The Power of Conservation and Renewables

An Analysis of the Potential for Energy Conservation and Renewable Energy to Satisfy California's Electricity Needs

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Introduction

California continues to face challenges satisfying its electricity demand. However, this does not preclude the state from making a transition toward clean energy sources. In fact, it offers the perfect opportunity to change the way the state generates its electricity and to use less power.

Potential near-term shortfalls can only be reduced if the state aggressively pursues renewable energy sources and puts in place an array of energy conservation programs. As these options are often quicker and cheaper than traditional generation sources, pursuing them immediately is in the best interest of the state. Energy conservation and renewable energy production are win-win solutions – helping the state out of its power supply difficulties and reducing the adverse impacts of electricity generation.

Recent analysis by state agencies shows that energy conservation efforts can provide significant savings on peak demand, though the legislature may be losing much of its window of opportunity for this year. Throughout the next decade, in-state wind resources can be tapped to provide for much of the expected increases in demand. In the long term, decentralized production from solar cells combined with regional sharing of resources from the windiest areas can provide for much of our energy needs.

1. Energy Conservation and Efficiency Improvements

California is at risk of significant power shortages at peak demand times this summer. According to recent state analysis, policy makers could have averted shortfalls with confidence had they acted quickly to install new programs for energy conservation and energy efficiency improvements. As such programs have been slow in coming, however, it is unknown how much savings can be achieved by this summer. At this stage, the quicker the legislature acts on current proposals, the greater the portion of savings that will be achieved for this year's peak demand time.

The California Energy Commission (CEC) estimates that if temperatures this summer reach ten-year highs, electricity use will peak at 57,126 megawatts (MW). Adding the standard 7% emergency reserve, California needs to plan for a capacity of 61,125 MW. With current and coming generating capacity, this could lead to a shortfall of 1,225 MW at peak demand times.[1]

[1] California Energy Commission, *California Summer 2001 Forecasted Peak Demand-Resource Balance*, 8 February 2001.

Table 1: Summer 2001 Peak Demand-Resource Balance (MW)

Projected Summer Peak Demand	57,126
7% Reserve	3,999
Total Need	61,125
Current Capacity	56,159
Capacity Under Construction	3,741
Total Capacity	59,900
Potential Shortfall	1,225

The CEC demand forecast includes ongoing load reduction programs which will continue to bear fruit through the summer, estimated at 200 MW. However, it does not include any new energy efficiency and conservation programs that can be put in place now.

According to a staff analysis prepared for the Assembly Subcommittee on Electrical Energy Oversight on March 5, 2001, California could have reduced peak demand this summer by 6,244 MW through projects then under consideration had they passed immediately. Together with supply projects now being built, this would have given the state a reserve of 18%.[2]

Table 2: Summer 2001 Supply & Demand: Electrical Energy Oversight Subcommittee Proposals (MW)

Existing Resources	56,159
Resources Under Construction	3,741
Total Supply	59,900
Current Demand Forecast	57,126
New Efficiency and Conservation	6,244
Total Demand	50,882
Reserve	18%

The Legislative Analyst's Office (LAO) published more conservative estimates on March 13, 2001. With current facilities, LAO estimates California will have 56,159 MW of generation available this summer, 4% less than the CEC prediction. LAO predicts that 2,465 MW of new generating capacity will be on-line by the first of July, 34% less than the CEC prediction. On conservation and energy efficiency, LAO predicted that 4,119 MW of energy savings could have been achieved by July 1 through programs then under consideration, also 34% less than the CEC prediction.

According to these more conservative projections, however, rolling blackouts would not have occurred this summer if temperatures do not go beyond a ten-year high and all of the programs were effectively implemented. On the hottest day of the year at peak demand time, electricity reserves would drop to 6.5% according to LAO figures. Such a reserve is less than the normal goal of 7%, but greater than the ISO's minimum of 3.5%

[2] Ibid.; Subcommittee on Electrical Energy Oversight, *Supply and Demand for Summer 2001*, March 2001.

for operational effectiveness and large enough to avoid anything worse than a Stage One power alert.[3]

Table 3: Summer 2001 Supply & Demand: LAO Predictions (MW)

Existing Resources	53,991
Resources Under Construction	2,465
Total Supply	56,456
Current Peak Demand Forecast	57,126
New Efficiency and Conservation	4,119
Total Peak Demand	53,007
Reserve	6.5%

These projections assumed several key actions:

- The conservation and energy efficiency programs contained in the projections are all effectively implemented.
- Legislation is enacted to ensure that the renewable generators known as "qualifying facilities" receive payment in order to stay in operation.
- Repairs currently under way are completed on schedule.
- Power imports from outside the state are consistent with the projections by CEC, ISO, and LAO.

Table 4: New Efficiency and Conservation Proposals (MW)

	Energy Savings		
		LAO	
Program	CEC	July 1	Summer
CPUC Summer Peak Initiative	67	67	67
CEC AB 970 Efficiency Programs	150	150	150
State Government Energy Efficiency	100	10	30
AC Incentives/Appliance Rebates	84	21	42
Low-Income Weatherization Program	8	4	8
Cool Communities Program, Oil & Gas Pumping, Commercial Lighting Efficiency	187	62	125
CEC AB 970 Demand Responsive Systems	70	70	70
State of California	150	150	150
DWR Peak Load Reductions	300	300	300
Local/Federal Governments	208	112	112
Demand Responsive Building Systems	220	73	147
Public Outreach	2,000	1,300	1,300
Utility Demand-Side Response Initiatives	2,700	1,800	1,800
TOTAL	6,244	4,119	4,301

[3] Legislative Analyst's Office, letter to Hon. Darrell Steinberg and accompanying charts, 13 March 2001.

Since the legislature did not act quickly to implement these programs, there is considerable uncertainty as to how much savings could be achieved by this summer. However, it is still imperative that new conservation and efficiency programs are implemented as soon as possible. At this stage, it is the only thing California policy makers can do to lessen the severity of likely rolling blackouts this summer. The state should at least do all it can to approach the savings estimates that are now three weeks old.

In the worst case scenario, the state would experience repeated rolling blackouts this summer, though less extensive than under a "no action" scenario, and would avert any outages in 2002 with confidence. In the best case, demand will not peak as high as the conservative projections estimate, and power shortages will be narrowly averted. In either case, the state would be addressing supply shortages with reductions in demand, rather than with costly and polluting new fossil fuel-based power plants.

2. Wind Energy in California

There is much untapped potential for wind power in California. Estimated growth in electricity demand in the next several years could be generated largely by new wind turbines if power producers were to aggressively pursue the resource.

California has enough windy spots to cost-effectively install the turbines to generate an average output of 6,770 MW, according to the Pacific Northwest Laboratory (PNL), a public/private research arm of the U.S. Department of Energy. This would produce 59,000 gigawatt-hours (gWh) of electricity per year – 23% of the amount of electricity the state used in 2000.[4]

The National Renewable Energy Laboratory, another public/private DOE lab, made more conservative estimates in 1994, measuring wind generating capability in locations with moderate land use and environmental restrictions within ten miles of existing transmission lines. They estimated that California could generate 5,546 MW of electricity from turbines in such locations – 48,000 gWh/yr, or 19% of total current demand.[5]

Wind turbines currently in use produce 535 MW – less than 2% of demand. This leaves an untapped potential of 5,011-6,235 MW.[6]

The wind energy industry has been gearing up for growth. If new state policies are put in place to facilitate and encourage wind development, wind power generators could deliver California's wind resources to the electric grid within the next decade. This year, the

[4] Pacific Northwest Laboratory, *An Assessment of the Available Windy Land Area and Wind Energy Potential in the Contiguous United States*, 1991, as cited by American Wind Energy Association, *Wind Project Data Base*, 6 November 2000.
[5] National Renewable Energy Laboratory, *U.S. Wind Resources Accessible to Transmission Lines*, 5 August 1994, as cited by U.S. Department of Energy, Energy Information Administration, *Renewable Energy Annual: 1995*.
[6] American Wind Energy Association, *Wind Project Data Base*, 6 November 2000.

industry will install enough turbines to generate 152 MW in California.[7] If installations were to increase by 35% each year thereafter – a rapid but feasible rate – the state could be harnessing nearly its full potential of wind power by 2009.

With such growth, increased capacity in wind generation could provide for much of the projected increase in demand over the next four years and all of the projected increase in the following four years.[8]

Table 5: Increase in Wind Energy Capacity with 35% Annual Growth (average MW)

Year	Wind Capacity Increase	Total Wind Capacity	Projected Demand	Growth in Demand	Pct of Growth Achievable by Wind
2000		535	29,437		
2001	152	687	30,058	621	24%
2002	205	892	30,758	699	29%
2003	277	1,169	31,398	640	43%
2004	374	1,543	31,914	516	73%
2005	505	2,048	32,443	530	95%
2006	682	2,730	32,938	495	138%
2007	920	3,650	33,522	585	157%
2008	1,242	4,892	34,155	633	196%
2009	1,677	6,569	34,759	604	278%

3. Wind Energy in the West

As California's fossil fuel-based power plants grow older, they can be replaced by non-polluting wind energy generated in other states.

California has moderate wind resources compared to other western states, and the state's large population clearly requires more electricity than in-state wind turbines could generate. Other states in the region, however, have vastly more wind resources than electricity demand. California should use long-term contracts to encourage these states to generate wind power and export it into a regional market.

The four Rocky Mountain states theoretically have enough wind resources to power the West many times over. While transmission losses do not make it practical to generate 100% of the region's energy from these states, we can increase production there without encountering barriers of transmission distance. With electricity supplies tight throughout the West, increases in energy production in the mountain states could easily ripple westward through the grid.[9]

[7] Ibid.
[8] Projected demand figures from California Energy Commission, *California Energy Demand: 2000-2010,* June 2000.
[9] Wind potential figures from National Renewable Energy Laboratory, "U.S. Wind Resources"; demand figures from U.S. Department of Energy, Energy Information Administration, *Electric Utility Retail Sales*

Table 6: Wind Energy Potential in the Western States (average MW)

State	Wind Potential NREL Estimates	Wind Potential PNL Estimates	1999 Use	Potential Pct of Use NREL Estimates	Potential Pct of Use PNL Estimates	Excess (Need) NREL Estimates	Excess (Need) PNL Estimates
WY	49,339	85,000	1,399	>100%	>100%	47,940	83,601
MT	43,753	116,000	1,145	>100%	>100%	42,608	114,855
CO	23,350	54,900	4,677	>100%	>100%	18,673	50,223
NM	13,262	49,700	2,067	>100%	>100%	11,195	47,633
ID	2,151	n/a	2,488	86%		(337)	
UT	803	2,770	2,506	32%	>100%	(1,703)	264
NV	826	n/a	2,999	28%		(2,173)	
OR	2,724	4,870	5,696	48%	86%	(2,972)	(826)
AZ	190	1,090	6,579	3%	17%	(6,389)	(5,489)
WA	3,417	3,740	10,622	32%	35%	(7,205)	(6,882)
CA	5,546	6,770	26,653	21%	25%	(21,107)	(19,883)
TOTAL	145,361	324,840	66,830	>100%	>100%	78,531	258,010

4. Solar Energy Potential

The greatest advantage of solar energy in warm climates is its ability to generate power most efficiently during times of peak demand. California can make use of this quality to forestall any summer power shortages in the coming years.

California currently has plenty of generating capacity for times of average electricity use. It is only at times of peak demand that the state is at risk of blackouts. These peaks happen in the heat of summer afternoons, when intense heat from sunshine creates an increased need for air conditioning in residential and commercial buildings.[10] For exactly the same reason at the same times, solar power generation is at its peak production. Every increase in solar energy capacity will directly help the state when it needs it most. By addressing peak demand directly, increases in solar energy capacity will also avoid unneeded electricity production from polluting plants that operate around the clock.

A 1998-99 study by the American Roofing Contractor's Association estimated California's long-term solar energy generation potential on commercial and industrial rooftops to be 16,000 MW. The California Solar Energy Industries Association adds to that an additional 4,920 MW from schools, municipal buildings, and state buildings.[11]

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of Electricity to Ultimate Consumers by Sector, Census Division, and State, 2000. California demand is slightly less than CEC figure because it does not include electricity that is produced and consumed by the same entity.

[10] The rolling outages in January and March 2001 were an exception. In January, an unusual number of power plants were down for maintenance. Such a situation can be prevented in the future by more thorough oversight of power plant operations. In March, many cogeneration facilities were off-line due to billing problems associated with utility deregulation. Legislative solutions are pending to address this problem.

[11] California Solar Energy Industries Association, *Background for Solar Electric Net Metering Legislation,* 17 January 2001.

Table 7: California Solar Energy Potential (MW)

Type of Building	Solar Energy Potential
Commercial & Industrial Buildings	16,000
Schools	4,000
Municipal Buildings	520
State Buildings	400
TOTAL	20,920

Fully tapping the state's solar resources, of course, will take a long time even under the best conditions. Because most solar panels are consumer-owned, high initial investment costs hamper rapid development of the resource, even though photovoltaic power generation is cost-effective over the lifetime of the panels. To help individuals get over the initial investment hurdles, the state should expand its buy-down programs. To help solar panel manufacturing companies achieve economies of scale, governments at all levels should embark upon extensive procurement plans.

Other reforms are also needed to encourage the solar energy market. Removing caps from net metering regulations would enable entrepreneurs to develop solar resources for sale to the grid. And permitting municipalities to aggregate their demand would enable them to invest in production facilities to serve that collective demand.

5. Geothermal Resources

Pockets of heat lie below certain surface regions of the Earth which can be tapped to drive turbines that generate electricity. California has 14 known geothermal resource areas with temperatures high enough to generate electricity. The areas in California with the most geothermal potential are the Imperial Valley near the Salton Sea, the Geysers region north of San Francisco, the northern Sierras, and the Medicine Lake region near Mount Shasta.

Geothermal generators currently provide 1,900 MW of power in the state, 5% of California's average demand. The California Energy Commission estimates that the state has a potential geothermal electricity generating capacity of 4,000 MW.[12]

Additionally, neighboring Nevada has more geothermal capacity than any other state. The Geothermal Policy Working Group estimates that Nevada can develop 2,000 MW of that potential within the next five years. As with wind energy in other states, California electricity retailers could encourage development of Nevada geothermal resources through long-term contracts.[13]

[12] All California geothermal figures from California Energy Commission, *Energy Commission Geothermal Program,* downloaded from www.energy.ca.gov/geothermal, 28 March 2001.
[13] Energy Central, *Nevada Can Tap Other Renewable Energy Resources,* 3 Feb 2001.

Conclusion

The California Energy Commission and the Legislative Analyst's Office both recently predicted that California could have averted rolling blackouts this summer, but only if extensive energy conservation programs were begun immediately. CEC projected that current proposals would have brought the state enough savings to have plenty of power during summer peak demand periods, including an 18% reserve. LAO projected tighter supplies, with a 6.5% reserve on the day of peak demand if temperatures reach ten-year highs. Three weeks later enabling legislation hasn't been passed, but state policy makers should still do all they can to approach these estimates.

California has the potential to generate an average output of 5,550-6,770 MW from wind power. Currently, wind turbines in the state produce 535 MW, leaving an untapped potential of more than 5,000 MW. An ambitious wind power development program could cover most of the expected increase in electricity demand over the next decade.

The Rocky Mountain states have much more wind power potential than energy needs. Encouraging the development of this resource could benefit the entire western states region.

Solar power has great potential to supply electricity at times of peak demand, eliminating the need for new power plants that operate wastefully beyond peak hours. A recent survey of prime rooftop space found the potential to install enough photovoltaic panels in efficient places to provide over 20,000 MW of electricity.

California also has untapped geothermal resources. The CEC estimates geothermal potential at 4,000 MW, while only 1,900 MW of this has been developed.

With power shortages as small as 500-1,000 MW sending the state into rolling blackouts in recent months, and with annual increases in demand forecast at around 600 MW, California would be irresponsible not to aggressively develop the vast resources of renewable energy generation and energy conservation to satisfy its growing thirst for power.