or expanded facilities have conflicted with local land use laws, ordinances, or regulations, and have been considered incompatible with existing and planned land uses, resulting in serious land use concerns on a local basis. This chapter will explore these issues.

Land Use and Energy Facilities

Energy facilities occupy only a small portion of the total land in California. Table 7-1 provides an overview of the acreage distribution of different types of land within California. As shown in the table, electric generation facilities (all types) occupy less than 0.01 percent of the state's land; transmission facilities are estimated to occupy approximately 0.72 percent.

Table 7-1
California Acreage Profile

Total California Acreage	104,765,120 acres[20]
Federally-managed Land	47,242,999 acres[21]
Agricultural Crop and Grazing Land	28,118,000[22]
Other Land	12,882,000[23] acres
Water Area	4,951,170 acres[20]
Urban Land	5,500,000 acres[24]
Electric Generation Facilities	12,800 acres*[25]
Electric Transmission Facilities	758,100 acres**[26]

*Does not include area covered by hydro power reservoirs, area within wind farms not occupied by turbines, or area of landfills where methane is collected for combustion in waste-to-energy facilities. Acreage updated to reflect the projects approved by the Energy Commission that have been built or are currently under construction.
**Based on 31,270 miles of transmission lines and assuming a 200 foot wide right-of-way.

Local Government Land Use Authority and the Warren-Alquist Act

Most land use decisions (i.e., project-specific approvals for development, and general plan and zoning update decisions) for projects proposed in incorporated areas within city limits are made by elected city council members in California's more than 400 cities. Similarly, land use decisions on projects proposed in the unincorporated areas within the state's 58 counties, are made by elected boards of supervisors.

The California State Constitution grants local government legislative bodies, such as city councils and boards of supervisors, the authority to draft ordinances that serve to protect the public health, safety, and welfare of their citizens. State Planning and Zoning Law requires each incorporated city and county to adopt a comprehensive, long-term general plan that governs the physical development of all lands under its jurisdiction (Gov. Code, §§ 65300-65457).

The general plan is a broadly scoped planning document and defines large-scale planned development patterns over a relatively long time frame, such as a 20-year planning horizon. The adopted general plan is the primary document that regulates land development within a local jurisdiction. All other documents that regulate land use must, by law, be consistent with the general plan. These include zoning codes, community plans, specific plans, and subdivision ordinances.

As provided in the Warren-Alquist Act (Pub. Resources Code, § 25000 et seq.), the Energy Commission has the sole permitting authority for thermal electric power generation facilities producing 50 MW or more. The issuance of a certificate by the Energy Commission is in lieu of any permit, certificate, or similar document required by any state, local, or regional agency for use of the project site (Pub. Resources Code, § 25500). For example, an Energy Commission certificate supersedes a conditional use permit that may ordinarily be required by a local legislative body to allow development of a power generation facility, but for the exclusive jurisdiction of the Energy Commission. The Warren-Alquist Act allows the Energy Commission to override a local jurisdiction's land use authority to certify facilities that are inconsistent with local laws, ordinances, regulations, or standards, but only in the extreme case where the Energy Commission finds that the facility is required for public convenience and necessity and that there are not more prudent and feasible means of achieving such public convenience and necessity (Pub. Resources Code, § 25525). Before proceeding to an override, the Energy Commission must consult with the affected state, local, or regional government agency to attempt to correct or eliminate the nonconformance (Pub. Resources Code, § 25523 (d)(1)).

Power Plant Consistency with Local Plans and Ordinances

As reported in the *2003 Environmental Performance Report*, the Energy Commission approved licenses for 33 natural gas-fueled, thermal electric generating facilities (totaling 13,266 MW) between 1996 and 2002. In 2003 and 2004, the Energy Commission certified 16 power plants (totaling 8,185 MW); all fueled by natural gas except the 185-MW Salton Sea Unit 6 geothermal plant.

Appendix E of the *2003 Environmental Performance Report* presented land use aspects of the 33 facilities licensed by the Energy Commission between 1996 and 2002. Appendix of this report provides land use aspects for the 16 power plants approved in 2003 and 2004.

Of the 33 power plant proposals approved between 1996 and 2002, four required an amendment to a local general plan and zone change or zone text amendment because the proposed site had a land use designation (e.g. agriculture) that did not allow a power plant. The four power plant projects were:

- Indigo Energy Facility, which required approval of a zone regulation text amendment by the Palm Springs City Council;
- Sutter Power Project, which required approval of a zone change from "Agricultural" to "General Industrial" and a general plan amendment from "Agriculture" to "Industrial," by the Sutter County Board of Supervisors;
- Metcalf Energy Center, which required a general plan amendment and zone change, both denied by the City of San Jose City Council (the Energy Commission exercised its override authority to permit construction and operation of the project); and
- Los Esteros Energy Facility, which required the City of San Jose's approval of a Planned Development Zone overlay to the existing Agricultural base zone district on the project site.

None of the power plants approved in 2003 and 2004 required a general plan amendment or zoning change. All projects were sited where the parcels' zoning either permitted power plants "by right," or as "conditional" uses. For those projects that were conditionally allowed, the Energy Commission incorporated the "conditions of approval" that the local agency would have required if they had jurisdiction over the project. One project, the Tesla Power Plant Project, required partial cancellation of a California Land Conservation Act Land Use Agreement (Williamson Act contract). While the Energy Commission had sole jurisdiction over permitting the power plant, only Alameda County could approve cancellation of the Williamson Act contract to allow the project to be built on the subject parcel (power plants are not permitted on Williamson Act-contracted land).

Community Controversies

Since 1996, the Energy Commission has reviewed several power plant proposals where a city council or county board of supervisors adopted a resolution and/or ordinance that opposed the siting of the power plant within their jurisdiction, or chose not to approve the required leases of local government property to allow the siting of the project.

The Nueva Azalea Power Plant project was proposed in the City of South Gate. The South Gate City Council adopted a resolution opposing the power plant project. In addition, a voter initiative was approved by the citizens of South Gate prohibiting future power plants from being built within the city. The proponent, Sunlaw Cogeneration Partners, chose to respect the outcome of the initiative and withdrew their application before the Energy Commission in 2001.

In 2001, the Energy Commission issued a license to construct and operate the proposed United Golden Gate power plant project. However, the project owner, El Paso Energy, was not able to obtain a lease agreement from the San Francisco International Airport Commission to construct the facility on airport property. Although the Energy Commission has override authority to permit projects that are not consistent with local laws, ordinances, regulations or standards, it cannot require a local agency to execute a lease for a site. The Energy Commission certificate for the United Golden Gate project has now expired.

On May 21, 2001 the San Francisco Board of Supervisors enacted San Francisco Ordinance 124-01, “Human Health and Environmental Protections for New Electric Generation.” The ordinance was created in response to community concerns over the proposed construction of a new 540 MW unit at Mirant’s existing Potrero power plant facility located in the southeast sector of the City of San Francisco. The ordinance directed the San Francisco Public Utilities Commission and the Department of Environmental Protection to adopt an energy resource plan that considers all practical transmission, conservation, efficiency and renewable alternatives to fossil fuel electricity generation in the City and County of San Francisco.

Power Plant Compatibility with Local Land Uses

Local governments have sometimes approved new residential areas and school sites near heavy industrial or infrastructure zones that would permit uses such as power plants and large, overhead electric transmission lines. Siting power plants within close proximity to sensitive land uses can present land use compatibility problems. For instance, power plants create noise that can be disturbing to sensitive populations, such as residential areas and school sites. Furthermore, power plants and the water vapor plumes emitted from evaporative cooling systems can potentially degrade a community’s visual resources, particularly if the facility is out of character with its setting or scenic resources are blocked from view by the project. Overhead transmission line projects have the potential to affect scenic views and

divide a growing urban area, and can be difficult to site. Local residents' perception about energy projects being incompatible or a "poor fit" in their neighborhood has often triggered community controversy and project delay. This controversy has been particularly intense in counties experiencing rapid residential growth such as Placer, San Joaquin, and Riverside counties.

Land Use Settings and Power Plant Siting

Power plant siting occurs throughout California, in both urban and rural areas. Both settings have their advantages and disadvantages.

The highest concentration of oil and gas powered plants is located in the most urbanized and populated portions of the state (i.e., San Francisco Bay Area, Southern California). In general, the concentrations of power plants within the state are correlated to areas of greatest electricity demand (urbanized/populated areas). One exception is the oil fields of Kern County. Siting power plants in close proximity to areas in need of electricity is advantageous because this minimizes power losses that occur when electricity is generated in remote areas and delivered to load centers via long transmission lines.

Power plants are preferably sited in "heavy industrial" areas because they are considered compatible (both in character and function) with these types of industrial uses. Urban areas often have available "brownfield" (highly disturbed, improved, or developed with available infrastructure) sites, which if located within existing heavy-industrial areas, can offer ideal locations for new power plants.

However, there are disadvantages to siting power plants within urban areas. These areas are often densely populated, and available sites may be in close proximity to residential communities and schools. Urban sites tend to provide less opportunity for physical separation (buffer) between industrial and non-industrial land uses, which can present land use compatibility (e.g., noise, odor, dust, visual impacts, heavy-duty truck traffic) problems. Urban sites designated for heavy industrial use and with infrastructure needed for a power plant are limited in number and command a high purchase price. If the electrical output of a proposed power plant would exceed existing transmission capacity, upgraded or new electric transmission lines often must be routed through developed areas.

Re-powers and modernization of existing power facilities take advantage of existing infrastructure and do not require additional land resources if carried out within the confines of the existing site. Many of the state's oldest power plants are located along the coast, particularly in Los Angeles and San Diego counties. Modernization of these facilities is not without controversy (see the later discussion of coastal area power plants).

The availability of large, low-priced parcels of land (when compared to a similar sized parcel in an urban area) is an advantage to a developer to siting power plants in rural areas. Rural areas, with their open spaces and large parcels of land, provide

greater opportunity for physical separation or visual screening from non-industrial land uses.

However, there are disadvantages to siting power plants in rural areas. If adequate infrastructure is unavailable, it can be costly to extend natural gas and water supply pipelines and electric transmission lines to the site. County government land use policies or regulations may prohibit industrial uses, such as power plants, where agricultural land and open space are preserved. Local jurisdictions seek to preserve farmland and open space for a number of reasons: 1) as an economic base, 2) to retain lower densities, 3) to provide a jurisdictional buffer or green belt, 4) as a population growth management strategy, 5) to protect wildlife habitat, 6) to provide outdoor recreation, or 7) to preserve scenic views. Local government participation in certain state programs may prohibit building of power generation facilities on agricultural land, such as an executed Williamson Act contract.

Electrical Power Plants Sited by the Energy Commission from 1996 to 2004

The sites of the 49 power plants licensed between 1996 and 2004 included productive agricultural lands, active oil fields, a former military base, vacant industrial parcels, and existing power plant or substation properties. The vast majority of new facility sites involved land that was developed for some type of urban or infrastructure use, or it had been developed in the past, with the generation facility placed on land designated for redevelopment. The power plant sites range in size from 0.67 acre to 80 acres. If all of these facilities are built, they would use approximately 814 acres of land (approximately 352 acres for the 16 plants approved in 2003 and 2004). However, electricity market uncertainties and project financing issues have caused delays in the construction of 11 of these facilities. The total acreage does not include land used for electric transmission lines and natural gas and water supply pipelines associated with the projects, and areas used temporarily for construction material and equipment storage and construction worker parking.

For the 33 power plants approved by the Energy Commission between 1996 and 2002, Appendix E of the *2003 Environmental Performance Report* presented information on: the physical setting of the project site at the time the Application for Certification was filed with the Energy Commission (categorized as either greenfield, intermediate, or brownfield), and whether the project would be built on agricultural land and within one mile of a school. Appendix of this report provides this information for the 16 power plants approved between 2003 and 2004.

Land Use Character – Greenfield, Intermediate, Brownfield

Greenfield sites are those that were undisturbed. These sites include agricultural crop producing land (e.g. row crops, vineyards, or orchards), range land, forest, and open space land. Six projects approved between 1996 and 2002, and eight projects

approved in 2003 and 2004, were sited on greenfield sites, totaling 93 acres and 285 acres, respectively.

Intermediate sites are those that were moderately disturbed, moderately improved or developed, or moderately distressed. These sites had limited infrastructure, and existing mixed land uses may have surrounded the sites. Sixteen projects approved between 1996 and 2002 were on sites (totaling 222 acres) categorized as intermediate. For projects approved in 2003 and 2004, one, 9.5-acre site is categorized as intermediate.

Brownfield sites are those that were highly disturbed, improved, or developed with available infrastructure. These sites may have been blighted or distressed. Many of these projects were in-fill development in an urban area. Thirteen projects approved between 1996 and 2002 were on sites (totaling 169 acres) categorized as brownfield. One of these facilities, High Desert, was built on the former George Air Force Base, near Victorville. For projects approved in 2003 and 2004, six sites (totaling approximately 57 acres) are categorized as brownfield. Four of these projects were sited on properties containing existing power plants.

Agricultural Lands and Power Plants

Building energy facilities on agricultural land contributes to the cumulative loss of farmland in California. Seventy-one acres of agricultural/open space land was permanently converted statewide for the building of four power plants approved by the Energy Commission between 1996 and 2002 (this figure assumes that agricultural lands temporarily removed from production due to construction activity will be returned to farming). While this is a small fraction of the total agricultural land in the state, conversion of agricultural land for energy facilities often occurs in areas where rapid development is already placing pressure on local agricultural land, so the conversion may be important at the local level. Seven projects approved in 2003 and 2004 resulted in the permanent conversion of approximately 261 acres of agricultural land. This total includes 16 acres for geothermal well sites and above ground pipelines associated with the Salton Sea Geothermal project, and 2.6 acres for a gas compressor station associated with the Inland Empire Energy Center project. In four of the licensing cases in 2003 and 2004, the Energy Commission found the conversion of agricultural land to be significant, and required mitigation for the loss of 186 acres of farmland.

Between 1996 and 2002, two of the four power plant sites (totaling 51 acres) involving agricultural land required the developer to obtain a cancellation of a Williamson Act contract on the project site in order to build. In 2004, one proposal (the Tesla Power Plant Project) required partial cancellation of a Williamson Act contract (applicable to 60 of 320 acres of contracted land). A power plant is not a use consistent with the “principles of compatibility” for uses on Williamson Act contracted land (Gov. Code, Section 51238.1), and as such, power plants are not permitted on land that is subject to an executed contract. The Tesla Power Plant Project will permanently convert to industrial use 25 acres of a 60-acre parcel used

for cattle grazing. Grazing will continue on the remainder of the parcel. Mitigation for permanent conversion of farmland and partial cancellation of a Williamson Act contract included the establishment of a permanent agricultural conservation easement on a 100-acre parcel adjacent to the project site.

Proximity to an Educational Facility

Schools, with their juvenile populations, are sensitive land uses often associated with new residential urban development. In counties with rapid population growth such as Placer, San Joaquin, and Riverside, new residential areas with school sites have been approved near zones designated for industrial/infrastructure uses such as power plants. In some cases little or no buffer of less intensive land uses has been left between the two areas.

Power plant developers have generally not involved school district officials in preliminary discussions regarding their proposed sites, which has resulted in community controversy and proposed legislation regarding power plant siting near schools.

Eight of the 33 facilities approved between 1996 and 2002 were sited within one mile of an educational facility. California Department of Education Guidelines state that new school sites should be at least one-quarter mile (1,320 feet) away from existing uses that emit hazardous air emissions or handle hazardous materials, substances, or wastes. This would include power plants. Of the 16 projects approved in 2003 and 2004, only one (Inland Empire Energy Center) was sited within one-quarter mile of an existing school. Community concern arose during the Inland case regarding a proposed school site. That site was located approximately 1,625 feet away from the power plant site, outside of the Department of Education's siting criterion.

Power Plants in Coastal and Bay Areas

California's coastal communities have experienced significant population growth in recent decades. Several communities (e.g., San Diego, El Segundo, and Huntington Beach in Southern California; Morro Bay and Moss Landing on the Central Coast; and San Francisco on the San Francisco Bay) have existing operating power plants. These power plants were constructed in the 1950s and 1960s along the coast so they could use seawater for facility cooling purposes. Many of these facilities were initially isolated from residential and commercial areas. However, subsequent population growth has surrounded the coastal-dependent industrial areas of these coastal communities.

As a consequence of population growth, many coastal communities have come to recognize their coastline as an important aesthetic, recreation, and ecological and conservation area. The California coast has been recognized as an environmental resource worthy of state protection by such laws as the California Coastal Act (Pub. Resources Code, § 30000 et seq.). The California Coastal Commission, in partnership with coastal cities and counties, plans and regulates the use of land and

water in the designated coastal zone. Proposals to construct new buildings, subdivide land, and activities that change the intensity of land use or public access to coastal waters generally require a coastal permit from either the Coastal Commission or the local government. Proposals to modernize or expand existing coastal power plants have triggered policy issues regarding the suitability of power plants being located on the coast, resulting in intense controversy and delays in Energy Commission siting proceedings.

Since 1996, the Energy Commission processed six power plant application requests involving power plants on the California coast or on the San Francisco Bay Estuary shoreline (Moss Landing, Morro Bay, El Segundo, and Huntington Beach on the coast; and Potrero and Contra Costa on the San Francisco Bay/Estuary). These applications involved a repowering, modernization or expansion of an existing facility. As of the end of 2004 the Energy Commission had licensed all of these projects except the Potrero project. The licensing proceeding for the Potrero project has been suspended until November 2005. The six projects have presented two major land use issues, summarized below.

Consistency with the Coastal Act

Coastal power plants require consideration of several issues in addition to those considered for non-coastal facilities, such as consistency with the California Coastal Act and city/county Local Coastal Plans, or consistency with the McAteer-Petris Act for a project within the San Francisco Bay Area. These acts establish a comprehensive approach to govern land use planning along the California coast and the San Francisco Bay Shoreline. The Energy Commission is required to consult with the Coastal Commission and the San Francisco Bay Conservation Development Commission on power plant applications within their respective jurisdictions, and receive a determination of consistency with their respective enabling legislation. Recently, conflicts arose between the Coastal Commission's interpretations of the Coastal Act and project approval determinations made by the Energy Commission for the El Segundo and Morro Bay power projects. In both cases, the Energy Commission conducted overrides of the provisions of the Coastal Act and local coastal plans with which the Coastal Commission asserted the El Segundo and Morro Bay projects did not comply.

Pursuant to section 30413(b) of the Coastal Act, the Coastal Commission shall designate specific locations within the Coastal Zone where the location of a facility (i.e., thermal power plant or electric transmission line) would prevent the achievement of the objectives of the Coastal Act. This designation does not apply to locations that are presently used for such facilities or would allow for the reasonable expansion of these facilities. Both the El Segundo Power Redevelopment Project and the Morro Bay Modernization and Replacement Project are consistent with Coastal Commission policy that that prefers onsite expansion of existing power plants to development of new power plants in currently undeveloped areas of the Coastal Zone.

Section 30251 of the Coastal Act states that "(T)he scenic and visual qualities of coastal areas shall be considered and protected as a resource of public importance. Permitted development shall be sited and designed to protect views to and along the ocean and scenic coastal areas, to minimize the alteration of natural land forms, to be visually compatible with the character of surrounding areas, and, where feasible, to restore and enhance visual quality in visually degraded areas."

For the Morro Bay Modernization and Replacement Project, enhancements to visual quality include the demolition and removal of the existing power plant and six oil storage tanks. The existing facility will be replaced with a new power plant less than one third as tall and with significantly less visual bulk. The existing facility is housed within a building that measures 500-feet long, 300-feet deep, and 148-feet high and has three 450-foot tall exhaust stacks. The stacks of the new facility will be only 145 feet tall. The Energy Commission found that most views in the area would be improved with the exceptions of views from Morro Strand State Beach and the Morro Dunes Trailer Park and Resort Campground. From these sensitive viewing locations, the project would present a strong industrial appearance because, unlike the existing facility, the proposed project would not be enclosed in a building. Furthermore, the new power plant would be located closer to these areas than the existing facility.[27]

In response to a request from the Executive Director of the Coastal Commission, the Energy Commission Siting Committee issued an order directing the applicant and Energy Commission staff to analyze the feasibility of full or partial enclosure of the proposed power plant. Both Energy Commission staff and the applicant found that full enclosure would involve a structure 620 feet by 550 feet with a height of 130 feet, and would require an increase in the height of the exhaust stacks from 145 feet to 190 feet. Both the applicant and staff concluded that full enclosure would create more impacts than the proposed project because it would substantially block views and create greater visual impact. Based upon these analyses, the Coastal Commission agreed that full enclosure would impose greater impacts than the proposed project and favored further consideration of a "structural shield concept" put forth by Energy Commission staff. In its final decision on the project, the Energy Commission adopted a condition of certification requiring the applicant to explore options for partial enclosure or shielding of the more industrial appearing elements of the facility. The applicant will be required to implement measures that are feasible, will not cause further harm to the environment, and can be achieved at a reasonable cost.

To ensure the El Segundo Power Redevelopment Project's consistency with section 30251, the Energy Commission adopted conditions of certification that require the applicant to install a decorative seawall, perimeter landscaping, and a landscaped berm to screen views of the project, while also maintaining ocean and scenic views, from residences in the City of Manhattan Beach and from two state beaches and an adjacent bike path. The applicant will also be required to install architectural panels on upper portions of the proposed power plant to enhance its visual quality.[28]

A major issue relating to consistency with coastal/shoreline land use regulations has been the need to examine alternatives to the existing facilities' cooling systems, which typically involve intake and discharge of ocean water. Once-through cooling can have detrimental effects on aquatic life. Small aquatic organisms can be drawn into the cooling system and fish can be trapped against the debris screens at the entrance to the system. Alternatives to once- through cooling, such as dry cooling (air-cooled condenser) or using reclaimed water in a traditional wet cooling tower, may result in additional noise, visual impacts (due to the size of these cooling structures, and in the case of wet cooling, visible water vapor plumes), or other concerns that must be considered in terms of land-use compatibility with surrounding properties.

Recreation and Public Access

The California coast provides an important resource in meeting the recreational needs of the state's growing population. Coastal recreational activities are a key land use concern for many communities. The recreational value of the coast and its beaches is based on many factors, including the coast's natural environment and scenic qualities.

Several operating power plants (e.g., the El Segundo and Huntington Beach generating stations) are located near beaches, parks and trails that receive large numbers of recreational users. While the existence of the power plants has not diminished the popularity of nearby recreational sites, local residents have sometimes argued that the quality of the recreational experience is diminished by the visual prominence of a power plant, temperature changes in the ocean water due to cooling water discharges, and noise among other issues. As a result, the impact of coastal power plants on recreational opportunities such as swimming, diving, surfing and other beach-related activities has become an issue of economic concern to coastal communities.

Section 30211 of the Coastal Act requires that new development not interfere with the public's right of access to the shoreline, where the access has been previously acquired by a federal, state, or local government authorization. Section 30212 (a) of the Coastal Act states that public access from the nearest public roadway to the shoreline and along the coast shall be provided in new development projects except where (1) it is inconsistent with public safety, military security needs, or the protection of fragile coastal resources, (2) adequate access exists nearby, or (3) agriculture would be adversely affected.

Pursuant to section 25529 of the Warren-Alquist Act, the Energy Commission shall require that facilities proposed in the coastal zone establish an area for public use. Lands within such area shall be acquired and maintained by the applicant and shall be available for public access and use, subject to restrictions required for security and public safety. The applicant may dedicate the public use area to any local agency agreeing to operate or maintain it for the benefit of the public.

The El Segundo Generating Station is surrounded by recreation and public access areas (Dockweiler and Manhattan state beaches and a county-maintained bicycle path). The Energy Commission found the El Segundo Power Redevelopment Project to be consistent with section 30211 of the Coastal Act because the project would not interfere with access to these public use areas. The Energy Commission also determined that the applicant's proposal to expand the area adjacent to the existing bike path by relocating a fence/seawall three feet back from its existing location, as well as enhancing the area by adding landscaping and benches along the wall, was sufficient to meet any requirement for establishing an area for public access and use.

For the Morro Bay Modernization and Replacement Project, the Energy Commission found the applicant's proposal for public access to be consistent with the goals and objectives of the Coastal Act and Warren-Alquist Act. The proposal included the provision of 8,355 feet of new bike paths and a new bike and pedestrian bridge over Morro Creek to enhance existing access to Morro Strand State Beach, and acquisition of property adjacent to Morro Strand State Beach for future public use.

Siting and Land Use Issues for Renewable Generation

The following discussion highlights the siting requirements and land use implications for wind and solar power.

Wind Energy

There are five primary wind resource regions in California that currently host commercial wind development:

- Altamont Pass in Alameda, Contra Costa, and San Joaquin counties, which generates approximately 494 MW;
- Tehachapi Pass in Kern County, which generates approximately 655 MW;
- San Gorgonio Pass in Riverside County, which generates approximately 439 MW;
- Montezuma Hills in Solano County, which generates approximately 227 MW; and
- Pacheco Pass in Santa Clara and Merced counties, which generates approximately 17 MW.

More than 7,000 MW of new wind power capacity could be added to California's existing power supply mix;[29] however, this would be subject to existing transmission constraints and limitations presented by California's environmental regulations and the siting issues that are discussed below. Approximately 5,782 MW of new wind capacity has already been proposed.[30] As one of the least expensive renewable energy sources, utilities are likely to continue to invest in wind power in order to satisfy their procurement requirements under the California Renewables Portfolio Standard (which requires investor-owned utilities to increase the amount of

renewable energy they procure by one percent per year toward a target of 20 percent renewables by the year 2017). The State of California is aggressively implementing this policy, with the intent of achieving the 20 percent renewable energy goal by 2010.[31]

Due to the remote locations of wind resource areas, electric transmission costs could be considerably higher than for fossil fuel plants that are more easily located near transmission lines and other infrastructure. A number of fossil fuel power plants have been proposed in counties near known wind resource areas, such as Alameda, Contra Costa, Kern, Riverside, and San Bernardino. As many of these proposed power plant projects would be located near potential wind power development sites[32], they may serve to facilitate future transmission from the more remote wind resource areas.

The size of a wind farm is determined by the quality and quantity of the local wind resource, and may require five to 17 acres per MW. However, the footprint of a wind turbine and associated infrastructure, including access roads, substations, and transmission lines, is limited to approximately five percent of the total land required for the wind resource, allowing other uses such as agriculture and grazing activities to occur jointly with the wind farm[33].

Despite the potential for joint use of the land, wind farms can conflict with local land use plans and cause compatibility problems with surrounding land uses. In response to these conflicts, the wind industry has attempted to adjust to local siting concerns by altering wind turbine spacing and uniformity, and by switching the types of towers that may be used, for example tubular poles versus lattice structures.[32] Wind turbines emit low-level mechanical and aerodynamic noise, which increase as the terrain becomes hillier. As they continue to be developed closer to urban centers, wind facilities will create increasing visual impacts. The removal of derelict wind turbines has been a concern in some communities.

Solar Energy

There are two types of solar generation currently available: concentrating solar power, in the form of solar thermal electric, and solar photovoltaics. Solar thermal uses high temperature solar collectors to convert the sun's radiation into heat energy, which is then used to run steam power systems. Solar photovoltaic systems use special semiconductor panels to directly convert sunlight into electricity.

The southwestern region of the United States, particularly Southern California, has the largest solar thermal and solar photovoltaic markets in the world, and the greatest potential for future development of solar energy facilities. Solar resource areas are rated by the calculated level of annual insolation (radiation from the sun received by the earth's surface). In California, high insolation areas are concentrated in the high desert or semi-arid areas, including the Mojave Desert in the southeastern region of the state and the Carrizo Plains west of Bakersfield.[34]

California has a total installed capacity of 354 MW of solar thermal facilities and over 44 MW of solar photovoltaics. The total technical potential for solar thermal and solar photovoltaic capacity is 66,161 MW and 9,451 MW, respectively.[30] Approximately 170 MW of new solar thermal capacity and 42 MW of new solar photovoltaic capacity have already been proposed within the state.[30] Examples of new projects include the City of San Francisco, which passed a $100 million bond initiative in November 2001 to support the installation of 10 to 12 MW of photovoltaic panels on city facilities. The first project to use these funds is a 675 kilowatt (kW) photovoltaic system on the roof of the Moscone Convention Center. The City of San Diego is also investigating the issuance of a similar solar bond initiative.[30]

The amount of electricity that can be generated from a solar energy facility is determined by the level of insolation at a particular solar resource area and the efficiency of the solar technology. The amount of solar insolation that reaches a solar energy facility and consequently the amount of electricity that can be generated depends upon the latitude, time of day, weather, shade patterns, and seasons of the year. The higher the annual insolation, the less land that is required per generated MW. Solar thermal facilities generally require between four to six acres per MW in good solar resource areas.[34] Photovoltaic power systems may require approximately four acres per MW.

Solar thermal power systems are ground-mounted facilities, while photovoltaic power systems may be either ground-mounted or building-mounted. For power systems of 250 kW or less, the photovoltaic industry is currently moving toward building-integrated photovoltaic systems that serve a dual purpose of providing shade and thermal insulation for a building as well as electricity. For power systems greater than 250 kW, ground-mounted photovoltaic systems are more common. Ground-mounted solar energy facilities are generally located in remote desert regions that can be a significant distance from existing power transmission facilities, similar to wind energy sources. Solar thermal facilities must also be located near an available water system for heat rejection and steam condensate, and to maintain high reflectivity on mirrors. The development of distributed solar generation would reduce the need to construct new transmission lines and infrastructure or to upgrade existing lines.[30]

More prominent solar technologies such as power towers are less acceptable to the public.[34] The height of facilities such as power towers varies from 290 feet for a 30 MW plant to 640 feet for a 200 MW plant. While there are currently no power towers in operation, Solar One and Solar Two were demonstration projects in Daggett California that operated in the mid-1980s and 1990s, respectively.[34] Some building-mounted PV projects have been required to construct parapets around the roof in order to hide the PV arrays and the electrical power equipment from public view

Siting and Land Use Issues for Electric Transmission Lines and Gas Pipelines

The following discussion highlights the siting requirements and land use implications for transmission lines and natural gas pipelines.

Transmission Lines

California has a total of 31,721 miles of transmission lines with voltages of 69 kilovolts (kV) and above.[26] Transmission lines are located throughout California, with the greatest concentration of facilities in the Los Angeles, Sacramento, and San Francisco Bay areas.[35]

There is a great deal of public interest and concern regarding potential health effects from exposure to electric and magnetic fields (EMF) from transmission lines. While there is no conclusive evidence that EMF creates a potential health risk, reducing magnetic fields near sensitive receptors such as schools and residences is often proposed. Of note, underground siting of transmission lines does not substantially reduce EMF levels, as discovered during the environmental analyses for PG&E's Jefferson-Martin 230 kV and SDG&E's Miguel Mission 230 kV #2 transmission line projects, and SCE's Viejo System Project.[36],[37] In fact, EMF levels tend to be more intense directly over underground transmission lines.

While new transmission lines are needed to provide electricity to growing urban areas, it is difficult to site transmission facilities in densely developed areas. Local government agencies and the transmission line development industry sometime fail to coordinate with each other, which can result in a lengthy and complex process for siting new transmission lines. Given this situation, San Diego Gas & Electric Company (SDG&E) came to the conclusion that getting transmission lines incorporated into local general plans could facilitate the siting of needed facilities. In 2003, SDG&E requested meetings with the 17 cities in San Diego County, the County of San Diego, and the San Diego Association of Governments with the intent of getting the local agencies to acknowledge "energy as a land use." Because the built environment requires energy to operate, and energy facilities require physical space to produce and convey this critical commodity, SDG&E reasoned that energy facilities should be considered a type of land use that requires integration into local planning efforts (e.g., general plan updates, and community and redevelopment plans). Only SANDAG, the county, and three cities accepted SDG&E's invitation. In addition to the presentation, SDG&E provided suggested policy language that could be incorporated into local plans. These policies included reserving land in new development plans for substations and transmission rights-of-way, providing open space and buffer areas between utility facilities and residential development, and providing opportunities for appropriate secondary land uses within overhead transmission facility rights-of-way. According to SDG&E, none of the information the utility provided was incorporated into any local plans.[38]

As new transmission lines face greater siting difficulties (i.e., identifying adequate space, eminent domain issues, community opposition due to visual and property value concerns), it is often easier to upgrade and reconductor existing transmission lines. The use of existing transmission rights-of-way typically does not disturb or permanently convert land from its current use. However, existing rights-of-way may need to be expanded to accommodate new transmission lines. For such an expansion, transmission developers will be required to coordinate with the many jurisdictions that are crossed by the right-of-way to obtain permits and easements, and with the agencies that regulate natural resources within the state (i.e., California Department of Fish and Game, State Water Resources Board, U.S. Fish and Wildlife Service, and U.S. Army Corps of Engineers).

State agencies such as the California Public Utilities Commission (CPUC), municipal utilities, and the Energy Commission (for infrastructure related to power plants) have ultimate authority over most, but not all, transmission line siting and, in the case of the CPUC and municipal utilities, the option of exercising eminent domain to acquire rights-of-way and site transmission lines. The expansion of residential and commercial development throughout the state may cause the future acquisition of transmission rights-of-way to be increasingly difficult and expensive due to overcrowded existing public rights-of-way and the scarcity of land. Senate Bill (SB) 1059, which was introduced on February 22, 2005, would authorize the Energy Commission to designate transmission corridors for the construction of future transmission lines. SB 1059 would require each city and county in which a designated corridor is located to take all actions necessary to integrate the designated transmission corridor into their respective land use plans and ordinances. Expected benefits of transmission corridor planning include preventing costly permitting delays of needed transmission facilities and ensuring that optimal routes are used to lessen environmental impacts. Without land available for transmission facilities, new facilities cannot be built, which will jeopardize California's ability to access less expensive energy sources and renewable resources to meet the Renewable Portfolio Standard.[39]

Local governments and jurisdictions may restrict the siting of transmission lines in areas that are considered incompatible with certain land use types (e.g., wilderness areas and national and state parks). For example, the proposed Jefferson-Martin 230 kV transmission line was inconsistent with the San Bruno Mountain Area Habitat Conservation Plan; mitigation was incorporated into the transmission line project to ensure that no conflicts with parks and natural resources would occur.

Many existing rights-of-way cross tribal lands, which are federally recognized sovereign entities. For example, the recently proposed (April 2005) Devers-Palo Verde No. 2, 500 kV transmission line would cross the Morongo Reservation, under the jurisdiction of the Morongo Band of Mission Indians. State agencies, utilities, and private developers are required to obtain permission from tribes to construct transmission facilities on their lands. While utilities can be granted an easement,

these expire after 50 years. Some tribes have considered establishing their own electric utilities, which may involve future ownership and control of the right-of-way.

Natural Gas Pipelines

California imports approximately 85 percent (1.7 trillion cubic feet per year) of its natural gas supply. A number of both interstate and intrastate pipelines are used to transport natural gas throughout California. Natural gas supplies from the Permian and San Juan Basins in the Southwest are transported to California via the Southern El Paso Pipeline, the Questar Southern Trails Pipeline, and the Transwestern Pipeline. Natural gas supplies from the Rocky Mountain Region are transported via the Kern River Pipeline, while supplies from Canada are transported via the TransCanada Gas Transmission Northwest Pipeline.[40]

Within California, natural gas fields are located in the following counties: Tehama, Glenn, Butte, Colusa, Sutter, Yolo, Solano, Sacramento, San Joaquin, Contra Costa, Merced, Madera, Fresno, Kings, Tulare, and Kern. Offshore natural gas fields are also located south of Santa Barbara County and west of Ventura County.[41]

The statewide demand for natural gas is anticipated to continue to grow by about one percent per year.[40] To meet this projected demand, California may be able to secure future natural gas supplies from the proposed Arctic gas development in Alaska and the MacKenzie Delta in Canada. However, it is unlikely that Arctic gas would be available to California before the year 2012, while natural gas from the MacKenzie Delta may be available by 2010.

The siting of natural gas pipelines is not limited to specific resource regions or geographic areas, such as with wind and solar generation facilities. However, concerns associated with the potential impacts of gas pipelines will influence the location of these pipelines. For example, active fault lines should be avoided; pipeline rights-of-way should also be sited away from populated areas to prevent risks to health and public safety in the event of a pipeline rupture, although additional protection measures can be installed when pipelines need to be located in populated areas.

The effects of siting a new pipeline may be determined by whether the pipeline is sited within an existing public right-of-way (e.g., road), or if a new right-of-way is constructed. Pipelines that are not sited within existing rights-of-way may temporarily preclude the use of land during construction and ongoing maintenance activities, thereby impacting adjacent land uses such as residences, commercial activities, and agriculture. Clearing and construction activities for a pipeline right-of-way would create temporary impacts to existing land uses along the pipeline corridor such as agriculture, open space, residential, and commercial that could halt operation of these lands temporarily.

Long-term or permanent impacts to landowners may arise from the placement of easements that prohibit or restrict certain activities near the easement.[42] In addition,

pipeline construction can result in the loss of soil fertility and organic matter and in the reduction of overall land productivity. However, siting natural gas pipelines within existing rights-of-way may also create potential impacts to utilities that are co-located in the pipeline right-of-way during construction and maintenance activities and in the event of a pipeline accident, such as leaks or explosions.

The CPUC and the California State Lands Commission are charged with permitting much of the linear infrastructure, such as pipelines and transmission lines. Linear infrastructure usually traverses multiple jurisdictions, and as such, the CPUC and the State Lands Commission attempt to be consistent with local plans and policies affected by the infrastructure in an effort to minimize siting impacts. However, as state agencies regulating such public utilities, the CPUC and State Lands Commission are not required to be in compliance with local plans and policy documents, and therefore do not regularly seek local zoning and land use amendments within affected jurisdictions.

CHAPTER 8: SOCIOECONOMICS

As required by Public Resources Code 25309.3(c)(2), this chapter describes the geographic distribution of statewide socioeconomic effects of existing generating facilities. Electricity generation provides public revenue and employment associated with power plant and related facility construction and operation. These socioeconomic benefits accrue at the local, regional and state level.

Summary of Findings

- **Utility Employment Will Increase Slightly**: In 2002, California had 18,000 electric generation, transmission, and distribution workers. In 2004, California had 4,100 power plant operators across all industries. By 2012, largely due to population growth, the number of workers in electricity generation, transmission and distribution is expected to increase to 20,200, and the number of power plant operators is expected to reach 4,700.
- **Modern Natural Gas Power Plants Require Fewer Operating Personnel**: Older steam boiler plants typically require approximately 40 to 50 maintenance and operation employees, while newer gas-fired peaker and combined-cycle power plants require approximately 2 to 24 operation and maintenance employees.
- **Public Power Utilities Pay Tax Equivalents**: While public power systems do not pay property taxes, they contribute to the economy financially through tax equivalents that are comparable to tax contributions made by IOUs.
- **RPS Should Help Spur Renewable Sector Employment**: Wind and solar electricity generation stimulate economic growth through the research and development necessary for these technologies. With the passage of the California Renewable Portfolio Standard (RPS), electricity generation continues to shift from conventional sources of generation to alternative technologies such as wind and solar. Renewable generation will continue to grow steadily over the next decade due to the RPS.

Importance of a Reliable and Affordable Electricity Supply

The availability of a reliable and affordable electricity supply is essential to the well being of the state of California and its citizens. Electric generating facilities supply electricity to California residences and businesses for a variety of uses that drive the economy. The energy supply is also essential to transportation, communications, public health and safety, as well as public comfort and convenience. California's generation system also creates benefits through employment and payroll, taxes, research and development, manufacturing, and equipment sales.

In California, total county electricity consumption is determined by county population and the location of businesses and institutions that are high electricity consumers. While small rural counties consume less total electricity than urban counties, rural

counties have the largest residential electricity consumption on a per capita basis, because rural areas:

- Typically have colder winters and hotter summers than urban areas, as most of these counties are located in the foothills and mountains. This results in higher use of electricity for space heating and cooling;
- Have higher use of electricity for water heating and cooking, as many rural residents do not have natural gas service; and
- Use electricity to pump well water, as many rural residents do not have water districts to supply water.

Property Taxation of Power Plants

A key local economic benefit of power generation facilities is the property tax revenue they provide. Power plants are assessed by either the California Board of Equalization (BOE) or the local county assessor for property taxation purposes (Board of Equalization, 2003). Determining the value of a power plant and how the allocation of the property tax revenue from a power plant is dispersed to local government is dependent upon the assessor that is used (see Table X-1).

Municipal-owned power plants (munis) located within the boundaries of the municipality are exempt from property taxes, while any munis located outside the municipality are taxable (Board of Equalization, 2003) under a constitutionally prescribed formula. All public utilities and investor-owned utilities (IOUs) owned or used by a company that is an electrical corporation as defined in section 218 of the Public Utilities Code are subject to property taxation (California Code of Regulations, 2002). The BOE assesses electric generation facilities of 50 megawatts (MW) or larger and power plants continuously owned by public utility companies regardless of location (Board of Equalization, 2001). Local counties assess electric generation facilities less than 50 MW, in addition to privately owned electrical generation facilities and cogeneration facilities[43] that are located within their jurisdiction (Board of Equalization, 1999). Table 7-1 summarizes the power plant property taxation assessments and the allocation of those property tax revenues.

TABLE 8-1: Power Plant Tax Assessment and Distribution in California

Power Plant Category	Taxation	
	Assessment	Distribution of Funds
Power Plants Continuously Owned by Public Utility Companies	BOE	Countywide
Power Plants Divested by Public Utility Companies after January 1, 2003	BOE	Local Tax Rate Area
Power Plants >50 MW	BOE	Local Tax Rate Area
Power Plants <50 MW	County Assessor	Local Tax Rate Area
Privately Owned and Cogeneration Facilities	County Assessor	Local Tax Rate Area

Property tax revenues from electric generation facilities owned by rate regulated public utilities that are assessed by the BOE are placed in a pool with other tax revenues assessed by the BOE, and distributed according to a formula by each county auditor among the taxing jurisdictions in each county in which the facility was located (Board of Equalization, 2005). A portion of the property tax revenue that was received by the county is retained for county government, while the rest is divided among the cities, public schools, and special districts, such as water and transportation districts located within the county according to a statutory formula (Board of Equalization, 2004). With the passage of Assembly Bill 81 (AB 81) in 2002, the BOE was given authority to assess certain electrical generation facilities (i.e., power plants divested by public utility companies after January 1, 2003, and power plants greater than 50 MW), and to allocate the property tax revenues entirely to the tax rate area in which the power plant is located (California Board of Equalization, 2005).

Power Plant Construction and Operation Impacts

Impact of Energy Facilities on Property Values

Community members and land developers often express concern that proposed energy facilities, such as power plants and electric transmission lines, will reduce the values of property near the facilities. Proximity impacts potentially affecting property values include health hazard risks to persons and obstruction of views. A number of studies cite several examples of proximity impact analyses, methodologies used to measure impacts, and types of possible proximity impacts on residential property values. The findings of these studies "yield an equivocal conclusion" that energy facilities may result in negative economic impacts, while at other times no economic impacts occur (Kinnard, 1995, and California Energy Commission, 1992). Thus, even for very large facilities that have a greater potential for health and safety impacts, there is no clear association with diminished economic impacts to property values.

An analysis of property value impacts from the Crockett Cogeneration Project found that there are many factors involved in purchasing a new home (e.g., affordability, age, size, schools, location). There was no clear demonstration that a view obstruction would be a major factor in a property value decline (California Energy Commission, 1992).

Data still indicates as it did in the 2003 EPR that impacts of wind resource facilities on property values are not significant. A study conducted by the Renewable Energy Policy Project systematically analyzed over 25,000 transactions for properties within view of wind turbines and found that views of wind facilities did not harm property values (Renewable Energy Policy Project, 2003).

Rooftop commercial and residential solar energy system improvements add to the value of property without any increase in the assessed value within most municipalities. Through decreasing utility expenses and tax benefit/incentive

programs, residential and commercial property containing solar energy systems experience an increase in property value (Department of Energy, 2005). It is unknown at this time what effect large utility owned solar energy facilities would have on surrounding property values, as there are very few of these types of facilities in existence at this time.

Comparison of IOU/Muni Payments and Contributions to State and Local Governments in California

In most cases, property taxes are a distant second to fuel costs in the operation of a power plant. About 66 percent of operating costs for power plants are fuel costs (APPA, 1994), which has not significantly changed over the past ten years.

While public power systems (i.e., municipal utilities, irrigation, and utility districts) do not pay the property taxes required of IOUs, they are required to pay a contribution or some tax equivalent. Contributions may include property-like taxes, payments in lieu of taxes, transfers to the general funds, and contributions in the form of free or reduced cost services provided to states and cities.

In 2002, a survey of 573 public power systems in the United States found that the median monetary contribution or transfer was 5.8 percent of electric operating revenues (APPA, 2004). According to the survey, IOUs in the United States paid a median of 4.9 percent of electric operating revenues in taxes and fees to state and local governments in 2002. When all taxes, tax equivalents, and other contributions to state and local government are considered, the median amount contributed by public power systems nationally in 2002, as a percent of electric operating revenues, was 18.4 percent higher than investor-owned utilities (5.8 percent vs. 4.9 percent).

The median amount paid by California IOUs in 2002 (i.e., PG&E, SDG&E, and SCE) was 5.7 percent of electric operating revenues. In this same year, public power systems (i.e., munis) paid 5.6 percent in tax equivalents. The median payments for all public power systems in California was 4.8 percent, or about 19 percent less than the median tax assessments for IOUs (Moody 2004 and 2005).

In summary, while public power systems do not pay property taxes, they contribute to the economy financially through tax equivalents that are comparable to tax contributions made by IOUs.

Estimated Socioeconomic Effects of California Power Plants

In March 2005, the California Energy Commission sent a questionnaire to the owners of the 913 operating power plants in California to ascertain the socioeconomic effects (i.e., employment, payroll, taxes paid) of their electricity generation facilities. Responses were received for 246 power plants (27 percent of the 913 operating power plants) representing approximately 50 percent of the State's installed capacity in megawatts. While the following section discusses the

socioeconomic effects of California power plants in regard to their size, location, and fuel type, the data only represents the 246 power plants that were included in the responses. In addition, some of these responses were not complete.

Because some of the power plant operators surveyed requested that their data remain confidential, unit specific data is not presented. The following data (in Tables 7-2 through 7-4) represent aggregate totals based on data provided for the 246 power plants. Consequently, these data may not accurately represent socioeconomic trends associated with all electricity generation facilities within the state.

Table 8-2: Socioeconomic Data Totals for California Power Plants

Permanent Operations Employees	Total Payroll For Permanent Operations Employees	Contract Operations Employees	Total Payroll Contract Employees	Total Property Tax Paid	Total Sales Tax Paid	Total City or County Taxes Paid
5,113	$744,716,065	285	$30,403,649	$116,870,076	$25,144,95	$7,931,898

The employment, payroll, and taxation data for California utilities vary by fuel type. Of the California power plants included in the questionnaire responses, oil and/or gas-based power plants accounted for the greatest number of permanent employees, followed by nuclear-based power plants. The total payroll for these employees was highest within the oil and gas power plants, followed by hydroelectric power plants. The oil and gas facilities also generated the most property tax revenue for the last documented tax year, while the highest sales tax was paid by the hydroelectric facilities. As noted above, this data set reflects only information provided by the survey respondents and is not unit specific.

Table 8-3: Socioeconomic Data for Power Plants by Fuel Type*

General Fuel	Total Megawatts	Permanent Operations Employees	Total Payroll Permanent Operations Employees	Contract Operations Employees	Total Payroll Contract Employees	Total Property Tax Paid	Total Sales Tax Paid	Total City or County Taxes Paid
BIOMASS	327	282	$19,978,976	17	$868,224	$1,532,889	$193,774	$0.00
COAL	391	211	$16,846,187	15	$1,298,479	$2,512,072	$1,112,253	$37
DIGESTER GAS	19	11	$634,130	0	$647,762	N/A	$11,593	N/A
GEOTHERMAL	716	330	$34,931,325	6	$277,830	$9,464,594	N/A	N/A
HYDRO	1381	556	$250,895,151	0	$0.00	$544,834	$17,336,692	$300
LANDFILL GAS	28	43	$4,157,000	4	$160,000	$0.00	$141,000	$0.00
MSW	52	87	$7,650,000	14	$570,000	$0.00	$540,000	$50,000
NUCLEAR	2160	1,162	$106,950,201	23	$2,116,914	$21,066,087	$64,441	$0.00
OIL/GAS	28,096	2,232	$287,816,599	174	$23,034,065	$77,375,170	$5,651,859	$7,856,498
SOLAR	170	66	$5,435,896	20	$395,024	$355,324	$71,890	$180
WIND	265	41	$2,111,781	0	$347,459	$1,957,407	$1,642	$5,500

*Data only reflect information provided by the survey respondents and are not unit specific.

The distribution of the socioeconomic benefits of California power plants is determined by the county in which they are located. Table X-4 summarizes the total employment, payroll, and tax revenue generated by the power plants within each county. Power plants located within San Diego and San Luis Obispo Counties accounted for the greatest number of permanent employees, while Fresno and San Luis Obispo Counties contributed to the highest total payroll for their employees. Orange County accounted for the greatest number of contract employees, while San Diego County contributed to the highest total payroll salaries for its contract employees. Power plants located within Kern County paid the most property tax, while facilities in Fresno County paid the most state sales tax.

Table 8-4: Socioeconomic Data for Power Plants by County*

County	Permanent Employees	Payroll Permanent Employees	Contract Employees	Payroll Contract Employees	Property Taxes Paid	Sales Taxes Paid	City & County Taxes Paid
Alameda	14	$1,457,612	6	$748,223	$461,955	$231,665	$116,396
Butte	23	$2,078,807	0	$0.00	$89,047	$1,478	$0.00
Calaveras	14	$916,000	0	$0.00	$0.00	$0.00	$300
Contra Costa	171	$12,677,115	3	$47,739	$13,535,305	$1,844,069	$0.00
El Dorado	71	$9,123,142	0	$0.00	$161,000	$53,970	$0.00
Fresno	457	$239,108,429	2	$56,176	$2,728,859	$17,339,529	$452,534
Humboldt	33	$1,200,000	0	$0.00	$112,000	$115,063	$0.00
Imperial	81	$4,769,315	0	$0.00	N/A	N/A	N/A
Inyo	16	$1,512,102	0	$0.00	$11,279	$0.00	$0.00
Kern	392	$39,938,765	60	$5,904,041	$23,598,062	$673,709	$5,189
Lassen	18	$1,493,049	0	$0.00	$49,030	$1,261	$0.00
Long Beach	49	$4,500,000	5	$300,000	$0.00	$400,000	$50,000
Los Angeles	955	$78,826,457	51	$3,442,622	$9,636,073	$656,037	$6,455,316
Madera	2	$119,129	0	$0.00	$330,100	$965	$0.00
Merced	5	$250,000	0	$0.00	$65,000	$1,300	$5,500
Mono	N/A	N/A	N/A	N/A	$332,747	$0.00	$0.00
Monterey	154	$14,308,463	5	$294,506	$10,567,462	$664,012	$0.00
Orange	83	$5,901,669	3	$1,315,077	$1,921,810	$19,612	$0.00
Placer	25	$2,198,389	0	$0.00	$182,467	$13,613	$0.00
Riverside	17	$2,332,727	5	$300,000	$895,668	$0.00	$0.00
Sacramento	5	$85,000	40	$0.00	$0.00	$0.00	$0.00
San Bernardino	244	$23,981,317	32	$1,679,181	$7,835,461	$711,497	$1,739
San Diego	135	$97,520,019	21	$12,469,529	$6,997,024	$306,749	$661,823
San Francisco	60	$6,800,000	0	$0.00	$1.20	$0.00	$1
San Joaquin	57	$4,730,100	3	$156,427	$673,443	$376,092	$37
San Luis Obispo	1,162	$106,950,201	23	$2,116,914	$21,066,087	$64,441	$0.00
Santa Barbara	5	$199,459	0	$0.00	$140,044	$753	$0.00
Santa Clara	60	$3,440,117	0	$52,000	$0.00	$125,359	$0.00
Santa Cruz	9	$1,121,497	0	$0.00	$0.00	$24,530	$0.00

County	Permanent Employees	Payroll Permanent Employees	Contract Employees	Payroll Contract Employees	Property Taxes Paid	Sales Taxes Paid	City & County Taxes Paid
Shasta	94	$7,994,957	6	$278,318	$621,107	$545	$0.00
Solano	19	$2,668,068	5	$291,146	$529,453	$863,051	$183,063
Stanislaus	17	$1,509,816	1	$29,397	N/A	N/A	N/A
Sutter	72	$6,380,941	0	$0.00	$18,995	$367,455	$0.00
Tehama	2	$172,257	0	$0.00	$339,396	$2,458	$0.00
Trinity	1	$61,000	0	$0.00	N/A	N/A	N/A
Tuolumne	23	$1,885,889	0	$0.00	$87,470	$2,181	$0.00
Ventura	54	$5,212,436	0	$0.00	$2,051,294	$61,149	$0.00
Yolo	28	$1,557,640	0	$0.00	$258,356	$50,000	$0.00
<undeclared>**	488	$49,734,180	11	$922,352	$11,574,082	$172,414	$0.00

N/A – Data unavailable at this time

*Data is not unit specific.

**Undeclared indicates that the county location was not specified in data reporting.

Electric Power Workforce

Natural gas-fired power plants are the predominant source of electricity generation in California. Steam boiler plants that were generally constructed prior to 1960 require 40 to 50 maintenance and operation employees. In contrast, modern gas-fired peaker and combined-cycle power plants only require approximately 2 to 24 operations and maintenance workers. For such facilities, the smaller plant components can be sent to the factory to be repaired while a replacement is installed, and hired contractors can repair larger plant components at the site. Some facilities are remotely operated and use personnel from nearby plants for maintenance.

As of 2004, California had 4,100 power plant operators across all industries. By 2012, the need for an additional 2,200 electric generation, transmission, and distribution workers is anticipated (California Employment Development Department, 2004).

Trends in the Energy Sector

Renewable Energy Resources

In recent history, a substantial portion of electricity generation in California has switched fuel type from fuel oil to natural gas which has fewer air emissions. With the passage of the California Renewables Portfolio Standard (RPS) in 2002, California is aggressively pursuing an electricity generation mix that will reduce the electric generation sector's environmental footprint with broader use of technologies such as wind, solar, geothermal, and biomass. This change to renewable resources will provide the added benefit of improved energy security for California by reducing the need for imported fuels.

The development of wind and solar resources would serve to stimulate the economy through the manufacturing of components, the labor involved with the installation and maintenance of facilities, and changes to the economic values of property containing renewable energy systems.

IOU Requirements to Reach Renewable Targets

The primary goals of the RPS are to increase the diversity, reliability, and environmental benefits of the energy mix; promote stable electricity prices; create new employment opportunities; and reduce reliance on imported fuels. Senate Bill 1078 (SB 1078, Sher, Chapter 516, Statutes of 2002) established the California RPS, which is implemented by a collaboration of the California Energy Commission and the California Public Utilities Commission. The California RPS is a mandate for electricity retailers (i.e., investor owned utilities, or IOUs) to increase their procurement of renewable energy sources by a minimum of one percent per year, until 20 percent of each IOU's electricity sales is generated from renewable resources. By law, this 20 percent target must be achieved by December 31, 2017.

This standard requires an annual increase in renewable generation equivalent to at least one percent of sales, with an aggregate goal of 20 percent by 2017 (California Energy Commission, 2003). However, according to the 2003 Energy Action Plan, the state is aggressively implementing this policy, with the intention of accelerating the completion date. As such, IOUs are expected to achieve the 20 percent goal by December 31, 2010.

The 20 percent renewable energy sales target for each IOU (i.e., PG&E, SCE, SDG&E) is based upon the utility's total electricity retail sales estimate for the year 2010. Accelerating achievement of the 20 percent RPS goal to 2010 would mean adding a net average of up to 600 MW (1.6%) of new renewable generation sources annually (California Energy Commission, 2003). In 2001, it was estimated that SCE had procured approximately 14 percent of its total energy portfolio from renewable resources, while renewable procurement for PG&E and SDG&E was approximately 10 percent and one percent, respectively (California Energy Commission, 2003). Table X-5 lists the amount of renewable energy sales that would be required for each IOU to satisfy its RPS requirement in the year 2010, and the percent increase in renewable energy sales needed each year to reach that goal.

Table 8-5 IOU Estimated RPS Sales Requirements

RPS Requirements:	PG&E	SCE	SDG&E
2010 Total Electricity Sales (GWh/yr)	80,751	80,520	17,213
20% Renewable Generation by 2010 (GWh/yr)	16,150	16,104	3,443
Percent Needed Per Year to Meet 2010 Goal	1.39%	1.0%*	2.38%

Source: California Energy Commission, 2004
*SCE will reach 20 percent RPS goal in 2007

The service area of each IOU and the availability of transmission facilities determine the type and availability of renewable resources that can be used to satisfy the RPS requirements. Renewable energy generated outside of California but used in California can qualify for the RPS (California Energy Commission, 2004). Generation from renewable facilities located out-of-state must meet the RPS eligibility requirements set out by the California Energy Commission in the RPS Eligibility Guidebook.

Wind Resources

Similar to conventional natural gas power plants, the manufacturing, installation, and operations of proposed wind facilities would contribute to economic growth (Renewable Energy Policy Project, 2004). However, as wind generation is a relatively new technology, the research and development associated with this form of electricity generation would also stimulate economic growth. As a general rule, every 1,000 megawatts (MW) of generated wind energy would result in the following (Renewable Energy Policy Project, 2004):

- $1 billion in rotors, generators, towers, and other related investments;
- 3,000 jobs in manufacturing;
- 700 jobs in installation; and
- 600 jobs in operations and maintenance.

In addition to the economic benefits listed above, public utility owned wind generation facilities could have an economic effect on privately owned property. Unlike natural gas plants, wind generation facilities can use land concurrently with conventional farming and ranching, since wind turbines themselves occupy only about 5 to15 percent of the land area encompassed by the wind facility. One large wind turbine, occupying just one quarter-acre of land, can provide approximately $2,000 to $4,500 in annual royalties to the landowner (Renewable Energy Policy Project, 2003).

Solar Resources

While solar power contributes to only a small portion of the state's total generation, it is predicted that the public utility solar photovoltaic (PV) market in the United States could grow more than 30 percent per year over the next 20 years, and that California will show similar growth in PV use. Recent studies show that the following types of new jobs are created with the development of solar PV facilities (Renewable Energy Policy Project, 2005):

- 80 percent of new jobs are in manufacturing; and
- 20 percent of new jobs are in construction and installation.

Similar to wind electricity generation, the research and development necessary for solar power would contribute to economic growth. Local incentive programs to encourage the development of solar technology create additional jobs and revenue. For example, several California rebate incentive programs are available to homeowners and businesses for installing new renewable energy systems (California Energy Commission, 2005).[44]

Hydroelectric Projects

Hydroelectric generation accounts for approximately 10 percent of electricity production nationally, and depending on the weather, the total hydroelectric production in California ranges from 15 to 20 percent. The larger hydroelectric plants within the state (e.g., Shasta, Folsom, Oroville) are operated by the U.S. Bureau of Reclamation and the California Department of Water Resources, while the smaller plants are primarily operated by PG&E and the Sacramento Municipal Utility District (SMUD) (California Energy Commission, 2005).

The Federal Energy Regulatory Commission (FERC) has exclusive authority to license all non-federal hydroelectric projects that are located on navigable

waterways or federal lands. Licenses are normally issued for a period of 30 to 50 years and contain conditions that regulate project operations.

Before receiving a FERC license, the utility or project proponent must review the recreational needs in the area of the hydroelectric facility, and may be required to develop additional public recreational facilities (FERC, 2001). As the development of hydroelectric reservoirs often coincides with the development of waterfront real estate (primarily upscale homes, planned communities, and retirement homes), there is an associated increased demand for additional recreational development. Such development includes private recreational facilities (e.g., resorts, marinas, dry docks, boat services and sales, golf courses, and campgrounds) in addition to public facilities (e.g., local and state parks, campgrounds, trails, hunting areas, fishing areas, wildlife preserves) (FERC, 2001).

To continue to operate project facilities, a licensee must obtain a new license for its project when the existing license expires. This process is called "relicensing" and is based on laws and regulations that require a minimum of five years of extensive planning, environmental studies, agency consultation, and public involvement. The process has changed considerably since the original project licenses were issued in the 1930's, 40's and 50's. The Federal Power Act was amended by the Electric Consumers Protection Act (ECPA) in 1986, requiring FERC to give "equal consideration" to power production (the purpose of the license), energy conservation, and water quality, recreation, and other non-power benefits of the natural resources, such as fish and wildlife conservation. In addition, relicensing provides the licensee, resource agencies, Indian tribes and the public the opportunity to comment on these issues in the context of project facilities and operations. Through this process, FERC ensures that the new license is consistent with a comprehensive plan for utilization of the affected resources.

The development of hydroelectric recreational facilities will contribute to increased visitation in reservoir areas, which will directly benefit local businesses. In addition to anticipated increases in real estate prices near marinas and other waterfront areas, local food stores, restaurants, and other retail commercial uses will benefit from increased sales. New businesses that may target tourist services include hotels or other visitor accommodations, souvenir shops, fishing and boating equipment rentals, and transportation rentals.

Several of California’s hydroelectric facilities are due for relicensing in the near future. From a socioeconomic perspective, FERC’s relicensing process of these facilities is likely to result in a range of impacts to recreational resources. Facilities planned for continued levels of operation could result in beneficial impacts to recreation because in many cases, FERC requires the facility operators to upgrade and maintain the recreational resources and facilities associated with power generation. Conversely, in cases where operation of a hydroelectric plant is reduced or ceases, recreational resources may be lost. However, from a natural resource and wildlife perspective, the removal of recreational resources associated with

hydroelectric plants may be seen as a benefit in that impacts to the natural environment would be reduced. In any of these cases, the FERC re-licensing process is supposed to ensure that the impacts are evaluated and disclosed.

Conclusion

The most notable socioeconomic developments in the last few years are that:

- for California power facilities, San Diego County had the greatest number of permanent employees and Fresno County had the highest total permanent employee payroll. Orange County had the greatest number of contract employees and San Diego County had the highest total contract employee payroll;
- the number of peak construction workers has almost doubled compared to previous years, whereas the number of operating jobs has more than doubled. This trend may be due to the rapid construction of new power plants that are now on-line; and
- the California RPS will accelerate renewable electricity generation throughout California, but predominantly in rural areas.

CHAPTER 9: ENVIRONMENTAL JUSTICE

Summary of Findings

- The Energy Commission and California Department of Transportation were the first state agencies to include environmental justice concerns and demographic information in their environmental impact analyses.
- The Commission's approach to environmental justice emphasizes local mitigation and seeks to reduce environmental impacts that could affect local populations to less than significant levels.
- As of Census 2000, minorities (several ethnic groups who are other than non-Hispanic white) comprise the majority of the population in the state, so environmental justice will likely be a consideration in most future power plant siting cases.
- Power plants proposed in densely-populated urban areas are often sited where residential land uses encroach on older industrial areas.
- Community involvement related to environmental justice during siting cases has occurred primarily in the large urban areas of the Los Angeles Basin and the Bay Area.
- The Energy Commission and the electricity generating industry should work together to develop criteria for identifying power plant sites to avoid disproportionately impacting low income and minority communities.

Environmental Justice Definition

Under California law, Environmental Justice is defined as "the fair treatment of people of all races, cultures and income with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies" (Government Code Section 65040.12 and Public Resources Code Section 72000).

Background

The concept behind the term "environmental justice" is that all people – regardless of their race, color, nationality or income – are able to enjoy equally high levels of environmental protection. Environmental justice communities are commonly identified as those where residents are predominantly minorities or low-income; where residents have been excluded from the environmental policy setting or decision-making process; where they are subject to a disproportionate impact from one or more environmental hazards; and where residents experience disparate implementation of environmental regulations, requirements, practices and activities in their communities. Environmental justice efforts attempt to address the inequities of environmental protection in these communities.

Environmental Justice Communities' Concerns

Power plants are just one of many industrial uses that contribute to pollution in environmental justice communities. Large refineries, chemical processing plants, freeways, bus yards, truck terminals, and other land uses contribute significantly to air pollution, water pollution, potential toxic spills and leaks, noise, and traffic.

When these facilities are sited in communities already overburdened with industrial uses, they contribute to residents' disparate impacts from criteria air pollutants, notably total organic gases (TOG), reactive organic gases (ROG), carbon monoxide (CO), oxides of nitrogen (NOx), oxides of sulfur (SOx), and particulate matter (PM).

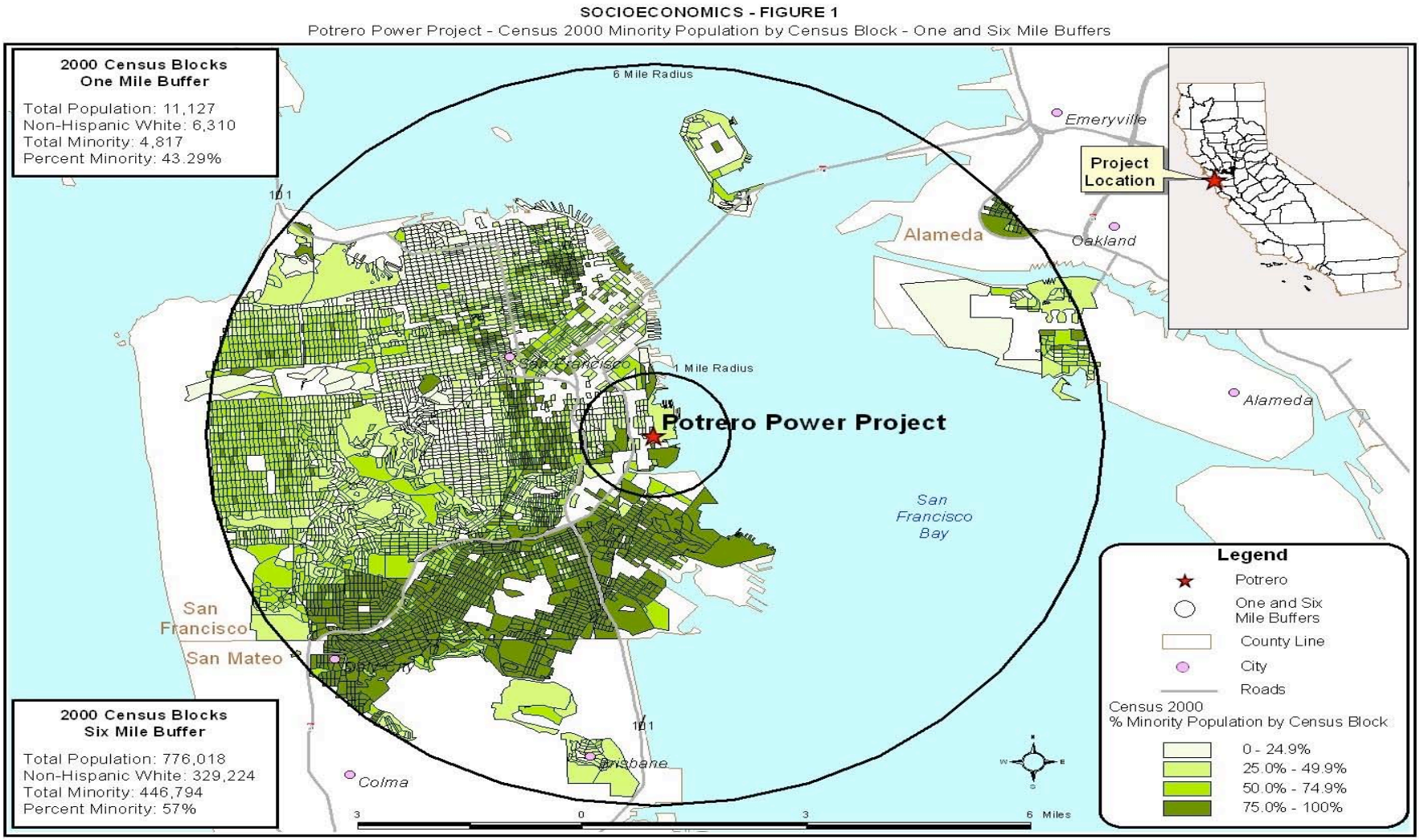
Elevated levels of occurrences of asthma and breast cancer may be common in urban areas with heavy concentrations of industrial and transportation land uses. Children in these communities may have high levels of lead poisoning from substandard housing and oral and dermal exposure from playing in contaminated soils.

Industrial facilities, including power plants have multiple impacts on communities. Although air emissions and public health may be the most significant issues, land use compatibility, water quality, property values, increased truck traffic, noise, and hazardous materials storage are all issues of concern in environmental justice communities. Often, these communities are seeking local government assistance in community revitalization, the planning of parks and open space, and residential and commercial growth. Siting additional industrial facilities in communities where industrial uses are adjacent to residential uses can reinforce through zoning and related policies historical patterns of land use incompatibilities.

Nueva Azalea and Potrero Power Plants

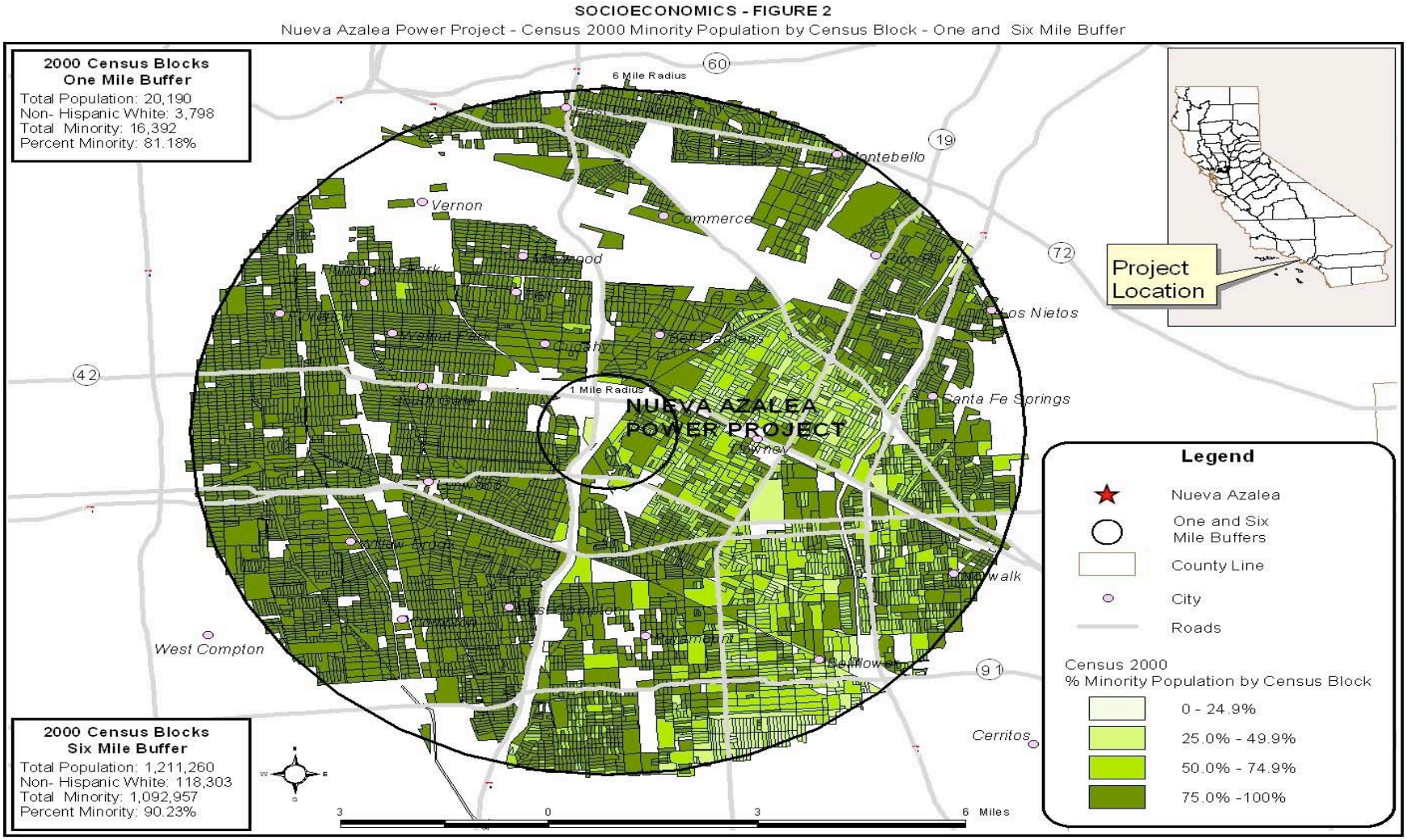
Two siting cases, the Nueva Azalea Power Plant Project in the City of South Gate and the Potrero Power Plant Unit 7 Project, illustrate how communities can respond to the siting of unwanted industrial facilities in their neighborhoods. In March and May 2000, Sunlaw Energy Corporation and Mirant Corporation filed applications with the Energy Commission to construct a power plant and expand an existing facility in South Gate and San Francisco, respectively. Both projects were to be sited in heavily industrialized areas with low-income and large minority populations. Both communities were home to Superfund sites and several state-designated "toxic hot spots."According to the South Coast Air Quality Management District, South Gate has some of the worst air quality in the Los Angeles Basin. Likewise, the community surrounding the Potrero site (which includes Bayview Hunters Point) was known to be the most heavily polluted area in San Francisco.

Figure 9-1 Potrero Power Project-Census 2000 Minority Population by Census Block–One and Six Mile Buffers



CALIFORNIA ENERGY COMMISSION, SYSTEMS ASSESSMENT & FACILITIES SITING DIVISION MAY 2005
SOURCE: California Energy Commission Statewide Power Plant maps 2005, Census 2000 PL 94-171 - Matrix PL2

Figure 9-2 Nueva Azalea Power Project-Census 2000 Minority Population by Census Block-One and Six Mile Buffer



CALIFORNIA ENERGY COMMISSION, SYSTEMS ASSESSMENT & FACILITIES SITING DIVISION, MAY 2005
SOURCE: California Energy Commission Statewide Transmission & Power Plant Maps 2005, Census 2000 PL 94-171 Data - Matrix PL2

Early during the siting procedures, environmental justice advocates and community groups challenged the projects on issues such as air quality, public health, noise, socioeconomics, and land use; all under the cause of environmental justice. City officials and other politicians became involved in the siting procedures because of the high level of community concern over air quality and health impacts.

After a highly publicized political battle and despite the promise of high-paying jobs and tax money, the South Gate City Council adopted a resolution opposing the power plant. In addition, Measure A, a local initiative regarding future power plant development in the City was defeated by the citizens of South Gate. Because the measure was defeated and the project had no local government or citizen support, the applicant withdrew their proposal from further consideration by the Energy Commission.

The City and County of San Francisco adopted Ordinance 124-01 “Human Health and Environmental Protections for New Electric Generation” on May 21, 2001. Like its counterpart in South Gate, the ordinance was initiated in response to community concern over the proposed Potrero power plant’s impacts on air quality and public health. The ordinance directed all City officials and departments to adopt minimum requirements for the protection of human health and the environment for any proposal for new electric generation at the Potrero Power Plant in southeast San Francisco and greater protections in regulatory proceedings regarding the proposal to build a new power plant at the site of the existing Potrero Power Plant. The Ordinance required approval from the Board of Supervisors for any agreement by City officials or departments for new electric generation in southeast San Francisco. Although hearings did proceed on the Potrero siting case, the applicant subsequently requested that the review of their project by the Energy Commission be suspended.

California Law and Regulatory Programs on Environmental Justice

Starting in 1999, a series of laws was enacted to implement environmental justice in state programs and agencies. The legislative response was due, in part, to constituents concerns regarding the environmental health of their communities, and as a state-wide effort to incorporate the principles of environmental justice with the programs, policies, and activities of the California Environmental Protection Agency and its boards, departments, and offices. Governor Gray Davis signed nine bills that promote the advancement of environmental justice goals in California.

Perhaps the most inclusive of these bills in terms of land use planning, AB 1553 (Keeley, Chapter 762, Statutes of 2001) requires the Governor’s Office of Planning and Research (OPR) to incorporate environmental justice considerations in the *General Plan Guidelines*. AB 1553 specified that the guidelines should propose methods for local governments to address the following:

- Planning for the equitable distribution of new public facilities and services that increase and enhance community quality of life.

- Providing for the location of industrial facilities and uses that pose a significant hazard to human health and safety in a manner that seeks to avoid over-concentrating these uses in proximity to schools or residential dwellings.
- Providing for the location of new schools and residential dwellings in a manner that avoids proximity to industrial facilities and uses that pose a significant hazard to human health and safety.
- Promoting more livable communities by expanding opportunities for transit-oriented development.

With the passage of AB 1553, OPR revised the *General Plan Guidelines* to include the concepts and goals of environmental justice. Thus, as and counties amend or update their general plans they are encouraged to incorporate the concepts of environmental justice to avoid incompatible land uses that may create health and safety issues in their communities. More specifically, OPR recommends that cities and counties incorporate policies supportive of environmental justice in all the mandatory elements of the general plan.

Resources Agency

It is the policy of the Resources Agency to promote the principles of environmental justice through the incorporation of such principles in all Resources Agency programs, policies, and activities. All Departments, Boards, Commissions, Conservancies and Special Programs of the Resources Agency must consider environmental justice in their decision-making process if their actions have an impact on the environment, environmental laws or policies. Such actions that require environmental justice consideration include:

Adopting regulations;
Enforcing environmental laws or regulations;
Making discretionary decisions or taking actions that affect the environment;
Providing funding for activities affecting the environment; and
Interacting with the public on environmental issues

The intent of this policy is to ensure that the public, including minority and low-income populations, are not discriminated against, treated unfairly, or experience disproportionate adverse impacts from environmental decisions.

California Energy Commission

The Commission's environmental justice analysis is composed of three primary steps: demographic screening, public outreach, and impact assessment. Under current procedures, when an Application for Certification is deemed adequate, Commission staff conducts a demographic screening analysis of the project area at the census block level. Census blocks do not correspond to city blocks (they may include four or more city blocks) and are the smallest unit of census geography for

which decennial census data is tabulated. Staff then uses the demographic maps to determine whether there exists a low-income or minority population that meets one or all of the following criteria:

- The minority or low-income population of the affected area is greater than fifty percent of the affected area's general population.
- The minority or low-income population of a pocket or cluster (one or more census blocks) within the affected area is greater than 50 percent.

Commission staff uses a six-mile radius around a proposed site as the area of potential impact, based on the parameters for air quality dispersion modeling used in staff's analysis. Staff conducts demographic screening analyses for transmission line expansions when they are proposed as part of power plant siting project. When a minority or low-income population is identified through the screening analysis, staff in the technical areas of air quality, public health, hazardous materials, noise, soil and water resources, waste management, traffic and transportation, visual resources, land use, socioeconomics, and transmission line safety and nuisance considers possible impacts on the minority/low-income population as part of their analysis. This analysis consists of identification of significant impacts (if any) and identification of mitigation.

Staff seeks appropriate mitigation to reduce impacts to a less than significant level in all cases, whether an environmental justice population is present or not. Of the projects identified as having greater than fifty-percent minority populations within a six-mile radius, the Commission has reduced all significant impacts to less than significant levels through appropriate mitigation, thereby removing the potential for an environmental justice issue. Therefore, the Commission has never considered denial of a project based on the findings of an environmental justice analysis.

The Energy Commission is one of only two California state agencies that have an appointed position, the Public Adviser, whose sole purpose is to assist the public to participate in Commission proceedings to the extent they desire. The Public Adviser's Office conducts outreach to local community groups and provides translations, when appropriate, of public meeting notices and some project information to community members.

California Environmental Protection Agency (Cal/EPA)

Cal/EPA's boards, departments and offices have implemented an EJ Action Plan to:

- Develop guidance on precautionary approaches.
- Develop guidance on cumulative impacts analysis.
- Improve tools for public participation and community capacity building.
- Ensure EJ considerations within the Governor's Environmental Action Plan.

These priorities are the foundation for Cal/EPA's EJ Program and have established the framework for integrating key environmental justice concepts into their regulatory functions.

South Coast Air Quality Management District

The South Coast Air Quality Management District (SCAQMD) has an extensive environmental justice workplan and a number of innovative community initiatives including the public's right to live in an environment of clean air, to be informed of scientific findings concerning hazardous and toxic emission levels, and to participate in the development of environmental regulations affecting their community. SCAQMD's Environmental Justice Task Force includes representatives of business, environmental and community groups, and Governing Board members.

Some of SCAQMD's environmental justice program initiatives include the Clean Air Congress, Clean School Bus Program, Asthma and Air Quality Consortium, Brain and Lung Tumor and Air Pollution Foundation, air quality presentations to schools, community and civic groups, and Neighborhood Environmental Justice Councils to address specific air quality issues in targeted communities. One initiative involved an 18-month study of ambient air toxics exposure to help determine which communities are disproportionately affected by hazardous and cancer-causing pollutants.

The California Department of Transportation (Caltrans)

The California Department of Transportation (Caltrans) incorporates environmental justice into its programs, policies, and activities to ensure there are no disproportionate adverse impacts to minority and low-income populations. The Office of Policy Analysis and Research assists planning offices, modal divisions and districts, and regional agencies to integrate environmental justice into the transportation planning process, thereby identifying and engaging communities early in the planning process to prevent or mitigate adverse impacts of transportation plans, programs, and activities and to factor equity into transportation investment decisions. Caltrans Division of Transportation Planning also provides grants to regional planning agencies and community based organizations to promote environmental justice.

The California Air Resources Board (CARB)

The California Air Resources Board (CARB) has adopted a plan to ensure that its programs, policies, and regulations do not adversely impact low-income and minority communities. The plan, Policies and Actions for Environmental Justice, grew out of a two-year project by CARB staff, who worked with the state's 35 local air pollution control districts, environmental and community groups, and industry. The South Coast Air Quality Management District and the Bay Area Air Quality Management District also have incorporated environmental justice into their programs, policies, and regulations.

In addition, the Carl Moyer Memorial Air Quality Standards Attainment Program was created by the California State Legislature in 1998. The program's aim is to encourage the use of alternative fuel vehicles. Each year the California Air Resources Board (CARB) disburses money to the South Coast Air Quality Management District (SCAQMD), which is in charge of administering Carl Moyer funds in the Southern California area.

California Assembly Bill (AB) 1390 (Firebaugh) approved and signed into law (Chapter 763 of the Statutes of 2001) requires that at least half of Carl Moyer funds be allocated in communities that bear the heaviest burden of poor air quality. This often includes low-income and/or minority communities, as they often experience disproportionately high pollution levels.

Integrated Waste Management Board (Board)

Recently, the Board has initiated policies to effectively address environmental justice through its decisions, programs, and activities. The policies focus on identification of key environmental justice community based groups, Board siting and permitting impacts, increased effective communication with identified community based environmental justice groups, and successful marketing of the Board's programs and activities to these groups to ensure the achievement of environmental justice. These policies will provide the Board the following tools:

- Coordinated, cohesive presentations on environmental priorities and concerns related to Board decisions, programs, and activities from community based environmental organizations at Board meetings.
- Methods of increased effective communication with community based environmental organizations and the Board.
- Methods of successful marketing of the Board's programs and activities for environmental justice achievement to identified community based environmental organizations.
- A final report summarizing environmental community based concerns and priorities on environmental justice and recommendations to the Board about community based perspective consideration and effective approaches to address environmental justice.

Population Trends In California

Table 1 below illustrates population trends in California. The table shows that California's population is not only growing but is changing in racial and ethnic composition. Thus, the recent census confirms California's trend of increasing racial and ethnic diversity since World War II. According to the 2000 census, non-Hispanic whites, although still the largest population group, are no longer the numerical majority in the state. The Department of Finance expects these trends to continue and predicts that by 2025, Hispanics will be the largest population group in the state. It is important to note that the term "minority" is not a numerical reference because, as of the 2000 census, no racial or ethnic group constitutes a majority in California.

Also, the 2000 census was the first census enumeration where multiracial Americans were allowed to identify with multiple groups on the questions of race and ethnicity. As with other issues of racial and ethnic diversity, California is leading the nation with five percent of the state's population identified as being of more than one race. This is roughly twice the rate as the rest of the nation (California Counts 2004).

Table 9-1 California Population Trends

1980 Population	1990 Population	2000 Population
Total Population 23,639,094	Total Population 29,760,021	Total Population 33,871,648
Non-Hispanic white 15,829,355	Non-Hispanic white 17,093,961	Non-Hispanic white 15,816,790
Minority 7,809,739	Minority 12,666,061	Minority 18,054,858
% Minority 33.03	% Minority 42.56	% Minority 53.30
	% Change in Total Pop. 25.8	% Change in Total Pop. 13.8

Source: California Energy Commission Cartography Unit 2005; US Census Bureau.

Table 2 below, illustrates demographic change within a six-mile radius of various power plants from 1980 through 2000. The power plants are representative of the geographic locations and demographics surrounding power plants licensed by the Energy Commission. With the exception of the Potrero Power Plant Unit 7 Project, all projects in Table 2 were licensed. Population growth near power plants reflects the same overall growth trends of the state with the fastest growing areas in large metropolitan and newly urbanizing areas. Likewise, the increase in minority populations in these areas reflects the overall growth in minority populations statewide.

Given the state's population growth and racial and ethnic diversity, it is likely that many future power plants will be proposed in areas with large minority populations. Deregulation of California's electricity markets in 1996 means that market forces will determine the location of proposed power plants. The effect of deregulation on the Commission's power plant licensing decisions can be significant in siting cases where environmental justice communities are involved. An unanticipated consequence of deregulation may be that communities with more industrial facilities and potential sources of pollution may be vulnerable to a disproportionate amount of new power plant proposals.

In California, as well as other states, community activism in environmental justice is a growing component of regulatory land use decisions. Community involvement in environmental justice is due to many factors, some of which include historical patterns of incompatible land uses, disparate enforcement of environmental laws, a growing state-wide racial and ethnic diversity, regional population shifts in the state, and increased opportunities to address local concerns.

Table 9-2 Demographic Change Near Select Power Plant Projects

1980 Population	1990 Population	2000 Population
Otay Mesa	**Otay Mesa**	**Otay Mesa**
Location : San Diego County		
Total pop. 943	Total pop. 5,476	Total pop. 19,728
Non Hispanic White 355	Non Hispanic White 2,002	Non Hispanic White 5,765
Minority 588	Minority 3,474	Minority 13,963
% Minority 62.4	% Minority 63.4	% Minority 70.8
El Segundo	**El Segundo**	**El Segundo**
Location: City of El Segundo, Los Angeles County		
Total pop. 422,120	Total pop. 474,233	Total pop. 506,356
Non Hispanic White 268,397	Non Hispanic White 240,335	Non Hispanic White 198,564
Minority 153,723	Minority 233,898	Minority 307,792
% Minority 36.4	% Minority 49.3	% Minority 60.7
High Desert	**High Desert**	**High Desert**
Location: City of Victorville, San Bernardino County		
Total pop. 33,353	Total pop. 70,232	Total pop. 78,619
Non Hispanic White 25,769	Non Hispanic White 50,186	Non Hispanic White 44,617
Minority 7,584	Minority 20,046	Minority 34,002
% Minority 22.7	% Minority 28.5	% Minority 43.2
Pastoria	**Pastoria**	**Pastoria**
Location: Kern County		
Total pop. 370	Total pop. 1,539	Total pop. 1,635
Non Hispanic White 274	Non Hispanic White 1,330	Non Hispanic White 1,076
Minority 96	Minority 209	Minority 559
% Minority 25.9	% Minority 13.5	% Minority 34.1
Morro Bay	**Morro Bay**	**Morro Bay**
Location: City of Morro Bay, San Luis Obispo County		
Total pop. 23,454	Total pop. 28,146	Total pop. 28,881
Non Hispanic White 21,438	Non Hispanic White 25,013	Non Hispanic White 24,360
Minority 2,016	Minority 3,133	Minority 4,521
% Minority 8.5	% Minority 11.1	% Minority 15.6
Potrero Unit 7	**Potrero Unit 7**	**Potrero Unit 7**
Location: City and County of San Francisco		
Total pop. 677,246	Total pop. 733,278	Total pop. 781,090
Non Hispanic White 352,328	Non Hispanic White 337,421	Non Hispanic White 329,889
Minority 324,918	Minority 395,857	Minority 451,201
% Minority 47.9	% Minority 53.9	% Minority 57.7
Three Mountain	**Three Mountain**	**Three Mountain**
Location: Shasta County		
Total pop. 4,596	Total pop. 4,755	Total pop. 4,703
Non Hispanic White 4,272	Non Hispanic White 4,388	Non Hispanic White 4,055
Minority 324	Minority 367	Minority 648
% Minority 7.0	% Minority 7.7	% Minority 13.7

Source: California Energy Commission Cartography Unit 2005; US Census Bureau.

Environmental justice communities often lack funds to hire attorneys and expert witnesses in the technical areas analyzed by the Commission in the power plant certification process. Organizations like the Golden Gate University School of Law's Environmental Law and Justice Clinic, the Lawyer's Committee for Civil Rights, Communities for a Better Environment, and Greenaction provide some legal and resource assistance to communities seeking a voice at hearings and workshops and to those who file for intervener status. The state's growing population, particularly with respect to ethnic and racial diversity and increased community activism in environmental justice, makes it crucial that the Commission's environmental justice approach continue to be responsive to community concerns. This is particularly important in the areas of community participation, cumulative risk assessment, mitigation of significant adverse impacts, and the assessment of disproportionate impact.

CHAPTER 10: CULTURAL RESOURCES

Summary of Findings

- **Increasing Recognition of Native American Interests**: Native Americans are becoming more involved—and are being asked to become more involved—in project planning and cultural resources management. A trend is evident at the Energy Commission and in other government agencies and has even been formalized in a new tribal consultation policy for the Federal Energy Regulatory Commission, and in a new California state law, SB 18, which requires local governments to consult with Native Americans whenever General Plans are altered.
- **The Power Plant Siting Process Addresses Cultural Resource Issues**: Between 1999 and 2004, no power plant has been denied a license due to the presence of cultural resources in the vicinity of the proposed plant, which can be credited to developing ways to mitigate most impacts to cultural resources.
- **California Tribes Are Exploring Environmental Justice:** Native Americans who wish to continue to use contemporary cultural resources in traditional ways are expanding the understanding of the intersection of cultural resources and environmental justice.

Introduction

California has been the home of approximately 90 Native American language groups consisting of several hundred dialects. The Spanish and Mexicans explored and settled early California. The discovery of gold brought an influx of large numbers of Euro-Americans and many immigrants of Chinese, African-American, and European origin. Because of this rich cultural history, evaluations for energy facility siting cases at the California Energy Commission frequently involve mitigation for damages to various kinds of cultural resources due to the building and operating of power plants and transmission facilities. The Energy Commission has looked to federal law and to the U.S. Secretary of the Interior's standards and guidelines for archaeology and historic preservation for guidance in the mitigation of these impacts on cultural resources. Along with California's Environmental Quality Act (CEQA), these federal guidelines provide the professional methods and procedures for the protection of archaeological and historic properties in California.

The California Department of Transportation (CalTrans) has developed a useful definition of cultural resources, "Cultural resources are physical or observable traces of past human activity, regardless of significance, in direct association with a geographic location, including tangible properties possessing intangible traditional cultural values."[45] A cultural resource is ordinarily identified as significant and considered a historical resource if it meets requirements in CEQA Guidelines §15064.5 (a) (1) (2) (3) (4). A historical resource is defined as "Any object, building, structure, site, area, place, record, or manuscript which is historically or

archaeologically significant, or which is significant in the architectural, engineering, scientific, economic, agricultural, educational, social, political, military, or cultural history of California."[46]

Four primary kinds of cultural resources must be considered during energy facility siting:

- Prehistoric and historic-era archaeological resources, both known and unknown (underground).
- Historical resources present in the built environment (45 or more years old or determined exceptional with specific qualities defined in the Public Resources Code 5024.1).
- Ethnographic resources (materials or areas important to the heritage or religion of a particular ethnic or cultural group, such as Native Americans or immigrant groups).
- Native American sacred sites and areas of traditional concern, which can be a particularly sensitive ethnographic issue, since more than one tribe may declare a portion of a landscape or geographic location to be a sacred or traditional site for their tribe.

During construction of energy projects there is frequently ground disturbance such as grading, trenching and excavation. Whether the project involves the installation of wind towers, transmission towers, geothermal investigation, or preparation for a turbine generator, there are often potential impacts to cultural resources. Underground archaeological sites might be affected, and above-ground built-environment resources and Native American heritage sites might be impacted. As has occurred with past hydropower development, there may be impacts to areas where ceremonies are conducted, where subsistence fish or animals are obtained, or where traditional medicinal plants are gathered. Examples of significant impacts to cultural resources can be seen in the following discussions of hydroelectric plants.

Although impacts to the environment can be caused by any type of development, a number of particular and significant impacts can occur from the operation of hydroelectric power plants. Production of electricity on the Klamath and Trinity Rivers illustrates many of these issues.

Protection of Native American Sacred Sites (SB 18)

A new state law, SB 18, is likely to have an important effect on the identification and preservation of Native American cultural resources as part of the local planning process. With the signature of Governor Schwartzenegger in September 2004, Senate Bill 18 became law. Intended to promote the preservation of Native American traditional cultural places, including sacred sites, it requires cities and counties to notify and consult with California Native American Tribes about proposed local land use planning decisions. Beginning on March 1, 2005, when preparing or revising their General Plans (and, by extension, specific plans, as well), California cities and

counties must now provide their proposals to those Native American Tribes who have traditional lands located within local jurisdictions and who are on the contact list established by the Native American Heritage Commission. Before any adoption or amendment of General Plans (and specific plans) after March 1, 2005, cities and counties must also initiate a consultation process with these tribes. The new law also gives Native American tribes the right to acquire and hold conservation easements as a means of protecting their cultural places.[47]

As energy facility permitting, construction, and operation may in some jurisdictions require a city or county General Plan amendment, SB 18 potentially adds an additional step to the environmental review conducted for the certification of energy facilities. Although this required Native American consultation is new, it need not retard the environmental review phase of the permitting process. The California Energy Commission has a responsibility to ensure compliance with all applicable laws, ordinances, regulations, and standards, which will now include SB 18. To minimize delay, the Energy Commission will need to work with the applicant toward two objectives: to ensure that local jurisdictions conduct consultation with Native Americans in a timely manner; and to verify the consultation process and outcome.

Traditional cultural places and sacred sites are not limited to rural areas, nor are they to be considered only in the siting of power plants. While SB 18 addresses the cultural places of California Native Americans, other ethnic groups can also have traditional cultural places.[48] Consequently such properties may exist in either urban or rural areas and may have to be considered in the siting of any kind of power-generating or power-transmitting facility. Ideally, such properties would be considered prior to development in general.

Involving Native Americans in Planning

One of the intents of SB 18 is to get interested California Native Americans involved in the local land use planning process as early as possible, so that traditional cultural places, including sacred sites, can be identified and considered. Until SB 18, no law required that Native Americans be considered in preservation activities. The Native American Heritage Commission[49] has pointed out that one of the chief legal protections for historic resources in this state, the California Environmental Quality Act, leaves Native Americans out of the process of assessing the significance of Native American cultural properties. The Environmental Quality Act also does not advise or require the input of Native Americans when archaeologists or ethnologists are determining mitigation measures for Native American cultural properties which may be damaged or destroyed.[50]

To aid the consultation between local governments and California Native American tribes required by the new law, the Governor's Office of Planning and Research has prepared guidelines for this consultation, issued on March 1, 2005. These guidelines inform local governments in four areas of the consultation process:

- Protocols for consulting with tribes on preserving cultural places and/or mitigating impacts to cultural places.
- Identifying which tribes to consult.
- Protecting the confidentiality of tribes regarding cultural places.
- Facilitating voluntary landowner participation in preserving cultural places and keeping them secret.

SB 18 provides a model for the appropriate involvement of Native Americans in project planning for even those energy facility permitting, building, and operating activities not subject to its provisions. The general objectives of SB 18 are worthy of emulation by all project planners:

- To recognize that cultural places are essential to tribal heritage and identity.
- To establish a dialogue with Native Americans so cultural places can be identified and considered in planning.
- To avoid conflicts over cultural places by involving tribal governments early in the planning process, [even in the project concept stage, if possible].
- To develop proper treatment and management plans to preserve cultural places.[51]

Native American Involvement in the Management of the PG&E Watershed Lands

Involving Native Americans in planning is finding increasing recognition and support in the state, a trend evidenced by the recent (December, 2004) invitation of the Pacific Forest Stewardship Council to Larry Myers to serve on the Council. Myers is the Executive Director of the Native American Heritage Commission, and he has joined the Council to represent the interests of California Native Americans in the management of 140,000 acres of prime forested watershed lands[52] in the Sierra Nevada and Southern Cascade mountain ranges. Numerous tribes live in the watershed lands, and Myers hopes that his participation in the Council's development of a resource inventory and management plan for the watershed lands will result in the creation of economic opportunities for these Native Americans.

Myers sees a number of prospects, including grants of land to now landless tribes, assignment of revenue-producing recreational facilities to local Native Americans, and possibly even conservancy grants of sacred or archaeological sites to be made to tribes under the provisions of SB 18 (if that law applies to these lands). Myers would like to see his Heritage Commission play a role in educating California Native Americans about the opportunities that the PG&E watershed lands represent for them and hopes funding for an outreach program can be provided by the Council.[53]

Federal Energy Regulatory Commission Establishes New Tribal Policy

Similar developments are occurring on the national level, and, in one notable instance, could even stimulate Native Americans to engage in planning of their own. The Federal Energy Regulatory Commission in July, 2003, set forth a new policy of promoting a government-to-government relationship between itself and federally-recognized Indian tribes.[54] To facilitate consultation between itself and Native American tribes, it also established the position of tribal liaison.[55] The same policy statement recognized the particular need for the Federal Energy Regulatory Commission to consult with tribes during the hydroelectric licensing process. To implement that consultation, the commission committed itself to notify tribes in advance of hydroelectric licensing proceedings, to learn more about each tribe's culture, and to establish consultation procedures on a case-by-case basis.

The Commission also pledged to consider, in their evaluation of a proposed hydropower project, any comprehensive plans prepared by Indian tribes for developing or conserving a waterway affected by the project.[56] In addition, the Federal Energy Regulatory Commission noted the written policies recognizing government-to-government relationships with Indian tribes that other federal agencies also have, including the Federal Communications Commission, the Federal Emergency Management Agency, the Environmental Protection Agency, and the Nuclear Regulatory Commission.[57]

Native Americans, Sensitive Information, and Confidentiality

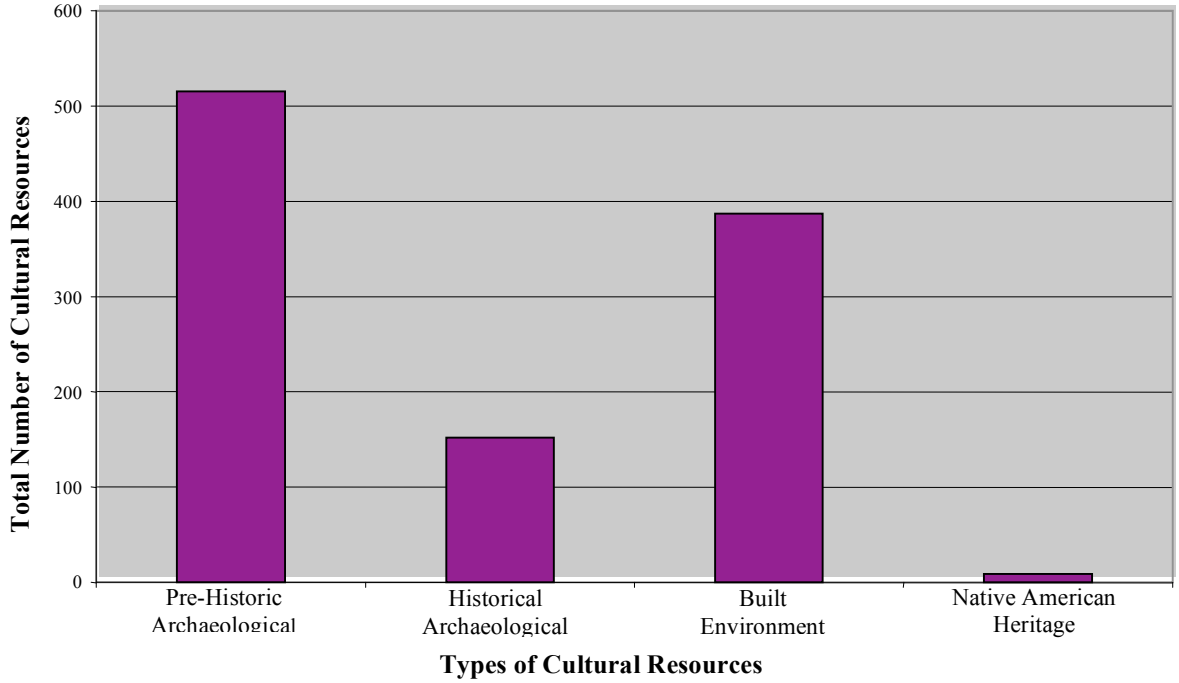
Native Americans, as well as planners, benefit from consultation intended to discover any previously unidentified traditional cultural places in areas slated for development. Identifying and locating such places will aid in preserving them. The discovery process may also ensure that tribes have continued access to and use of such places. The locations of such places, however, and their traditional uses and cultural significance, may be secret tribal lore. Because of cultural differences between mainstream planners and Native Americans, sensitive information may be difficult for planners to obtain. They may have to work through a specialist who can mediate regarding eligible recipients of sensitive information, the appropriate circumstances of sharing sensitive information, and how much sensitive information must be conveyed.[58] If Native Americans entrust confidential information to planners, directly or indirectly, it becomes incumbent on the planners to protect the confidentiality of that sensitive information. This requires that planners be aware of the circumstances where public disclosure laws apply, so that unintended disclosure of sensitive information can be avoided.[59] In practical terms, planners have a number of options for maintaining confidentiality. They can propose to hold not just an open meeting for the public at large, but a separate, private meeting for interested Native Americans. They can work through a tribal liaison or through Energy Commission cultural specialists, by means of private meetings or telephone calls. Of the greatest importance in any communication with Native Americans about

traditional cultural places is that planners ask what information can be made public, and what cannot.

Cultural Resources and California Energy Commission Facilities Siting

The following graph categorizes and quantifies cultural resources identified during the environmental review of the applications of 48 power projects processed by the California Energy Commission since 1998.[60]

Figure 10-1: Cultural Resources Identified in Record Searches and Inventories for 48 Energy Commission Approved Projects, 1998-2005



Despite the large numbers of cultural resources identified, no project since 1998 has failed to obtain a permit due to the presence of cultural resources within the impact area of the project. This is true because impacts to cultural resources can usually be mitigated to a less than significant level. For example, to mitigate the impact of a project where a significant archaeological site was present within the proposed project footprint, a prehistoric site was extensively excavated and the artifacts professionally curated. Although not a required part of the mitigation, an exhibit at the San Diego Archaeological Center of artifacts from this site and others in the same area was sponsored by a donation from the project's owner, Calpine, Otay Mesa Energy Generating Center, LLC.

On another project, multiple mitigation measures were required. An existing power plant that was determined to be a historically significant structure had been built on top of a Native American archaeological site that had previously contained human remains. Moreover, an adjacent natural feature was declared sacred to Native Americans, and two Native American tribes (composed of several bands) identified the power plant area as their ancestral lands. Recordation of the power plant to the standards of the Historic American Engineering Record was required as mitigation for the historic building. Mitigation of the impact to Native American cultural resources entailed having both interested tribes monitor ground disturbance at the project site during construction to address heritage concerns if artifacts were discovered.

Because the assistance of Native Americans is very important in identifying cultural resources, the California Energy Commission, in its California Environmental Quality Act-required review of the environmental impact of proposed energy facilities, encourages applicants to consult with Native Americans when projects are in the conceptual stage. The Energy Commission follows the policies of the Native American Heritage Commission, relies on Heritage Commission guidance in consulting with Native Americans, and seeks to include Native Americans at all stages of the certification process for a proposed project.

In the early and middle stages of the certification process, identification of cultural resources and determination of significance of and impacts to cultural resources predominates:

- The applicant is required to contact the Native American Heritage Commission regarding Sacred Lands in the project vicinity to obtain a list of names of Native Americans of all possible tribes who might be interested in the area of the project location (the Native American Heritage Commission advises that the concerns of all interested groups be considered and addressed), and to send them a letter and map describing and depicting the project and all its linear facilities, asking them to inform the applicant about any cultural resources concerns they have.
- Energy Commission Cultural Resources (Environmental Office) staff also obtains names of Native Americans of all possibly interested tribes, sends letters asking to be contacted if the Native Americans desire to consult with staff or the Energy Commission Public Adviser, and places the names on the list of persons to be notified of all Energy Commission hearings and workshops regarding the project.
- At public workshops, Cultural Resources staff announces their availability to Native Americans for private consultation regarding confidential information and such problems as resources without specific boundaries.
- In writing their preliminary and final California Environmental Quality Act assessments, Cultural Resources staff considers all obtained Native American information in their determination of significance of each cultural resource.

In the final stages of the certification process, determining mitigation measures becomes the focus. Cultural Resources staff writes conditions of certification which state what actions, including involving Native Americans, the applicant must take to mitigate impacts to significant resources and specify how these actions will be verified by the Energy Commission. The applicant could be required to:

- Hire an ethnographer to document traditional Native American use of and beliefs regarding the project area before construction begins.
- Avoid Native American heritage locations, include Native Americans in archaeological data recovery prior to construction, and/or include Native Americans in monitoring earth disturbing activities during construction.
- Direct the Cultural Resources Specialist for a project to include Native American comments on the identification and significance of recovered finds in the final cultural resources report on the project.
- Allow Native Americans to perform ceremonies of blessing and purification at the project site.

For all the efforts of the Energy Commission to involve Native Americans in the power plant certification process, it must be noted that Native American concerns have been raised in only 16 of the 48 siting applications processed by the Energy Commission since 1998. At only seven proposed project locations have multiple Native American groups expressed concerns. It is expected that Native American participation in power facilities siting will increase, spurred by SB 18 and the new Federal Energy Regulatory Commission policy discussed above. When a power plant application falls under federal and state oversight, the California Energy Commission participates in the Native American consultation process of the federal agency, thereby assuring the appropriate government-to-government relationship is in effect.

Native Americans, Cultural Resources, and Environmental Justice

The term “environmental justice” is used to refer to the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies.[61] In the realm of power production and distribution, environmental justice concerns must be evaluated by a careful analysis[62] which can determine if existing or proposed facilities produce disproportionately high and adverse impacts on the environment and/or public health of any minority or low-income population, including Native Americans. Natural resources and public health are routinely included in environmental justice analyses, but what about cultural resources?

Native Americans, like all citizens, can seek protection from adverse impacts to cultural resources (provided these are physical properties) by having them assessed under the National Historic Preservation Act of 1966 and 36CFR60 as eligible for the National Register of Historic Places, or by having them assessed under California

Public Resources Code 5024.1 as eligible for the California Register of Historical Resources.[63] But could the question of environmental justice also be raised if the cultural resources of Native Americans, as a minority and possibly low-income population, are disparately and adversely impacted by an existing or proposed power project in a rural part of the state? The controversial Medicine Lake geothermal power development project in northeastern California provides a case for which the answer is, yes.

Medicine Lake is an extensive mountain area where several Siskiyou County tribes continue to practice their traditional religious rites and spirit quests. The development of geothermal power generation there will negatively impact the Native American spiritual and cultural values traditionally attached to the place. According to the Advisory Council on Historic Preservation, the highest authority on cultural resources in the nation, the impact will be unmitigatable.[64]

The Medicine Lake Environmental Impact Report, filed by the Bureau of Land Management,[65] found that the impact of this project to natural resources and public health would be insignificant, once mitigation measures were applied. Native Americans disagreed, as did the Advisory Council, since the Medicine Lake Highlands are listed on the National Register of Historic Places. The Advisory Council recommended that the project not be allowed to proceed. The anticipated adverse effect to a sacred site is not just disproportionate to Native Americans, a minority population, but exclusive to them. Consequently, environmental justice complaints based on Title VI of the 1965 Civil Rights Act have been filed with the Environmental Protection Agency and the Department of Energy.[66] A group supporting the Native Americans has challenged in court the Bureau of Land Management's and U.S. Forest Service's renewal of the Medicine Lake geothermal development leases to the energy developer, alleging failure to carry out environmental review and consultation with affected tribes.[67] The Energy Commission, while not the permitting authority for the Medicine Lake geothermal development project, has provided funding for the study of the power generation potential of the geothermal resources of the Medicine Lake area through its grants programs.[68] This has resulted in criticism of the Commission from environmental and Native American groups.

Native Americans and Hydropower

Water from the Trinity River originates in the Trinity Alps and flows into the Klamath River. Built primarily in the 1950s, three dams and a series of other features, including a tunnel, provide water to the Central Valley Project. The Trinity River Division of the Central Valley Project has four power plants that generate power, supply irrigation water to Shasta and Tehama Counties, and supplement Sacramento River water that is used to irrigate the San Joaquin Valley.[69]

To carry out their several purposes, the Trinity dams control the water-flow levels on the river. This is a primary source of concern to the Native American Hupa and Yurok tribes, who want water flow to remain at levels that will support salmon,

steelhead trout, and lamprey populations. Both individual and commercial Native American fishermen are affected by the declining fish populations. Tribal members are also concerned that lowered water levels on the Trinity River have affected other components of their diet and traditional activities like gathering willow roots for baskets and ceremonies.

The Native Americans assert that numerous laws give them rights to the use of the environment along the Trinity River. In 1876 President Grant issued an executive order creating a reservation to be set aside for Indian purposes[70]. In 1988 Congress enacted the Hoopa-Yurok Settlement Act to divide the Hoopa[71] Valley Reservation into the Yurok Reservation and the Hoopa Reservation[72]. Several Yurok and Hoopa treaties provide for fishing rights, and the Indians also have rights to the water quality and flow rates that sustain the fish they traditionally depended upon for subsistence[73].

The Klamath River originates from the Upper Klamath Lake in southern Oregon. The river flows into California, where it empties into the ocean west of the town of Klamath. There are a total of six dams along the Klamath River with associated facilities that produce electricity.[74] The Federal Energy Regulatory Commission is completing a 50-year required review of licenses for the six Klamath dams. As with the Trinity, there is the possibility that the dams and power houses aged 45 years or older may be historic resources. The dams are owned and operated by PacifiCorp.

As with the Trinity River, the Native American groups who fish for subsistence or commerce are affected by insufficient stream flow. They insist that water in sufficient amounts to facilitate the migration and spawning of several species of fish be allowed to flow down the Klamath. The Klamath, Modoc Yahooskin, and Yurok have also expressed concern regarding the impacts of hydroelectric power to the general Klamath River environment. Rituals and ceremonies associated with the river have been affected.[75]

A treaty between the United States and the Klamath, Modoc and Yahooskin tribes gave the Indians "…the exclusive right of taking fish in the streams and lakes, included in said reservation, and of gathering edible roots, seeds, and berries within its limits."[76] A 1954 law enacted to terminate the federal government's supervision of the Klamath, Modoc and Yahooskin tribes supported their fishing and water rights.[77]

As noted above, the Federal Energy Regulatory Commission, which deliberates on the relicensing of hydroelectric plants on the rivers where these Native American fishing and water rights issues are in dispute, has adopted a new licensing process for hydropower. To address Native American concerns, the Federal Energy Regulatory Commission has also established a tribal liaison position to serve as a point of contact for Native American concerns. Further, as a result of tribal consultation, the Regulatory Commission has developed a tribal policy statement that affirms its commitment to the sovereignty of tribal nations and its commitment to its trust responsibilities for Indian tribes.[78]

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Appendices

Supporting Data for Chapter 3 – Air Resources

Appendix A: Supporting Technical Analysis
Appendix B: Methodology For In-State Power Plant Air Emissions Analysis

Supporting Data for Chapter 7 – Land Use

Appendix C: Thermal Electric Generating Facilities Licensed by the California Energy Commission in 2003 and 2004

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