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United States General Accounting Office  
Washington, DC 20548

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June 29, 2001

Congressional Requesters

Subject: California Electricity Market Options for 2001:  
Military Generation and Private Backup Possibilities

Since May of 2000, California's restructured electricity market has experienced rapidly rising prices and uncertain reliability. These problems led to widespread disruptions in service (referred to as blackouts) during the winter of 2000 and into spring this year. In response to these problems, the state has taken initial steps to increase electricity supplies—such as by streamlining the process of adding new power plants—and reduce demand through conservation. The California Independent System Operator (the agency in charge of balancing electricity supply with demand) expects high prices and reliability disruptions to continue, and perhaps worsen, in the summer of 2001.

In light of these concerns, you asked us to (1) describe the condition of California's electricity market, including changes in demand, supply, and prices; (2) determine the extent to which the Department of Defense (DOD) can help enhance western electricity supplies during the summer of 2001; and (3) discuss available private backup generation resources and any benefits and problems associated with their deployment. We briefed you and your staff on the results of our work on May 15, 2001, using the enclosed briefing slides (see encl. I). A summary of the information follows. A complete list of the requesters appears at the end of this letter.

### **California's Electricity Market Has Changed in Recent Years**

California's electricity market has exhibited more rapid increases in demand than in supply and recently has witnessed sharply higher prices. In addition, the California Independent System Operator (ISO) expects electricity supply shortages this summer

to range between 3,000 and 6,000 megawatts.<sup>1</sup> Because California's electricity market operates within a larger electricity system encompassing roughly 11 western states, shortages in California may also affect states across the West.

- Demand for electricity in California has risen sharply in recent years. From 1990 through 1995, demand rose only 1 percent, but from 1995 through 2000, demand rose 13 percent. Peak demand (that is, demand during the highest use part of the day) also rose by 16 percent, or about 7,000 megawatts, from 1993 through 2000.
- Electricity supplies have not kept pace with demand. California generates about 80 percent of the electricity it uses and imports the rest from neighboring states. California has added 2,800 megawatts in new generating capacity since the early 1990s. Transmission constraints and market forces limit the state's ability to import electricity and move electricity within the state.
- Wholesale prices are high and expected to remain so through the summer of 2001. Furthermore, the state's already high retail rates have recently increased, which could make California's electricity rates the second highest in the nation.<sup>2</sup>

### **DOD Could Help Enhance Western Electricity Supplies Through Increased Generation and Conservation**

DOD could help augment western electricity supplies in two ways. Specifically, DOD could potentially reduce demand on the western system by generating an estimated 90 megawatts of electricity and implementing conservation initiatives. Use of DOD assets raises environmental and mission concerns, however, and a number of logistical issues are currently unresolved. Nonetheless, the California ISO told us that DOD's 90 megawatts of electricity, as well as its conservation efforts, would help to reduce demand on the western electricity system this summer.

- In our analysis, the military services own an estimated 300 megawatts of electricity generation capacity.<sup>3</sup> The services have 30 power plants in the western states capable of generating 109 megawatts and 158 mobile generators throughout the United States capable of generating an additional 189 megawatts. However, according to DOD officials roughly two-thirds of DOD's generating capacity cannot be used to assist the western system because it is being routinely used, providing backup, being used for training purposes, or undergoing maintenance. Therefore, roughly one-third of DOD's generating capacity—16

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<sup>1</sup>A watt is the basic unit used to measure electric power. A kilowatt is equal to 1,000 watts. A megawatt is equal to 1,000,000 watts. A megawatt would provide electricity for about 1,000 homes at a given moment. This 3,000 to 6,000 range does not reflect steps taken to minimize the shortage through actions such as load curtailment and the use of reserve generation. A shortage of 6,000 MW is equal to about 13% of the peak demand for the California ISO.

<sup>2</sup>Electricity rates in Hawaii are currently the highest in the United States.

<sup>3</sup>Our inventory of DOD's generators includes generators with a capacity of 750 kilowatts and greater. We also limited our inventory to power plants in the West and mobile generators in the continental United States to identify the resources most immediately available to provide power to western system states in the summer of 2001.

megawatts from power plants and 74 megawatts from mobile generators—could potentially be used to reduce demand on the western system.

- While estimated costs to deploy and operate DOD’s mobile generators are high, the California ISO anticipates that wholesale summer prices may be higher. DOD estimated that costs to transport, set up, and operate generators would range from \$350 to \$1,000 per megawatt-hour of power produced, assuming that the generators would operate 20 days per month for 4 hours per day, over a period from 1 to 4 months. We estimated that costs could be lower, ranging from \$200 to \$500 per megawatt-hour of power produced, in the event that the generators operated 30 days per month for 8 hours per day over the same period. Even if actual costs of operation reached the highest level estimated, however, the cost of using DOD’s generators could still be below the market price for electricity. The California ISO anticipates that wholesale 2001 summer prices may frequently exceed \$1,000 per megawatt-hour.
- Deployment of military generators raises environmental and mission concerns. DOD’s mobile generators have pollutant emission rates two to eight times the maximum allowed in the state. In addition, DOD officials expressed concern that increased use of these generators would impair military readiness by restricting the availability of generating assets and increasing maintenance requirements.
- Logistical issues further complicate the decision whether to deploy DOD assets. Both DOD and Pacific Gas and Electric Co. (the principal power distributor in Northern California) have proposed sites in California for mobile generators, but other questions remain unanswered: (1) How long will it take to deploy generators? (2) If diesel generators are used, how will the government address the environmental consequences? (3) Who will direct the use of DOD’s generators and assume the risk? (4) How will the services be reimbursed for the use of their generators?
- DOD officials told us they can best contribute to easing the California electricity crisis by reducing DOD’s demand in California during peak consumption periods. On May 3, 2001, DOD announced a plan targeting a 10-percent reduction in its peak electricity demand in California in 2001, with the total estimated reduction equal to about 42 megawatts. However, DOD’s plan commingles conservation initiatives with generation. Specifically, the 10-percent target reflects plans to reduce peak demand by 6 percent through conservation and 4 percent through generation and the purchase of power. DOD’s plan also contains few details on how such initiatives would be implemented or funded.

### **Use of Privately Owned Backup Generation Faces Obstacles**

Although significant private backup generation capacity exists in California, its potential use is limited because of business and environmental risks. Backup generators, generally relatively small equipment driven by internal combustion engines fueled by gasoline or diesel, are directly connected to single homes or businesses to supply electricity in the event of an interruption in service from

commercial sources. Given the risks involved, increased incentives would be needed to encourage businesses to use this backup generation, and a balance would need to be achieved between the need for additional electricity and the need to protect air quality.

- Privately owned backup systems in California have an estimated generating capacity of 3,500 to 5,000 megawatts of electricity, but the potential for California to benefit from this capacity is limited. Most privately owned systems are not configured to add electricity to the commercial system. However, operating these systems to meet the electricity needs of their private owners would reduce demand on the western electricity system. Because most backup generators do not have the capacity to fully power business operations, a business that agreed to switch to backup generation during periods of high demand would face significant risks. These risks include the potential need to shut down the business or operate without a critical electricity-powered amenity, such as air conditioning, during periods when operating solely on private backup systems.
- Existing incentives to increase the use of backup generation may be insufficient. Costs to operate backup generators are generally higher than the retail price of electricity, even with recent rate increases. In addition, businesses using backup generators that do not have the capacity to fully power business operations would probably require a greater incentive to switch to backup generators and risk temporarily disrupting their business. Programs recently introduced by the California ISO and the state are providing additional incentives, yet it is too early to assess their effectiveness.
- Finally, most privately owned backup generators, which are primarily diesel fueled, are located in heavily populated urban areas, such as the California southern coast and San Francisco Bay area. Because of regulatory restrictions and emissions rates that are four to five times those of other plants, extensive use of private backup generation could result in violation of federal, state, and local regulations and air quality standards. Recently, the federal Environmental Protection Agency has taken steps to extend the allowable hours for operation of backup generators. Moreover, the state exempts some backup generation from regulation. Nonetheless, some local air districts continue to restrict the number of hours generators are allowed to operate.

### **Agency Comments**

We provided DOD with a draft copy of this letter for its review and comment. In commenting on the draft, DOD agreed that our letter was generally accurate. However, DOD said we did not fully address the environmental issues associated with using diesel generators and expressed concern about whether their use was cost effective.

In response to DOD's first comment—that we did not fully address the environmental issues associated with using diesel generators—we believe the letter and briefing

slides clearly point out that there are environmental and other obstacles to the use of diesel generators in California. Specifically, while we reported that the ISO said that DOD's 90 megawatts of fixed and mobile generation would be helpful, we also pointed out in the letter that use of mobile units poses environmental and mission concerns as well as logistical issues. Given these trade-offs are a matter of policy, GAO does not take a position on whether mobile diesel generators should be used. We did not change the letter in response to this comment.

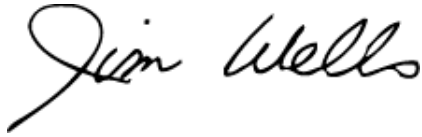
In response to DOD's second comment—that the use of diesel generators may not be cost effective—we believe the DOD is using the wrong cost comparison. They state that “it is hard to foresee a scenario in which military installations were paying electricity rates high enough to justify the expense of using mobile diesel generators.” In making this statement, DOD is pointing out one of the basic problems with the California market—namely, that retail rates paid by consumers, such as DOD and others, are set by the state at a level below the wholesale costs to purchase electricity. As we pointed out in the letter and briefing, expectations were that wholesale market prices this summer could be higher than estimated costs of using the mobile generators and, thus, wholesale market participants would be willing to purchase electricity produced by these generators. Moreover, in the event that having access to mobile generators forestalls blackouts that would otherwise occur, the value of these units would be even greater, reflecting saved business and consumer costs associated with the averted blackouts. Therefore, it is important that the cost-effectiveness of mobile generators be considered in light of the wholesale market clearing prices instead of the retail rate paid by DOD. We did not change the letter in response to this comment.

### **Scope and Methodology**

To describe California's electricity market, we interviewed officials at California state agencies and regional electricity organizations; obtained database files on electricity consumption, generation, supply, and prices; and analyzed the data to identify market trends. To identify generating capacity owned by DOD, we interviewed officials of the Office of the Secretary of Defense and military services; obtained data on DOD power plants and generators; and analyzed the data to determine generating capacity, current use, costs to operate, and emissions. We also obtained information on DOD's conservation efforts and interviewed California state officials on air quality and technical issues associated with using DOD assets. To identify private backup generating capacity, we interviewed federal, state, and industry officials; obtained information on private backup and mobile generation equipment; and analyzed the data to identify barriers and challenges to deployment. We conducted our review from March through May 2001 in accordance with generally accepted government auditing standards.

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If you have any questions about this letter or need additional information, please call me on (202) 512-3841 or Daniel Haas on (202) 512-9828. Copies of this letter are also available on GAO's home page at <http://www.gao.gov>. Other key contributors to this report were Christine Frye, Randy Jones, Jon Ludwigson, and Frank Rusco.

A handwritten signature in black ink that reads "Jim Wells". The signature is written in a cursive, flowing style.

Jim Wells  
Director, Natural Resources  
and Environment

Enclosure

List of Requesters

The Honorable Mike Thompson  
The Honorable Bob Filner  
The Honorable Barbara Lee  
The Honorable Gary Condit  
The Honorable Joe Baca  
The Honorable Robert Matsui  
The Honorable Michael Honda  
The Honorable Brad Sherman  
The Honorable Lynn Woolsey  
The Honorable Pete Stark  
The Honorable Henry A. Waxman  
The Honorable Susan Davis  
The Honorable Sam Farr  
The Honorable Ike Skelton  
The Honorable Duncan Hunter  
The Honorable Hilda L. Solis  
The Honorable Grace Napolitano  
The Honorable Juanita Millender-McDonald  
The Honorable Darlene Hooley  
The Honorable Zoe Lofgren  
The Honorable Loretta Sanchez  
The Honorable Gene Taylor  
The Honorable George Miller  
House of Representatives

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# California Electric Markets

California Electricity Market Options for 2001:  
Military Generation and Private  
Backup Possibilities





**Briefing Covers Three Broad Areas**

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## **Background on California Electricity Market**

**Military Could Help in Two Ways: Adding Generation and Through Conservation**

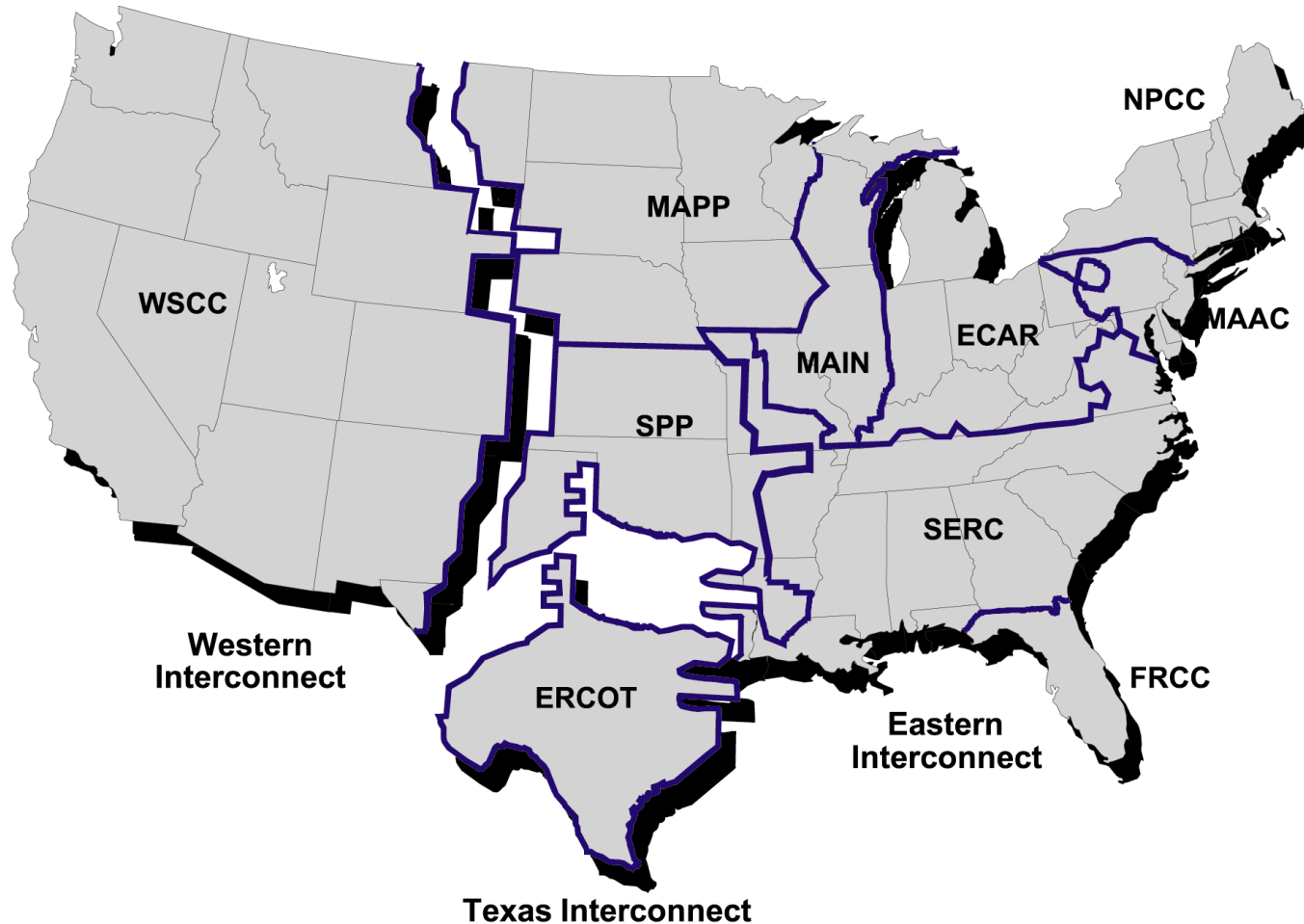
**Private Backup Generation Limited, Poses Risks**



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## Background on California Electricity Market California Operates Within Large Western System



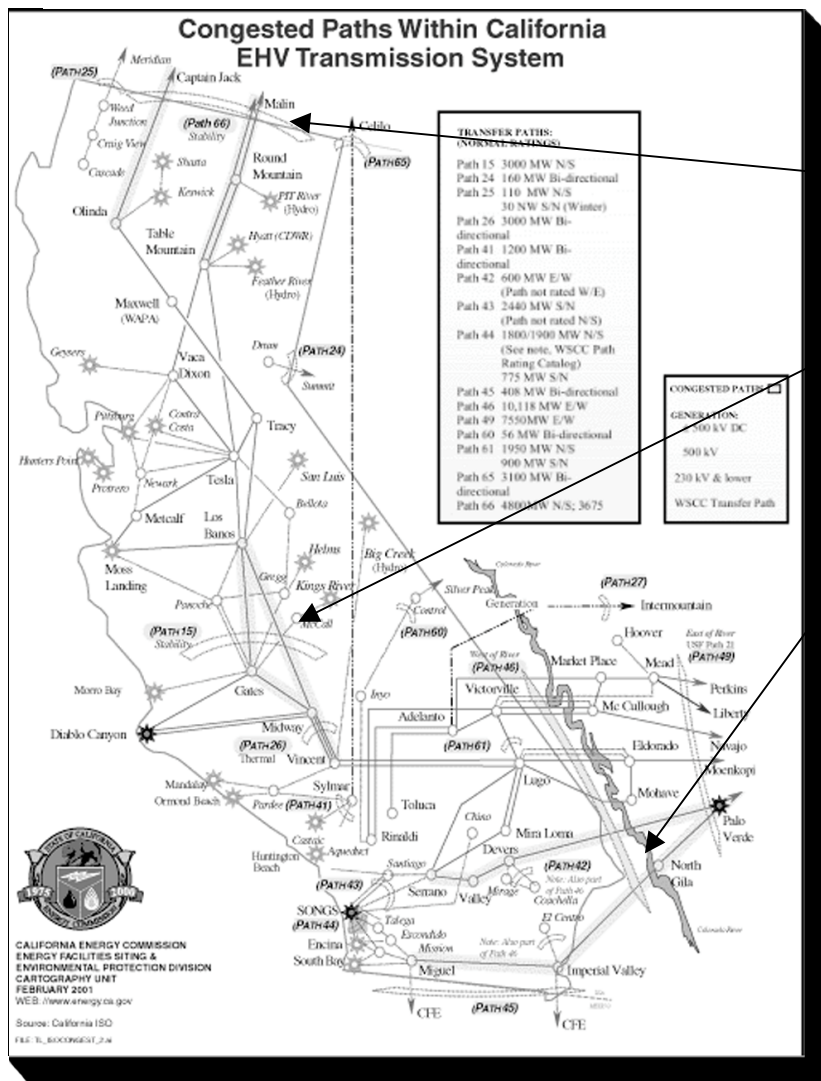
Source: Energy Information Administration.



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## Background on California Electricity Market Grid Constraints Limit Flows Into and Through State



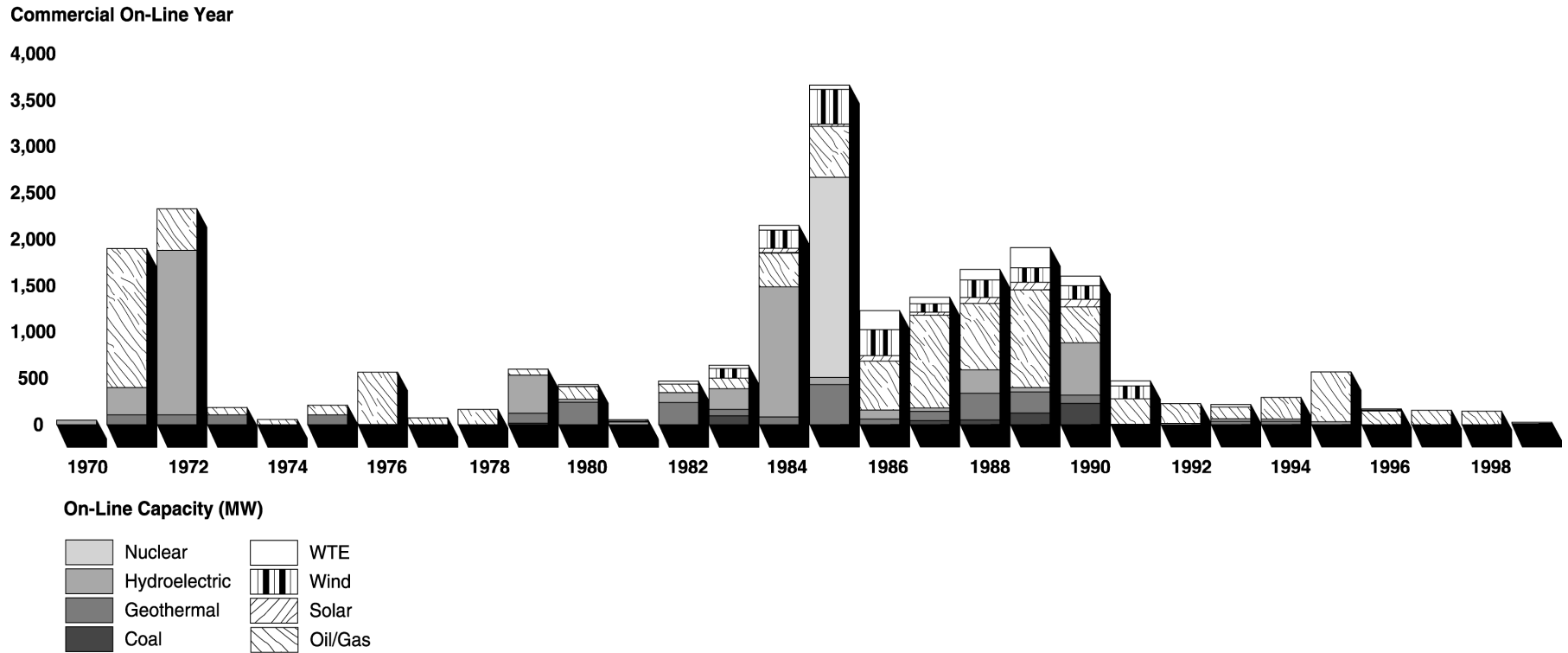
### Three Primary Grid Capacity Constraints

- California-Oregon Border
- Path 15
- California-Southwest Ties

# Background on California Electricity Market

From 1991-1999, State Has Added About  
2,800 Megawatts (MW)

California On-Line Capacity by Year, 1970-1999



Source: GAO analysis of California Energy Commission data.



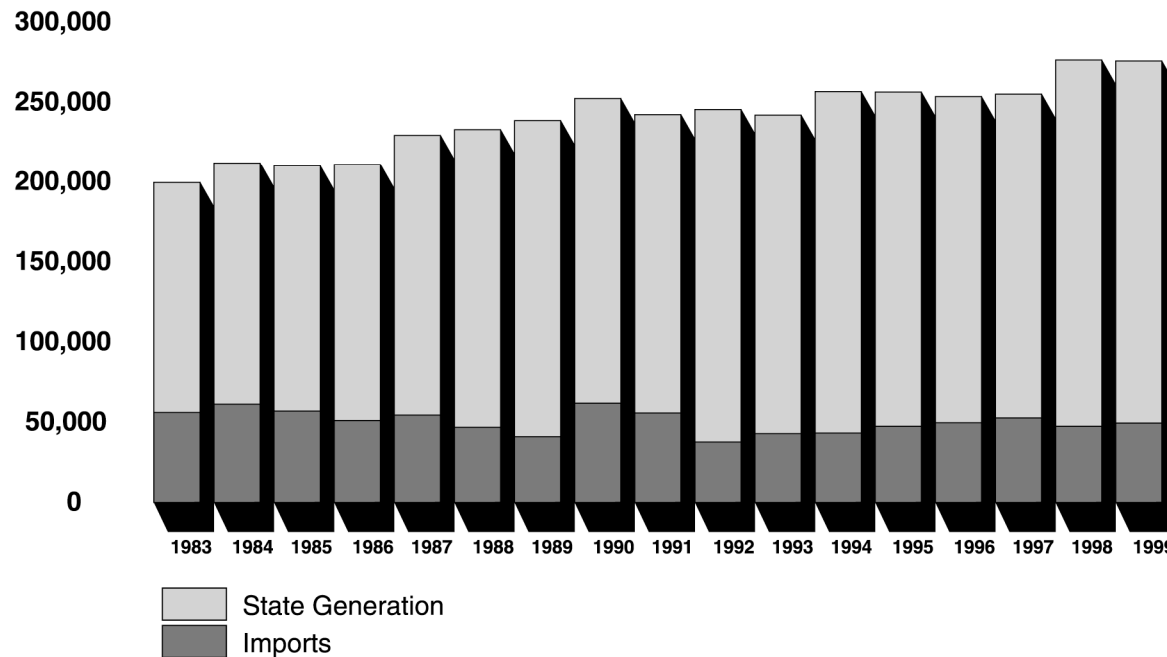
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## Background on California Electricity Market In-state Generation and Imports Supply State

Electricity Supply, 1983-1999

Electricity Generation (1,000's MWh)



**In-State Generation  
from Natural Gas,  
Nuclear, and  
Hydroelectric Sources**

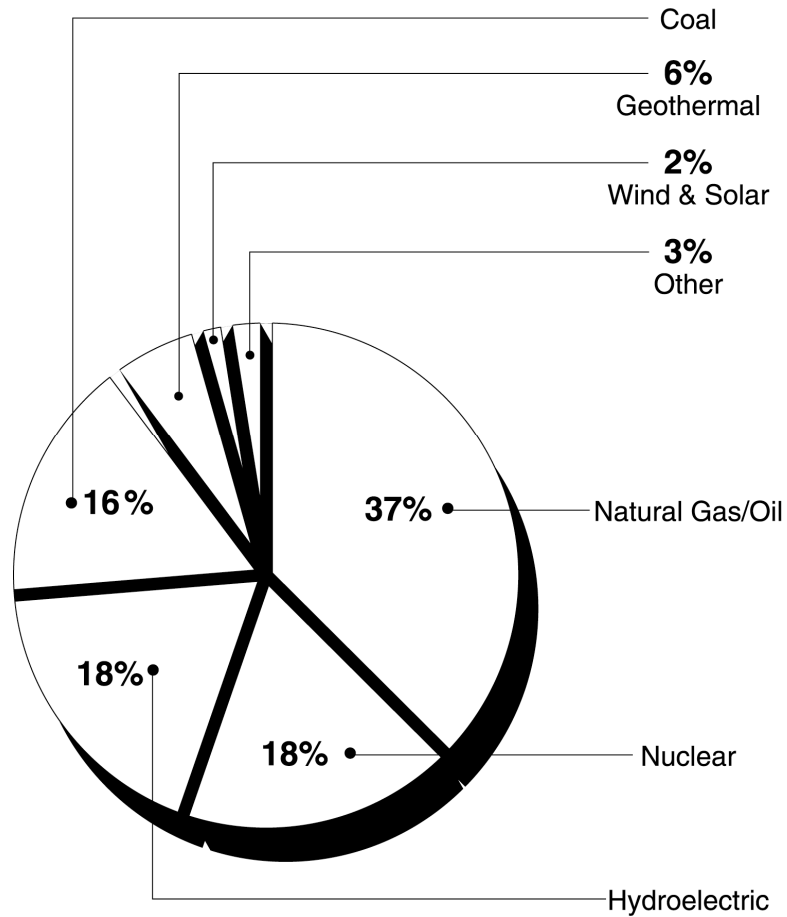
**Annual Imports from  
Pacific NW and  
Southwest Vary**

Note: State generation includes out-of-state capacity owned and formerly owned by state retail utilities, including power plants located in the southwestern U.S..

Source: GAO analysis of California Energy Commission data.

# Background on California Electricity Market

## Generation From Natural Gas, Nuclear, and Hydroelectric Sources



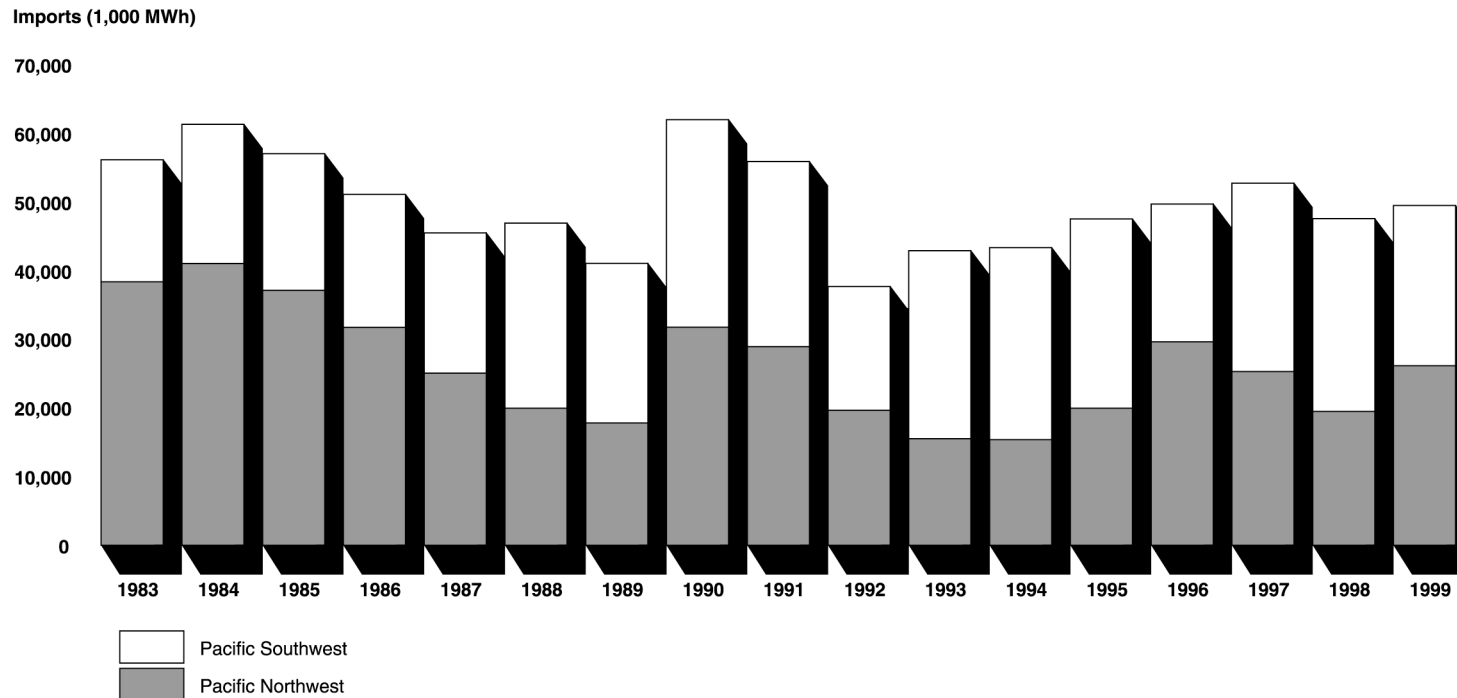
Note: Includes capacity owned and formerly owned by state utilities located in the southwestern U.S..

Source: GAO analysis of California Energy Commission data.

# Background on California Electricity Market

## Annual Imports From Pacific Northwest, and Southwest Vary

Electricity Imports, 1983-1999



Note: Does not include capacity owned/formerly owned by state utilities including capacity at plants located in southwestern U.S..

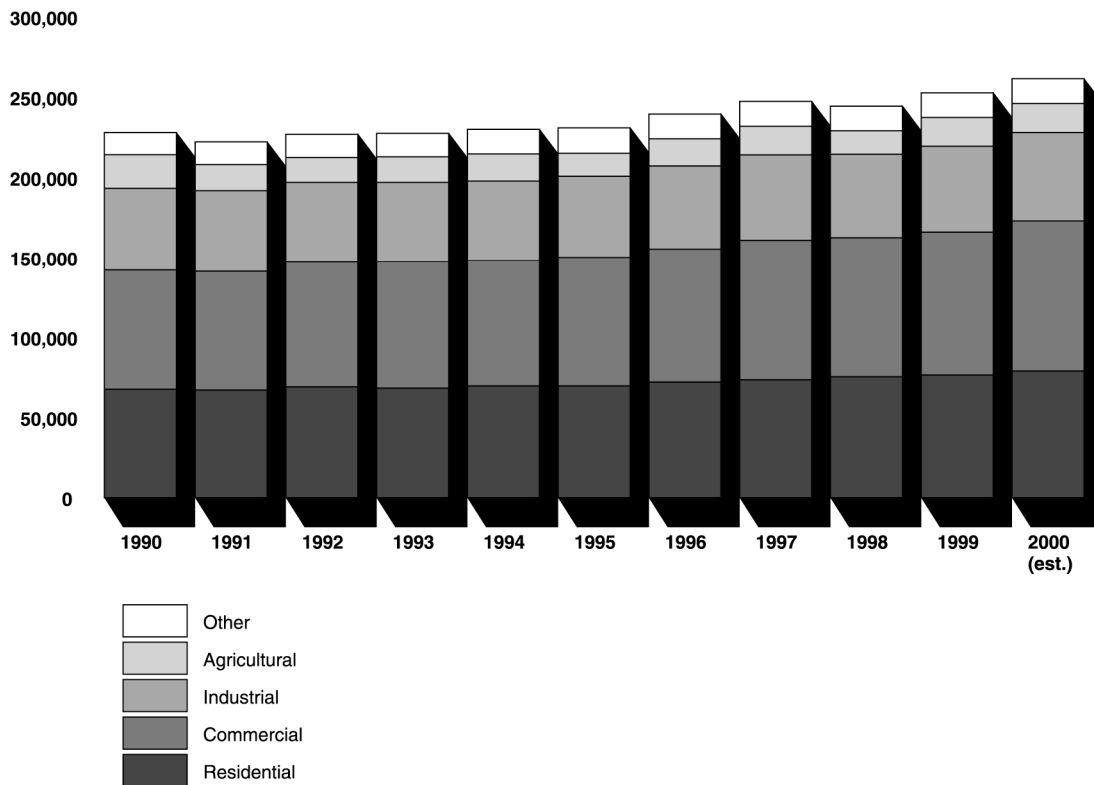
Source: GAO analysis of California Energy Commission data.

# Background on California Electricity Market

## Consumption Growing Across Sectors

Consumption of Electricity, 1990-2000 (est)

Statewide Consumption (1,000 MWh)



**Consumption growth up sharply over past 5 years**

- 1990-1995: up only 1%

- 1995-2000: up 13%

**Peak loads also up sharply**

- 1993-2000: up 16%

Source: GAO analysis of California Energy Commission data.





## Background on California Electricity Market ISO Expects Summer 2001 Shortages, West Also Tight

### **California Independent System Operator (ISO) study shows 3,000-6,000 MW gap**

- Including substantial plant additions, due in July
- Weather and outages could create problems early

### **Western Council estimates entire West could be tight**

- Drought could limit imports from Northwest and Canada
- Weather could increase loads, limit imports from Southwest



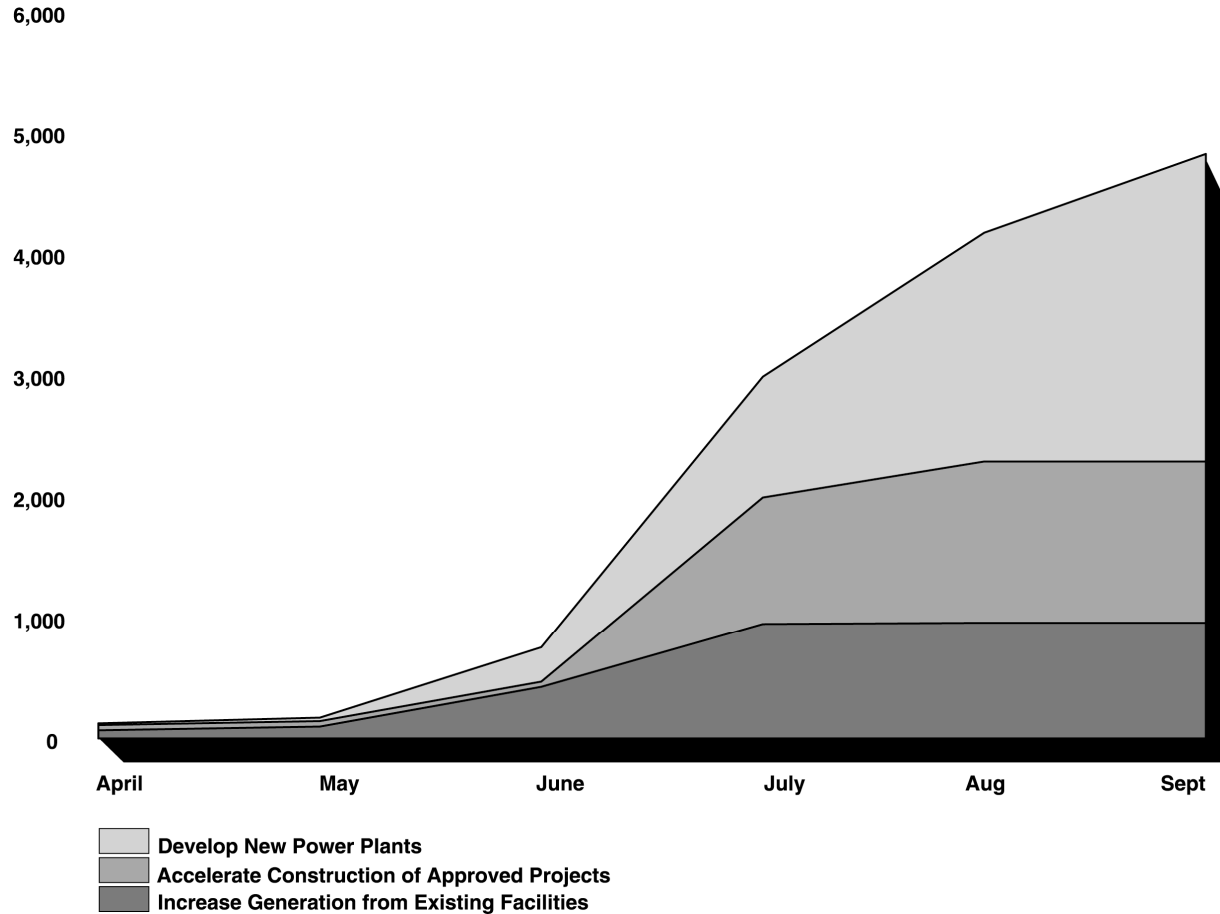
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# Background on California Electricity Market

## Few Plant Additions Scheduled Before July 2001

Megawatts On-line      2001 Generation Progress Report (Megawatts On-line by Month)



Source: California Energy Commission, April 20, 2001.

## **Providing additional generation**

- DOD says 90 MW available from fixed and mobile generators
- Costly, but may be lower than summer prices
- Deployment would raise environmental and mission concerns
- Deployment may require lead time and raise logistical issues
- ISO believes that this capacity could provide significant boost

## **Conservation--reducing load/consumption**

- DOD believes that conservation is best contribution
- DOD provided few details of conservation efforts
- Reducing load during peak hours can substantially reduce total system costs

## **Military could make available additional generation**

- DOD estimates that 90 MW is available
  - 16 MW fixed
  - 74 MW mobile
- Military owns 298 MW of electric generation
  - 109 MW of fixed power plants located in West
  - 189 MW of mobile generating units located in U.S.
- Mobile generation often deployed in emergencies

## **Unavailable units operating or committed to missions**

- Most fixed plants utilized on-base
- Many mobile units performing backup or in maintenance
- GAO did not verify reasons for unavailability



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## Military Options Mobile Generation in Operation



U.S. Army's Prime Power 4.5 MW Plant

## **Military cost estimates for mobile generators are high**

- Services estimated costs from \$350-\$1,000/MWh
- GAO analysis identifies costs may range from \$200-\$500 /MWh
- Actual costs depend on duration and frequency of use

## **Summer wholesale prices may be higher**

- FERC estimated costs of some existing generators in \$300-\$430/MWh range for early 2001
- ISO stated that prices in May top \$200/MWh and it expects that prices during summer 2001 will often top \$1,000/MWh

## **ISO Believes that 90 MW or more could provide boost**

- Provide last-minute stop-gap generation
- Help in negotiations to buy electricity

## **Operation of plants poses environmental consequences**

- Mobile units are mostly older, diesel-fueled with high emissions
  - Emissions rates 2-8 times current allowable rate in California (7lbs/Mwh)
- Air Resources Board concerned about diesel generation

## **Use of plants may compromise intended mission**

- Control of asset
- Limits mission readiness
- Deteriorates equipment

## **Logistical issues unresolved**

- Where should mobile units going to California be located and connect to the grid?
- Who should direct the operation of the generating capacity and assume risk?
- How long will it take to deploy the generating capacity?
  - Services provided varying estimates ranging from 30 to 90 days
- How will the services be reimbursed for deployment?
- How will the federal government and the state deal with environmental consequences? (waiver, offset, other)

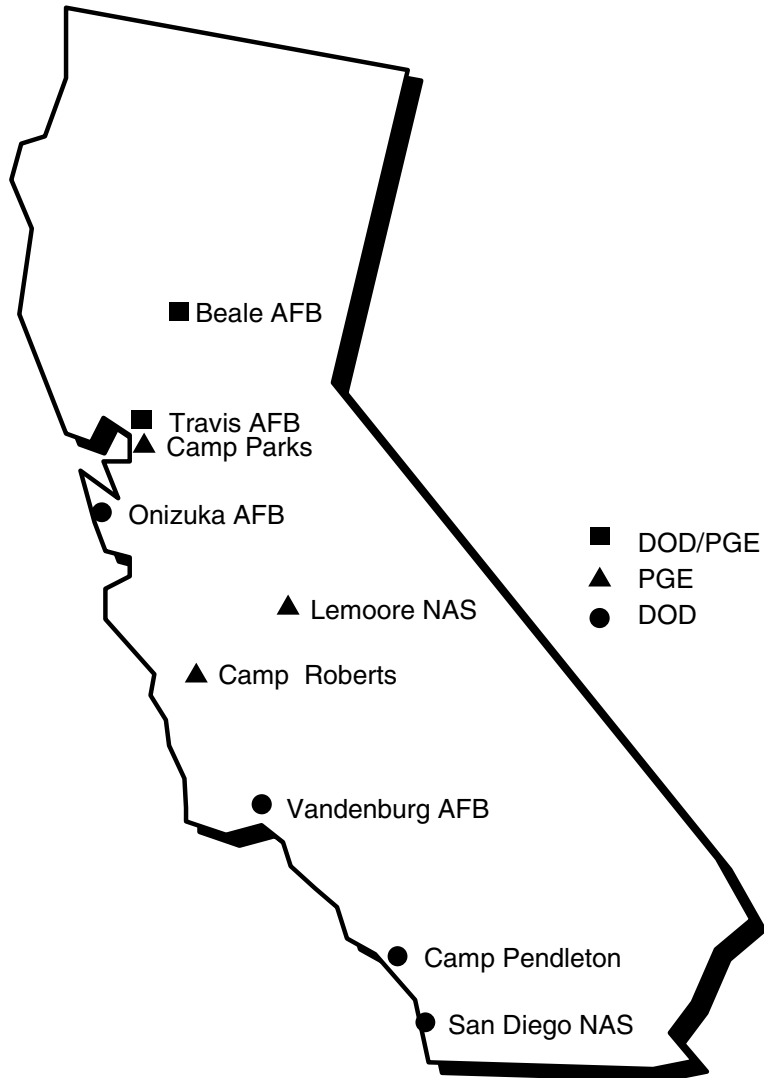




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## Military Options DOD/PG&E Identified Potential Sites



### DOD assumed siting at various locations

- Fixed at Vandenberg, Onizuka, Beale, and San Diego Naval Air Station
- Mobile at Travis and Pendleton

### PG&E conducted preliminary evaluation

- GAO asked ISO to identify potential sites on military installations; ISO asked Pacific Gas and Electric (PG&E) for locations with appropriate sites
- ISO prefers locations in Northern CA

### More work may be required before interconnection

## **DOD believes conservation is best contribution**

- California is home to 10 percent of total DOD population
- Largest single electricity consumer in the state
- DOD accounts for about 1% of state peak load

## **DOD provided few details of peak demand reduction plan**

- DOD announced plan targeting 10% reduction, but this includes generation
  - DOD to reduce peak demand by 25 MW
  - DOD to generate 11 MW with on-site plants and 6 MW renewable energy
  - Some proposed DOD actions not yet funded



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## **Role of Existing Back-Up Generation Limited, Has Risks**

### **Incentives Needed to Boost Output**

### **Actions May be Needed to Allow Use**

## **Potential of backup generation limited, poses business and environmental risks**

- 3,500-5,000 MW of backup generation may be available
  - Air Board estimated 11,300 units = about 5,000 MW
  - Energy Commission preliminary estimates of 8,000 units = about 3,500 MW
- Ability to rely on most systems is limited, poses business risks
  - Not configured for on-grid operation
  - Backup not adequate for full business operations
- Ability to operate limited, poses environmental risks
  - Currently not permitted for full-scale operations
  - Mostly diesel engines in urban areas, uncontrolled for nitrogen oxides (NOx), particulate matter (PM), and sulfur oxides (SOx)
  - Emissions rates 4-5 times those for other plants (NOx and PM)

## **Need adequate incentive to encourage deployment**

- Lack of data limits policy options
  - Incomplete data on capacity, locations
  - No data on capability to serve business needs
- Recent rate increases provide inadequate incentive
  - New rates still lower than potential average wholesale prices
  - Rates continue to reflect state subsidy
  - Rates still not reflective of time-variable costs
- Programs by ISO and California offer promise
  - Several programs, allow businesses to sell “load”
  - Some programs focus on enterprises with backup generation

## **Limit business exposure to environmental implications**

- Extensive operations could violate existing federal/state/local air quality rules

## **Actions taken help, but may not be enough**

- EPA changed rule that restricted hours of operation
  - Summer 2000
  - Monthly extensions
- State actions vary
  - Some backup generation exempt from regulation
  - South Coast and San Joaquin have restricted hours of operation