Title
An energy crisis from the past: Northern California in 1948

Author
Ross, Stuart A.

Publication Date
1973

AN ENERGY CRISIS FROM THE PAST?

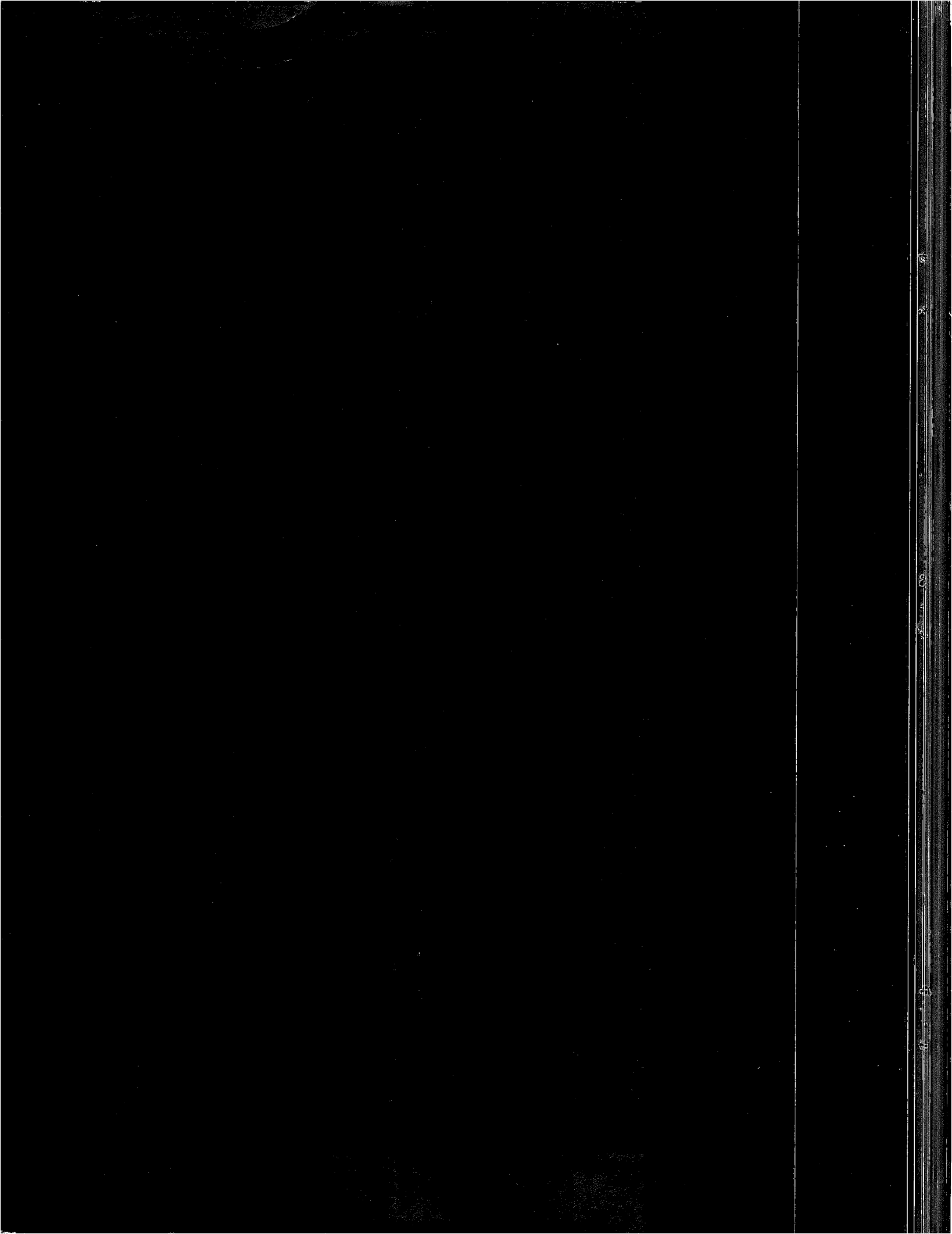
Northern California in 1918

Stephen A. Ross

November, 1973

Working Paper No. 8
Institute of Governmental Studies
University of California, Berkeley

January 1974



Contents

TABLES AND ILLUSTRATIONS

The political and scholarly discussions about the energy crisis have been limited in important ways. As writers race to the presses to keep up with events and with each other, there has been little pausing for historical perspective. As economists and technologists despute prices and processes there has been very little integrated analysis of supply and demand together in a real social setting.

This paper seeks to stretch against both limits simultaneously. It is a study of an electric energy shortage that occurred in Northern California a few years after World War II. That shortage is not widely known, but it was very real at the time. At its extreme it had to be met with compulsory rationing aimed at a 20% curtailment of use. In its particulars, the shortage was quite close to the shortages of 1973 in the Pacific Northwest. In its general features, it speaks to all aspects of the energy crisis.

Like the energy shortages we worry about today, the 1948 shortage resulted from the tightening of several constraints, not just one. No one of the constraints by itself, probably, could have caused the crisis, but together they could and did. The four principal constraints were:

1. During the immediate postwar years the demand for electric power and energy grew much faster, and more persistently, than had been expected. This was true for Northern California and for the nation as a whole.

---

*This paper was first prepared for a colloquium entitled "Energy Consumption and the Social Future," sponsored by the Institute of International Studies at the University of California, Berkeley. The Institute also supported part of the costs of this research. The author wishes to express particular gratitude to Todd R. La Porte, Kai N. Lee, Harry L. McMasters and Robert P. O'Brien for their assistance in this effort. The Institute of Governmental Studies, at the University, provided the use of its facilities and general support.

2. The winter of 1947-1948 was an extremely dry one in Northern California, an area dependent to a major extent on hydroelectric power at that time.

3. A heated dispute between the Pacific Gas & Electric Company and the Bureau of Reclamation over responsibilities for power development endangered efforts to speed that development.

4. The construction of new generating facilities and the acquisition of materials and machines for the facilities had not yet readjusted from the impact of wartime disruptions.

So, demand was high, supply was low, and new supply was slow in coming; hence the crisis.

From first signs to final easings the shortage lasted over two years. As early as 1946 there had been public predictions that a crisis was forthcoming; by late 1947 some steps were being taken to avert it. In early 1948 the Public Utilities Commission (PUC), doing what it could to speed completion of new generating facilities, also imposed emergency rationing. All signs pointed to a dry summer, but spring brought unusually heavy rains and replenished the reservoirs. The need for rationing came to an end, although the need for caution remained well into 1949.

The succeeding parts of this paper will analyze the many elements of the crisis in more detail.

The Setting

A first task is to set the background for this crisis in terms of the electricity demand and supply during the postwar years.

Demand. There are two measures of the demand (and supply) that must be kept in mind. One is electric power, which refers to the rate at which electrical energy is being used at any given moment. Power is measured in kilowatts (kw). The other measure is the total energy used over some designated period of time. Energy is measured in kilowatt hours (kwh). The distinction proves important because a crisis of insufficient power and a crisis of insufficient energy are two different things. In the one, the generating systems are too small to handle the peak rates of usage; in the other, the reserves of fuel or hydroelectric storage are insufficient to last until replenishment at the foreseeable rates. Each kind of crisis presents different technical and social problems.

The usage of electric energy in 1948 was split more or less evenly among four major sectors. The usage in billions of kwh in Northern California was:[1]

Residential	2.0 billion kwh
Commercial	2.9 "
Industrial	2.5 "
Agricultural	2.1 "
Other	.4 "

Residential customers made up about 80% of the electric customers by number. Electricity use by residential customers grew steadily throughout this period, at an average annual rate of 9% between 1938 and 1948.[2] Between 1946 and 1948, the number of customers grew by 10% and the use per customer grew by 7% per year.[3]

Commercial use of electricity grew more sharply, at about a 12% annual average for the decade 1938-1948.[4] Between 1946 and 1948 the number of commercial customers grew almost 16% and the use per customer grew over 12%.[5]

Industrial use of electricity hit a peak in 1944, then it entered a decline, as industry changed from the long production shifts of wartime to the shorter ones of peacetime. A decline of 25% in annual energy usage occurred by 1948.[6] After that the figure began to rise again, averaging about 7% per year into the early 1950's.[7]

Agricultural use of electricity was widespread; about 89% of all the farms had electricity by 1945, a figure well ahead of the national average. There were relatively few REA-assisted farm operations in California; most electrified farms in Northern California were PG&E customers.

Most of the agricultural use was for irrigation or reclamation pumps, and as might be expected this use varied considerably with the weather. Thus from 1940 to 1941 there was a drop of 11.3% in energy usage in agriculture, while from 1946 to 1947, a fairly dry winter, there was an overall increase of 27.7%.[8] When the drought was at its worst, in February 1948, total agricultural usage exceeded the previous February by 180%. For individual areas this 1947-1948 variation ranged from a 36% decrease in Nevada and Sierra Counties to an increase of 894% in the San Jose and Santa Clara areas.[9] The additional load imposed on the system by the unusually high irrigation pumping was more than the combined normal usage of the cities of Stockton, Fresno, Sacramento, and San Jose combined.[10] A Agricultural pumping is no longer as great a part of electricity usage as it was in 1948; it has grown much less than the other three sectors. Agricultural use is now closer to 10% of the energy usage in Northern California.

Other uses of electricity included primarily uses by public authorities, for street lighting and urban transportation. The electric transportation

uses decreased while street lighting increased, and the net effect was that during the postwar years this sector was not only small but relatively steady.

As Figure 1 shows, there was a decline in sales of electric energy from 1944 to 1946, roughly, but in early 1946 a definite upswing took place inaall the state and national figures. (The large drop in L.A. in 1944 was occasioned by the closing of one aluminum plant.) The entire economy, as is well known, entered a boom period.

As these data indicate, the use of electricity rose rather sharply just after the war. Figure 1 shows that during the immediate postwar period the prevailing pattern was that each week brought sharp increases in use over the same week of the previous year. Record-setting month followed record-setting month with hardly any respite

The evidence available in the business and industry press of the time generally indicates that the demand increases were greater than had been expected, and that the industry was more or less caught short. (A postwar recession had been feared by many observers. If one looks at Figure 1 for the years 1944 and 1945 a pessimistic prediction for the electric power industry is perhaps understandable.) A nation-wide power shortage seemed quite possible. Electrical World stated in September of 1947:[11]

> The ability of the industry to carry December and January peak loads is a challenge.... There are still a few remedies if demand goes too high--interconnections, voltage drops, or strategic cutoffs of large customers.

Only a few optimistic claims about the supply picture were made, by groups such as the Edison Electric Institute. PG&E,in their 1945 Annual Report at least, indicated an early awareness of the magnitude of the boom.[12]

The particulars of supply in Northern California are our next concern.

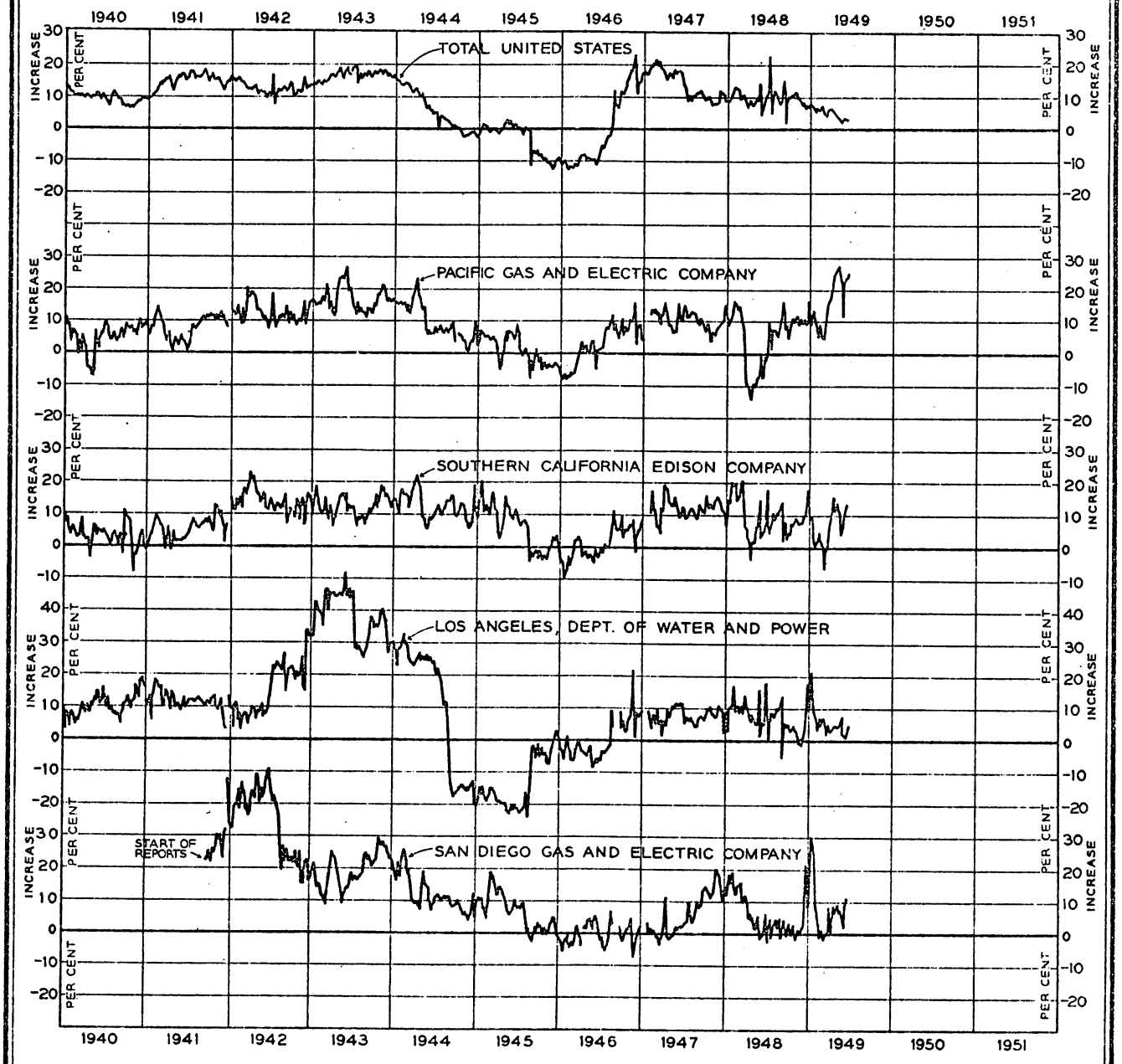
CHART 12

Figure 1

STATE OF CALIFORNIA

ELECTRIC PRODUCTION STATISTICS

WEEKLY INCREASES COMPARED TO PREVIOUS YEAR



SOURCE: REPORTS TO EDISON ELECTRIC INSTITUTE

MWE 490930

Supply. The electricity in Northern California was supplied then, as it is now, primarily by the Pacific Gas and Electric Company (PG&E). PG&E plants turned out about 85% of the electric power and energy used in Northern California during those years. Figure 2 shows the relative position of PG&E within Northern California and shows, for comparison, the outputs of San Diego Gas and Electric, the Los Angeles Department of Water and Power, and the Southern California Edison Company. Another worthwhile comparison is to the present. PG&E now has a capacity over 10 million kw, more than five times its capacity in 1948.

The source of power next in size to PG&E was the Federal Government, in the form of its operation at Shasta Dam. Several smaller public and private generating stations made up the rest of the supply. The relative proportion of public and private sources of power remains about what it was in 1948.

Figure 3 shows the area served by PG&E. This area once provided PG&E with a nice balance between urban winter lighting loads and rural summer irrigation loads, but the advent of air conditioning has upset that balance somewhat. The area shown was the area throughout which the rationing was in effect; it is the area defined for purposes of this paper as Northern California.

Northern California has always had a relatively high reliance on hydroelectric power, developed in the streams and rivers of the Sierra Nevada. In 1928 the area derived 77% of its generating capacity from hydroelectric sites; in 1948, 67%; and in 1956, 51%.[13] At present the figure is closer to 43%. By the very nature of the Sierra rivers, hydroelectric development in Northern California has been characterized by many small storage sites rather than a few giant ones.

It is not possible to give any simple picture of how close demand & supply came. When they are close, details & contingencies become the major factors, and this whole paper is about those.

FIGURE 2

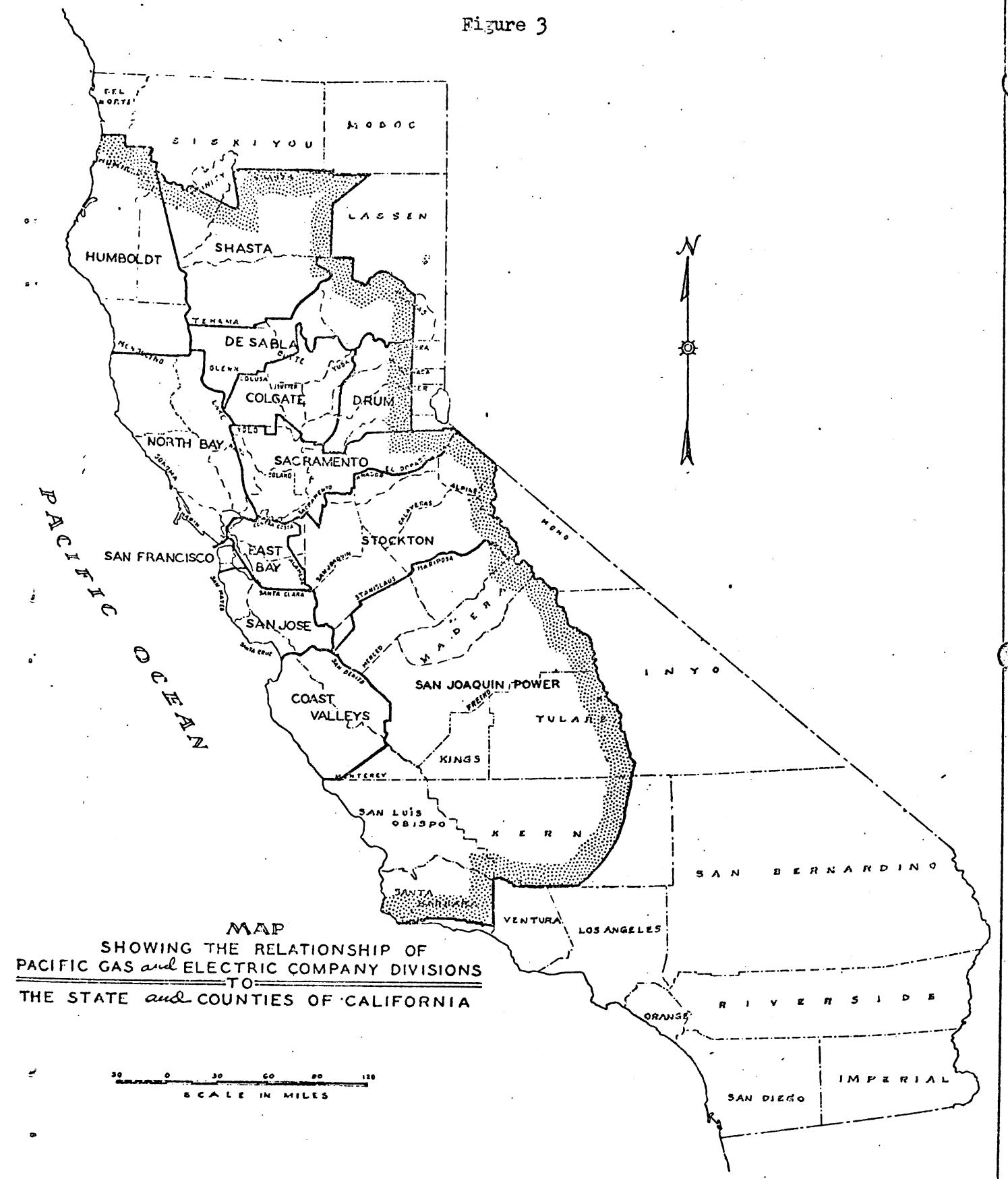
ELECTRICITY GENERATION BY PUBLIC AND PRIVATE UTILITIES IN CALIFORNIA FOR AN AVERAGE WEATHER YEAR

as of December 31, 1948

Source	Capacity in 10^3 kw	Loads in 10^6 kwh
PG&E	1,819	11,029
Bureau of Reclamation (Shasta)	300	1,500
Other Public (SF, Merced, Turlock, EBMUD, etc.)	162	1,030
Other Private (California Oregon, Sierra Pacific, etc.)	60	378
Total Northern California	2,341	13,937
Southern California Edison,	1,079	6,578
San Diego Gas & Electric,	180	1,310
City of Los Angeles,	455	2,837

SOURCE: CPUC, Special Study 696, 1949, Table 24

Figure 3



MAP
SHOWING THE RELATIONSHIP OF
PACIFIC GAS and ELECTRIC COMPANY DIVISIONS
TO
THE STATE and COUNTIES OF CALIFORNIA

The Weather. Because of the dependence on hydroelectricity, the weather has always played an important part in determining the supply of electric energy. PG&E employs men to measure the depth and moisture content of the snow pack, and the Company keeps track of rain to aid in predicting later amounts of runoff. Figure 4 shows the statewide precipitation levels for the years 1898-1949. The total average rainfall for the area is about 25 inches, 15 of which normally fall during the months of November, December, January, and February. The table shows that it was precisely during that period that precipitation was severely deficient in the 1947-1948 season. Rainfall was well below normal, and the snow packs in the Sierra Nevada Mountains were light and low in moisture content--about one-third what they had been the previous year.

All the years since 1944 had been deficient in total precipitation, so that carryovers from previous yearly storage cycles were minimal. Furthermore, the experience with dry winters had been that they were usually followed by dry springs. See, for example, 1939, 1931 and 1924. Thus it was that in February, with storage levels dropping when they were supposed to be rising, and with the prospects for more rain disappearing, the PUC had to take emergency action.

Fortunately, as Figure 4 also shows, the Spring of 1948 happened to be an exceptionally wet one. The rains of March and April--unusual and unexpected--largely relieved the crisis. By June 30, in fact, all the PG&E reservoirs were filled to capacity once more.

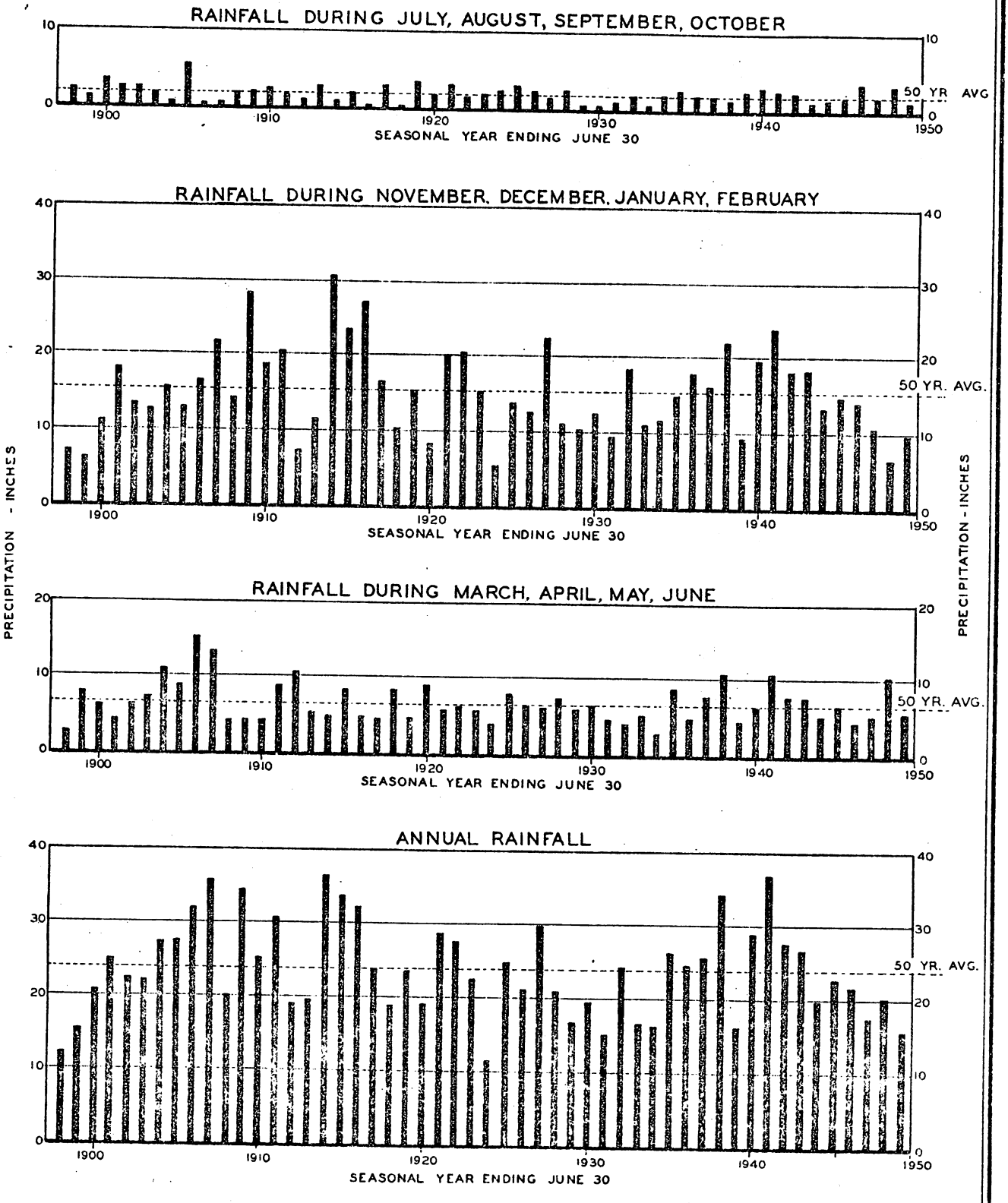
The data from individual hydroelectric storage sites also tell the story of the drought. At Bakersfield, for example, the rainfall had been 20% of normal as of early March. At the Salt Springs reservoir storage was at 5% of normal, with the water level 213 feet below the "full" level.[15]

CHART 18

STATE OF CALIFORNIA Figure 4

STATEWIDE AVERAGE PRECIPITATION
TOTALS FOR ANNUAL AND FOUR MONTHLY PERIODS

1898 - 1949



MWE 490630

S-696

In several places the drought of 1948 equalled or surpassed the record drought year for Northern Califonria, 1931.[16] Water for domestic purposes was short in some cities, such as Santa Barbara. These individual precipitation reports were watched with close attention each week.

The drought in 1931 did not entail as serious an electricity shortage. The difference is instructive; demand levels were depressed in 1931 below what had been expected in earlier building programs.

The drought in 1924 had necessitated rationing of electricity in Southern California but not in Northern California. During that drought PG&E made strenuous and successful efforts to enlarge the power supply.

The drought in 1948 caused no energy shortage in Southern California. That part of the state was less dependent than Northern California on hydroelectric power. Furthermore, its major source of hydroelectric power, the Hoover Dam project, using runoff from Colorado River watersheds in the Rocky Mountains, was not seriously affected by the drought; Hoover Dam was able to supply considerable power and energy to Southern California.

Actions by the Government and the Utilities

The Bureau of Reclamation had been predicting a shortage for California since late 1946,[17] but PG&E was repeatedly expressing calm optimism. President Black of PG&E told Congress in 1946 that there was no shortage, there had been no shortage, and there would be no shortage.[18] Both viewpoints have to be discounted somewhat, for the two parties were engaged in a much larger struggle against each other, as will be seen later.

Controlling the Demand. By late 1947, however, supply margins had already grown slim, and everyone directly involved knew that special steps would probably be necessary to avert a real blackout. A few farm and labor organizations had

warned the PUC of a shortage. Even PG&E noted in PG&E Progress, its bill enclosure newsletter, that the power situation would be tight, although it neither forecast nor called for any emergency measures.

What special steps were possible? In the basic policy of the PUC, there were only very general and flexible provisions about what was to be done during a power shortage. This policy was contained in Rule and Regulation No. 14, which is still applicable today. In its key paragraph (of three paragraphs in all), the rule provides:

> In case of shortage of supply, the Company will make such apportionments of its available supply of energy among its customers as shall be ordered or directed from time to time by the Railroad Commission [now the Public Utilities Commission] of the State of California, acting either directly or by a power administrator or other official appointed by it for that purpose. In the absence of such order or direction by the Railroad Commission, the Company will, in times of shortage, apportion its available supply of energy among all customers in the most reasonable manner possible.

One form of curtailment stood out as an early option. Three large chemical plants in Contra Costa County--Shell Chemical Co., Dow Chemical Co., and Hercules Powder Co.--had "interruptible" contracts with PG&E. PG&E had attracted the firms by offering special rates for less-than-firm service, the arrangement being predicated on the operating advantages of interruptibility for PG&E. In August, 1947, PG&E with the concurrence of the PUC, asked the three companies to undertake power and energy cutbacks of two-thirds their normal usage. On later experiencing the furor raised by the affected workers and customers, PG&E might have had second thoughts about the supposed flexibility of such arrangements.

More rain than usual fell in October (see Figure 4), and it was hoped the worst was past. But by February, 1948, the shortage was apparent to all. On February 3, President Black told the PUC there was indeed a power problem at hand. He called for voluntary conservation efforts by all consumers. A

spokesman for Governor Warren captured the reaction of many observers; he said the Governor was "happy that Black now agrees with him."[19] PG&E, which until late 1947 had been engaged in the direct sale of appliances, and which had run national magazine advertisements to attract industry to Northern California, now published suggestions for saving electricity, through both the San Francisco Chronicle and the company's bill enclosures.

Throughout February there were voluntary reductions undertaken by various private and public groups. Some of these are mentioned below.

On February 10, the PUC established an Energy Conservation Division, headed by Robert P. O'Brien, an engineer with the Commission since 1938, as Power Supervisor. The Division's job was to monitor the prospective power supply and to draft alternative conservation and curtailment programs.

By late February, the chances for rain had dwindled, and the need to act was obvious. O'Brien's staff had developed estimates showing that all available energy (including borrowing from other systems) would still fall at least 10% short of demand if demand went uncontrolled.[20] The staff's study of means of energy conservation showed that across-the-board rationing, if it were sucessful, would save far more than any technical means available to them in the immediate future.

On February 20 the Commission served notice on the major utilities that it was opening an investigation into the need for emergency action. On the 24th, hearings were held in San Francisco to review the power situation with the utilities and to review the emergency rationing proposals developed by the staff. The proposals were amended somewhat, adopted, announced to the press, and made effective as of February 26th.

There were eight regulations in all.[21]

1. The utilities were authorized to cut voltage up to 5% and/or to reduce the frequency "from approximately 60 cycles per second to such lower frequency as may be necessary to meet load requirements from time to time."

Both of these measures were adopted; see below for a discussion of their application.

2. The utilities were authorized to suspend or curtail the delivery of electricity to certain large users (over 500kw peak demand) "upon request."

PG&E chose two methods of using this authorization. One was to make unscheduled cutoffs, giving notice by telephone only a few hours or days in advance. This was done with a Bethlehem Steel plant, for example, and some of the major irrigation districts.[22] A later modification was to schedule rotations of cutoffs (now characterized as "rolling brownouts"), so that a plant might be scheduled to be shut down, say, every Friday.

3. Stringent curtailments were imposed on public, commercial, and outdoor lighting. Show windows in stores were ordered blacked out; ballparks, theaters, new car lots, and public monuments were put under tight restrictions.

These lights were thought by the Commission staff, at least,to be largely unnecessary, their visibility was very important politically, and they were easy to police. The staff estimated that the brownout of exterior lighting would save about 0.5% of the electrical energy use--not inconsequential in a time of very tight margins, but actually one of the smallest savings sought.

4. Priorities were established for new load service applications:

   a. businesses for which applications had already been submitted;

   b. services essential to public health and safety;

   c. residential lighting

   d. other loads, if small enough

New load applications were refused in advance for these applications:

a. uses of electricity to replace non-electrical sources of power;

b. space heating and air conditioning;

c. outdoor sports and commercial lighting

d. street lighting where existing lights were deemed adequate

e. electrical heating where fuels could be used.

Although service never conected is hard to see, this form of curtailment--literally stopping growth--proved to be both effective and painful.[23]

5. Residential customers were restricted each month to 90% of their use in the corresponding month of 1947.

O'Brien said in testimony at the February 24 hearing that he expected to use persuasion, rather than coercion, on residential customers. The Chronicle reported that attitude to the public on February 26th.[24] O'Brien and the PG&E gave many helpful hints to house holders (e.g., don't put hot food in the refrigerator), but little was done by way of enforcement.

6. Agricultural pumping was limited as follows:

a. Pumping plants that had been in use less than 2/3 of the time could not operate during peak periods and had to reduce their total seasonal use to 90% of what it was in 1947.

b. Pumping plants that had operated more than 2/3 of the time could operate in peak periods but had to reduce their use each month to 90% of their 1947 seasonal average monthly use.

c. New agricultural pumps were to be restricted to the usage levels of "like plants...within the area."

7. Industrial and commercial users were restricted to 90% of the kwh used in the corresponding month of 1947, provided further that the use during peak periods was also reduced to 90%. Uses "for the protection of public health and safety" were exempted from this rule.

8. It was provided that billing calculations involving maximum demands in earlier periods would be modified by using 10% reductions in those figures.

The regulations on peak-hour usage derived from the fact that the system could not handle peak usage rates without using the hydroelectric plants. Shifting usage to off-peak hours would allow the steam generating plants to carry a larger proportion of the energy load.

These regulations were made explicitly applicable to seven utilities:

Pacific Gas and Electric Company

Southern California Edison Company, San Joaquin Valley Service

Coast Counties Gas and Electric Company

The California-Oregon Power Company

Sierra Pacific Power Company

Vallejo Electric Light and Power Company

California-Pacific Utilities

Several smaller generation or transmission operations, variously owned and operated, were implicitly expected to cooperate. These operations included the cities of Palo Alto, Alameda, the Alameda Naval Air Station, and several others.

The drought area did in fact extend beyond PG&E's domain. Since SCE was not experiencing a shortage, this raised a political question as to whether the SCE customers in the Valley should be under curtailment or not. If they were, they could claim discrimination with respect to other SCE customers. (For this reason, SCE refused to voluntarily consent to the regulations, although it did in fact cooperate once the regulations were ordered.) If they were not, the rest of the Valley farmers could claim discrimination. The decision made was that effective curtailment required maintaining the same standards for all the farmers in the Valley,[25] so the San Joaquin Division of SCE was brought under curtailment.

In developing these curtailment regulations the Commission staff relied on their own decisions about which uses were more expendable than others (or more visible politically), the experiences with electricity rationing during the war, and their study of what had been done in the 1924 crisis. Mr. H.G. Butler, the PUC Power Administrator during the 1924 crisis, was retained by the PUC as a consultant during this crisis. The regulations were in keeping with the kinds of voluntary curtailments that had already been urged.

Except for Regulation No. 8, no attempt was made to change usage patterns by changing electric billing rates. The Commission staff judged that electricity use was too inelastic in response to rates for this measure to be effective.[26]

More hearings were held, on March 4 in Fresno, to hear the agricultural interests, and on March 11 in San Francisco, to hear the commercial and industrial interest. No hearings were scheduled for hearing residential complaints, and very few were filed with the Commission. At these hearings various interest groups were given an opportunity to present their views on the curtailment regulations and the power shortage in general.

The full diversity of the cases presented at the hearings is explored below, but three points were very commonly expressed. The first was dissatisfaction with the seeming arbitrariness and suddenness of the curtailments being ordered by PG&E under regulation No. 2. The second was dissatisfaction with the basing of most curtailments on a month-to-month comparison between 1947 and 1948 for each metered point; it was widely felt that a more flexible set of comparisons to previous use was needed. Third, all of the parties involved were clamoring for greater certainty as to what would happen--would the rationing last until Fall; would it go to 20%? With greater certainty, it was argued, the various parties could know what adjustments to make. Of course O'Brien

and his staff could not answer those questions, save to point out that the answers depended not only on the rain but on how many special exemptions prevailed.

There is very little data readily available on how well these initial restrictions curtailed the use of electricity. PG&E is reported to have announced that peak use rates were down 5% under the voluntary curtailment.[27] The total use in February, however, was up 19% as compared with February of 1947--primarily because agricultural loads were so heavy and curtailment was not imposed until late in the month.[28] In general, it appears that the initial curtailments were not a success.

In the next few weeks there still was no rain. On March 4, after listening to the farmers, the Commission took another step, ordering a temporary suspension to all new load additions.

On March 16, the Commission appointed Robert O'Brien to be Emergency Power Director and gave him full authority to do whatever he thought necessary to handle the power crisis. As the newspapers put it, O'Brien became the state's "Power Czar."

As Power Director, O'Brien issued a new set of regulations which were stricter in their general effect but took cognizance of some of the special problems raised in the hearings. The significant differences in the new regulations were:[29]

--reductions in frequency or voltage were no longer authorized.

--the utilities were no longer authorized to cut off major customers as before, although they still had authority for action in "emergencies" that "imperil[led] future operations."

--residential customers were cut back to 80% instead of 90%. Persuasion rather than compulsion ramained the rule, however.

--new loads for public health and safety were permitted, as were most

new residential loads (but not ranges or water heaters). This provision was stiffer than in the February 24 version, but it was a relaxation of the March 4 order. O'Brien's office worked out standard kilowatt allowances for frequently-requested new loads.

--agricultural pumping was restricted to 85% of seasonal use for plants not operating during any peak periods and to 80% for plants operating during peak periods. Month-to-month comparisons to 1947 were abandoned, and provisions were made for large farms or irrigation districts to achieve their curtailments by cutting some pumping plants more than others.

--industrial customers were asked to reduce use to 80% of the corresponding month in 1947. However, provision was made for seasonal curtailments rather than monthly ones, for curtailments by firm rather than by metered point, and for curtailment of periods of operation rather than of maximum demand. The 80% figure had been put in practice already, in some places, through the efforts of PG&E.[30]

As was explained to a meeting of utilities and government officials the following day,

> These emergency rules supercede the rules formerly adopted by the Commission numbered C-1 to C-7. These rules, it is hoped, will end the switch pulling and confusion resulting under the former emergency operations.[31]

Enforcement of specific curtailment regulations was to be carried out, as before, by the cutting off of all service on three days' notice, if necessary.

> In handling violations the utility will give the first and second notices and will send a copy of the second notice to the Commission representative, whereupon the Commission will act in company with the utility representative when it is necessary to disconnect service.[32]

O'Brien immediately took the initial steps toward implementing the orders. On March 17 he formed two committees of various tility and government representatives,

the Power Supply Committee and the Field Engineering and Compliance Committee. Each was to meet in his office every other week.

He also dispatched letters to all mayors, city councils, and county boards of supervisors reminding them of Governor Warren's request of February 20 that they form local citizens' committees for ruling on permissible electric loads. These committees were to pass review on applications in their areas for new loads or for exemptions and to make recommendations to the Commission. There were about 30 of these committees in March and about 200 by the time curtailment ended.[33]

Notification of the public was done through the press announcements and through bill enclosures. Large customers were notified directly by the utilities, or by the PUC's field representatives.

O'Brien and his staff held the view that rationing could only be a short-term measure--that is, that in a free economy demand is autonomous and supply has to be adjusted to it. Had the shortage grown more serious (no rain until fall, say), his office would have put more emphasis on increasing the supply through temporary generating facilities rather than on further constricting usage.[34] The 1924 water shortage, which did last through the summer, had been handled by PG&E in precisely that fashion. Idle generating plants, some as small as 500 hp, had been leased from the Navy and from industry and restored to action.

As the regulations had their effect, as the unusually heavy rains relieved the drought, and as new power plants moved toward completion (see below), the shortage eased somewhat. The curtailment regulations were lifted during April and early May.

On April 12, the restrictions on commerce, industry, and agriculture were suspended entirely, as were the restrictions on outdoor lighting. Some but not all of the restrictions on new business loads were lifted.

On May 1, the remaining restrictions on new loads were removed, effectively completing the removal of all restrictions on electricity usage. However, as the May 1 order stated, "Should the present and prospective resources or loads be adversely affected by factors or circumstances which may develop later in the years, a return to some or all of the positive control measures may at that time be necessary."[35]

O'Brien and his staff, which remained quite small, continued to monitor the situation until June, 1949, when the Office of the Emergency Power Director was discontinued by order of the Commission. The staff participated during this time in the preparation of a report reviewing California's power loads and resources and projecting these to 1970.[36] The predictions for 1970 were, of course, far too low.

A second and separate attack was made on the problem of electricity use. After several weeks of discussion, Daylight Saving Time was put into effect for the entire state as of March 14, by action of the Legislature, to be terminated in January 1949, or earlier at the Governor's discretion. Daylight Saving Time was regarded as having been effective in conserving energy during the war.

Since Daylight Saving Time provides more light in the evening hours, it serves to lower the evening residential use of electricity and to decrease the effect of the overlap of this usage with the daytime industrial and commercial usage. Some extra energy is consumed in homes in the darker morning hours, as many people were quick to point out in 1948, but the net effect is a savings of power. More importantly, Daylight Saving Time has the advantage that it is automatically effective; no real enforcement effort was needed.

Figure 5 tells the story; it shows the pattern of energy use for a typical day in December, 1948. O'Brien's staff estimated in advance that the savings for 1948 from Daylight Saving Time amounted to 136 million kwh.[37] The Chronicle noted that the savings was about the same as the total amount of electricity used in San Jose during a year.[38] This figure was only about 1% of the total usage in Northern California, but for the power companies that was still a significant increment. They were operating on margins of 5% to 6% in a world where 15% was considered minimal.

Daylight Saving Time was reviewed at a conference open to all interested groups, convened by the Governor on October 22, 1948. The utilities were strongly in favor of keeping Daylight Time.[39] Even though the rest of the country had gone off Daylight Time in September, Warren decided it should be kept. Delays in the construction of new power plants earlier in October, and the fact that little rain had fallen in October, were two of the principal contributing factors to that decision. In December, the decision was made to remove Daylight Time as of January 1, 1949.

Figure 5

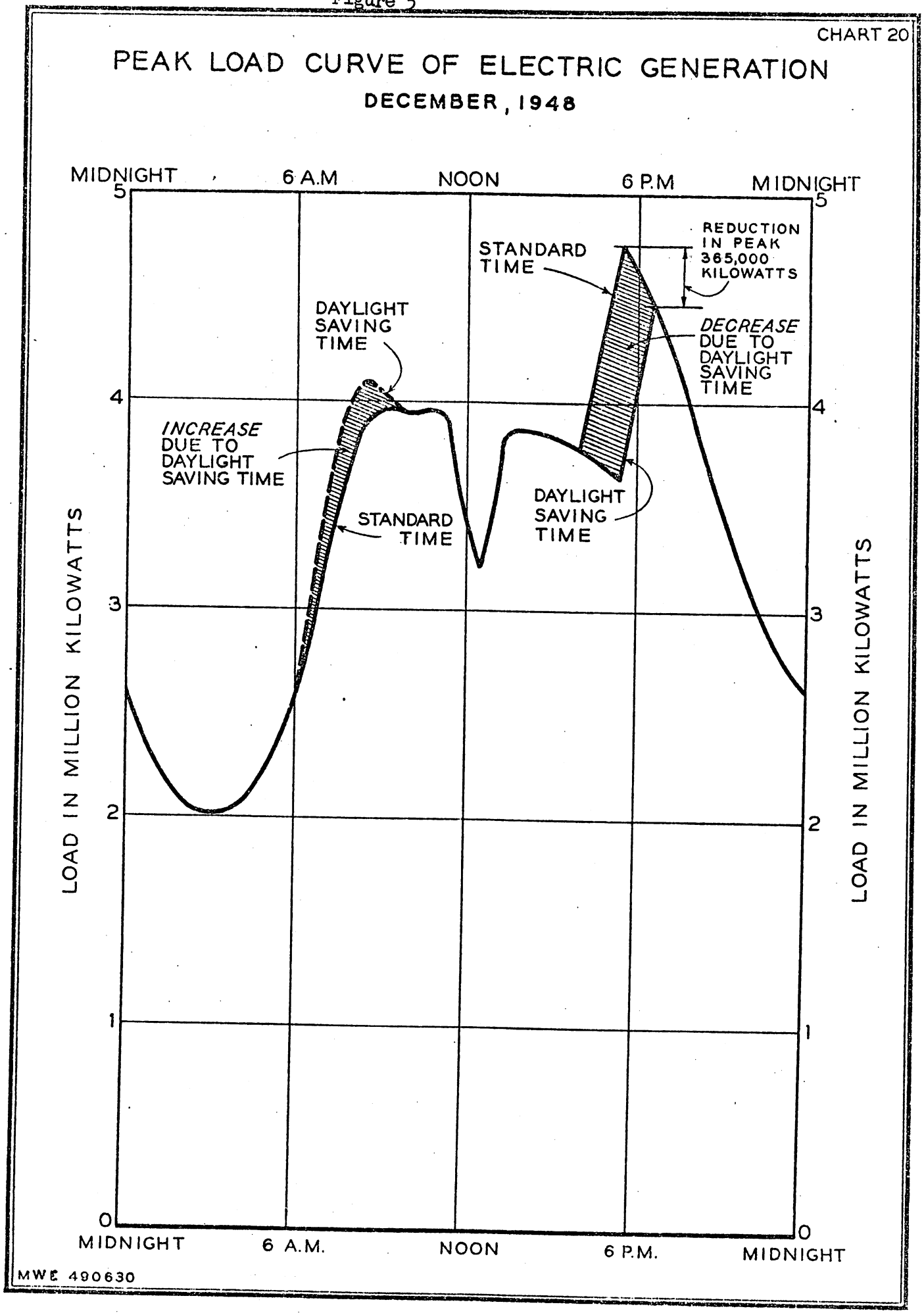


CHART 20
PEAK LOAD CURVE OF ELECTRIC GENERATION
DECEMBER, 1948
MIDNIGHT
6 A.M
NOON
6 P.M
MIDNIGHT
5
4
3
2
1
0
LOAD IN MILLION KILOWATTS
LOAD IN MILLION KILOWATTS
STANDARD TIME
REDUCTION IN PEAK 365,000 KILOWATTS
DAYLIGHT SAVING TIME
DECREASE DUE TO DAYLIGHT SAVING TIME
INCREASE DUE TO DAYLIGHT SAVING TIME
STANDARD TIME
DAYLIGHT SAVING TIME
MIDNIGHT
6 A.M.
NOON
6 P.M.
MIDNIGHT
MWE 490630

Various groups throughout the state opposed the imposition of Daylight Saving Time. Mothers did not like to send their children to school in the dark; tavern owners had to wait longer for their customers; interstate transportation interests did not like the confusion of schedules; and farmers argued that "neither their cattle nor their soil could be taught to obey a clock."[40] Governor Warren received a torrent of objecting mail, and it is not too much to speculate that the objections to Daylight Saving Time were one important factor in the defeat of the Dewey-Warren Presidential ticket in California.

The minutes of the Power Supply Committee indicate that by this time there was a clear reduction of electricity usage. Figure 6 shows the week-by-week comparisons with 1947 reported by PG&E; Figure 1 shows this same effect as a substantial drop in the PG&E curve for early 1948. Coast Counties Gas and Electric, Vallejo Electric Light and Power, and the cities of Palo Alto, Alameda, and Sacramento reported similar reductions. The information available for them, however, is much more fragmentary than for PG&E.[41] It is impossible to separate, in these figures, the effects of curtailment, Daylight Saving Time, and the rain, but together they worked.

FIGURE 6

ELECTRICITY SALES BY PG&E DURING THE PERIOD OF CURTAILMENT,

PERCENTAGE CHANGES FROM 1947

Period	Peak Demand	Total Energy
All February	15.6%	19.3%
Week ending:		
March 6	10.25	12.8
March 13	4.8	8.1
March 20	0.1	-6.5
March 27	-6.7	-9.4
April 3	-4.2	-10.2
April 10	-4.9	-10.0
April 17	-10.1	-12.9
April 24	-4.2	-9.0

SOURCE: California Public Utilities Commission
Minutes of Power Supply Committee Meetings
March 22, April 12, April 26, 1948
File No. S-685

There is little if any indication in the data that the rationing had any long-term impact on usage patterns. Reference to Figure 1 will show that demand resumed its growth after the crisis. Indeed, PG&E was able to state in its 1948 Annual Report that "Despite the temporary curtailment of power supply, the Company's sales of electricity exceeded those of 1947 by 6.7%."[42] Demand was merely pent up, not modified; the shortage followed the pattern of rationing in World War II and of other rationing programs. If energy usage is to be restricted, the imposition of short-term rationing on a population that retains its income and its expectations is apparently not the answer.

Stretching the Supply. Several approaches to stretching the supply were made: reducing the voltage, reducing the frequency, purchasing outside power, using existing steam plants to full capacity, and bringing new plants on line. In general, energy supply was more critical than power supply. The variable being watched most closely was the level of hydroelectric storage.

Cutting the voltage (by 5%) proved not very successful. The technical justification for the move is that lowering the voltage across the system lowers the power drain made by any given load on the system, thus lessening the strain on the generating system and, over time, lessening the energy drain. This technique has been used in many recent instances (e.g., New York City in the summer of 1969), but for technical reasons it did not work well in Northern California in 1948. The system in Northern California had voltage regulators located at many points throughout the distribution system; resetting the equipment to different limits for each cutback and restoration took considerable time and manpower. This measure would have resulted in only very small savings in any event.

The frequency of the electric current was cut to 59 1/2 cycles per second (cps), from the usual 60 cps, in early February. The change in frequency was made during the daylight hours. The technical justification behind this is similar, and the initial staff estimate was that this measure would save even more energy than Daylight Saving Time.[44] Again, however, in practice in this situation it did not work smoothly. The change in frequency irritated everybody slightly (clocks lost six minutes a day, for example, and radio tapes sounded a bit slow), and it nearly paralyzed some operations. One of these was in the steel industry, whose machinery at the lower frequency produced unsatisfactory tin plate for the production of tin cans. Another was in communications, where teletype machines in other regions could not maintain synchrony with those on the West Coast, resulting in garbled messages.[45]

Other technical steps were taken by PG&E, such as installing static capacitors in the network, but these had little direct effect on customer usage.

Emergency power was obtained from Southern California Edison and the Los Angeles Department of Water and Power, to the extent those systems could spare power. These arrangements were completed on March 8. This assistance amounted to about 200,000 kw during peak exchange times, or about a 10% addition to PG&E's capacity. The arrangements were facilitated by the operations of the Pacific Southwest Power Interchange Committee, which had been established at the beginning of World War II. Significant help could not be obtained from the utilities of Oregon, Washington, or Nevada, primarily because both the power available in those systems and the interconnections to them were relatively limited. (The Pacific Intertie now links all of these systems.) Western Nevada, in fact, was also under a partial brownout.

The transfer of power from Southern California was complicated by two technical considerations. One was that the transfer required the Northern California System to return to 60 cps in order that the two systems could mesh. This change was not strongly resisted, but it did reduce the net savings produced by the transfer. The second consideration was that some segments of the Edison system were still operating at 50 cps and therefore could not contribute. The firm had chosen 50 cps for their network decades earlier, betting that the then inchoate US systmes would follow other countries' example. The US systems did not, of course, and after the war Southern California Edison was hurriedly converting to 60 cps.

Smaller purchases were also made by PG&E--from the Navy's steam plant at Mare's Island, from the Palo Alto Municipal Utility District, and a few industrial plants.

The available steam plants were run at full capacity prior to and during the early months of 1948, without even normal maintenance interruptions. Although these plants represented only about one-third of the system's overall capacity, their operation used fuel, which was easily available, and thereby saved hydroelectric storage, which was being carefully husbanded in anticipation of a dry summer. The steam plants on PG&E's network were run more than twice as much during 1947 and during 1946.[47] During the heavy rains in March and April of 1948, however, the stream flow hydro plants were used to relieve steam plants for maintenance.

Another major effort, of course, was to bring new power plants--ones that drew on new sources of energy--into operation. Although many small generators were pressed into service by factories, municipalities, and Navy yards, most of the attention was focussed on two other activities. These were the construction programs of the Federal Government and of PG&E.

The Federal Government's Shasta Dam was the largest hydroelectric storage facility in Northern California. One of the Northernmost hydroelectric sites in the area, it had not been badly hit by the drought. It stood out, therefore, as an available source of electric energy. Unfortunately, the generating units were only partially completed. Worse still, the contractual arrangements for making the power available were highly controversial and uncertain.

Ultimately there were to be five units of 75,000 kw each at Shasta Dam. At the time of the power shortage, though, only two units at Shasta were in operation (at overload capacity) and two others were nearing completion. These second two units had done wartime service in Grand Coulee Dam and had been moved to Shasta in 1946.

The controversy and uncertainty arose because Shasta Dam was one battle in a larger war, the war between the advocates of public power projects and the private utilities. The war had been raging for years, embroiling a wide diversity of geographical areas and interest groups. It is not possible here to recount all the issues and bettles, but it is worth outlining the immediate dispute over Shasta in 1948.

Shasta Dam was part of the Central Valley Project (CVP), a huge water and power development managed by the Bureau of Reclamation. The CVP had begun as a state project in the 1920's, but during the Depression management was transferred to the Federal Government.

By the mid 1940's the government had undertaken Shasta Dam and other power plants, all over PG&E's opposition, but the government had not build any major transmission lines (that was another debate!). PG&E had major transmission lines a few miles away from Shasta Dam, lines which could service the whole general area.

In 1942, when power from Shasta first became available, the Bureau and PG&E had beeen unable to agree on a contract for transmission procedures until the Senate Appropriations Committee recommended an immediate compromise contract. That contract, signed in 1943, still prevailed, but it was due to expire in December of of 1948. In early 1948 no replacement contract had yet been agreed upon, and no provisions had yet been made for the new power from the third Shasta unit, due in April of 1948. A possible addition of about 8% to PG&E's system stood in the balance.

The dispute centered on whether and under what conditions PG&E should re-deliver power to the Bureau at various service points in the area.

The Bureau saw itself as bound by the various reclamation laws and by Presidential commitment to sell directly and preferentially to public bodies--municipalities, irrigation districts, and the like. For the new contract, the Bureau proposed to deliver Shasta power at PG&E's transmission lines and asked that PG&E agree to deliver power in exchange to various points from which the Bureau could resell the power at its own rates to its preferred public customers. The Bureau offered additional payment for the costs of transmission.

PG&E proposed instead that it would deliver and resell power to the government only at the major pumping stations of the Central Valley Project, which PG&E conceded should have first call on project power. For the rest, it would buy from the Bureau as from any other source of power and then resell to its own customers. That was basically what had happened under the previous contract, and PG&E denied that the government was under any legal obligation to deliver to public agencies. Anyway, PG&E added, only a few public bodies had shown any desire to deal with the Bureau, the Bureau's widespread solicitations notwithstanding.

More broadly, PG&E represented the Bureau's position as an attempt to become a commercial competitor to PG&E. The Bureau's plans for a steam power plant and for major transmission lines were seen as evidence of this intent, since such developments were not merely byproducts of the water development project. PG&E proclaimed its willingness to pay high rates for buying Shasta power and to charge low rates for transmitting some of the power to pumping stations, but the company refused (in laissez faire terms that now sound rather harsh) to help a competitor get established.

The rates really were the crux of the matter, in this battle as in the larger war. The Bureau's power rates to customers were as much as 30% lower than PG&E's rates, a difference PG&E attributed entirely to the fact that the Bureau paid no taxes to the rest of government. Thus what the Bureau portrayed as preferential availability of power PG&E saw as a preferential rate offered by a competitor with special tax advantages.

Publicly, at least, there was little willingness to compromise. Each side in effect declared its position to be fair and therefore non-negotiable. Each side charged the other with deliberately withholding power from the public at a time of critical shortage.

The participants' zeal sometimes led them into incautious statements. President Black, for example, asserted in a February 20 letter to the Bureau that his company could not really "transfer" Shasta power to anyone anyway, since once in the lines all the power inputs were mixed up and could no longer be identified.[48] Interior Secretary Krug, for his part, sent a telegram to Governor Warren offering all needed Shasta power directly to the state; the poor Governor was at a loss to see how that was of any help, since only PG&E had the transmission lines.[49]

The PUC held a hearing on the Shasta controversy on March 12 in San Francisco, and there were closed negotiation meetings after that. On March 29, a temporary

compromise agreement was finally reached. This agreement was to extend the existing contract on a day-to-day basis, at least for the duration of the emergency. Power was to be delivered to PG&E under the same general conditions of delivery but at higher rates, with some financial concessions to PG&E on ancillary arrangements. The new 75,000 kw unit at Shasta came on to the PG&E lines in the middle of April, under these terms, and the fourth unit, of equal size, came on in July. The day-to-day arrangements were continued in January, 1949, for the new contract.

The concurrent major effort was the construction program of PG&E. The last major PG&E plant prior to the shortage period, the Pit 5 plant on the Pit River, had been completed in 1944. It was built primarily to fulfill the urgent needs of war industries.

In 1945, 1946, and 1947 no major PG&E plants were completed, although some minor improvements and additions were made. The most remarkable of these was secured by buying the engine half of a ship that had broken up off the coast, towing it in and converting it to a 5,000 kw generating unit. That plant served for the lumber industry town of Eureka and the north coastal region until 1956.[50]

In May, 1948, the Kern steam plant, near Bakersfield, was completed by PG&E, too late to claim the role of savior but welcome nonetheless. The plant and its equipment had been ordered before the war, then denied by the War Production Board, and finally given a go-ahead in 1945. The rush to completion included double shifts of construction crews and the airlifting of some twenty tons of engines and materials to the site. Other plants were completed in July and December of 1948 with nearly as much urgency. Curtailment had ended, but the situation was still serious.

Figure 7 shows the complete schedule of major plant additions in Northern California between 1945 and 1949. In the two years 1948 and 1949 PG&E completed additions that represented a 20% increase in its generating capacity.

FIGURE 7

SCHEDULE OF MAJOR GENERATING PLANT CONSTRUCTION

IN NORTHERN CALIFORNIA, 1945-1949

Year	Company	Hydro (10^3kw)	Steam (10^3kw)
1945	PG&E Total	1,029	614
	Shasta Total	150	
1946	PG&E	3	
1947	PG&E	2	5
1948			
April	Shasta #3	75	
May	PG&E, Kern		75
July	PG&E, Electra		92
July	Shasta #4	75	
Oct.	PG&E, Colgate (retired)		-14
Dec.	PG&E, Hunters Pt. (1)		100
Dec.	PG&E, West Pt.	15	
1949			
Feb.	PG&E, Hunters Pt. (2)		100
June	PG&E, Colgate (replacement)	25	

These plants were part of a longer-term construction program on the part of PG&E. The company first announced a three-year, $160 million program in late 1946, but by early 1947 the program had been upgraded to five years and $300 million.[51] When completed it would expand PG&E's capacity by about 40%. Advertisements were placed in many national magazines, such as Business Week, to describe the program.

What were the reasons for the lag of several years in the construction of major plants? The answer depends on whom one asks. There were critics of PG&E--primarily the labor unions and the Federal Government--who insisted that the company was being lax and ignorant in its behavior immediately after the war. The company's public expressions of optimism, noted above, were interpreted as wishful thinking: "PG&E takes into account only existing needs while public-utility supporters stress new needs."[52]

A second answer lies in the indications that in the late 1930's and early 1940's PG&E had curtailed its plans for construction in anticipation of massive CVP inputs. James Black referred to this situation in his February 20 letter to the Bureau.[53] PG&E had made temporary purchase contracts with SCE, and PG&E eventually terminated the contracts as Shasta power became available. A third answer is that after the war all major construction efforts by utilities around the country were severely hampered by strikes, materials shortages, and the disruptions of priorities imposed by wartime. Many construction efforts by private utilities had been halted by the government during the war. One business magazine put it this way:[54]

> During the war, turbines, boilers, pumps, switchgear, and the like could be made for civilian use only when absolutely necessary. A synthetic rubber industry, a seven-ocean Navy, and a swarm of merchant ships were a-building. They took the same men, materials, and shop space that were needed for central-station power. To make up for lost time, utilities were given a quick go-ahead on their backed-up orders around V-E Day. But it takes 15 to 24

> months to build a turbine generator, much longer to get it operating. On top of that, major electrical manufacturers were hit by a strike in 1946...The steel strike delayed the delivery of necessary materials; the coal strike delayed the delivery of steel; copper became a scarce material.

PG&E, like many another company engaged in major construction at the time, hired agents whose only job it was to search the country and the world for supplies of the needed materials.

It should be noted that these factors affected the Bureau of Reclamation too; at least they so stated before Congress in 1946.[55]

These sorts of delays extended at least into late 1948. The plants completee in December, for example, had been held up by a boilermakers' strike in October.

It is not a task of this paper to determine whether either the Bureau or PG&E was in some sense at fault. The historical record of the two parties is far too tangled for that determination to be made here. For example, PG&E's casual optimism is hard to understand in the light of known construction delays and in the light of today's conventional wisdom that shortages are in the political interest of the utilities, but the optimism is easy to understand as a way of staving off an aggressive public power competitor. What does matter here is simply that the controversy added another major complication to an already difficult situation.

In all of these proceedings except the Shasta controversy, there seems to have been little difficulty in coordinating the actions of the utilities and of government agencies. O'Brien, to begin with, held virtually complete power for the state and was under only minimal obligations for interagency coordination. Secondly, the bulk of the electric generation and transmission in northern California was done by one organization, PG&E, familiar to O'Brien and his staff for years.

Social Impact and Public Response

It is worth reviewing the responses of the public and of various private interests to the shortage and to the rationing measures accompanying it. The situation was typical, rather than unusual, as another case of special interests reacting to a social problem. But these responses illustrate how complex the electrical usage picture is and how many unforeseen difficulties can arise. Most of the responses indicated here were made prior to the March 16 regulations, and some were reflected in them. In the actual course of events the period of curtailment was over before many special requests could be brought through to any sort of adjudication.

The residential public. Little effort was made to enforce the regulations for residences, although meter readers did report usage. The emphasis was placed rather on appeals for voluntary cooperation. Not much protest was heard from these people. There were a few "Letters to the Editor," asserting for example that the rooftop signs were a nuisance to highrise dwellers anyway, or that the cross on Mt. Davidson should be given priority for lighting over a baseball game. That latter letter, oddly enough was written by a person who had attended the baseball game.[56] (Letters not very different from these have appeared in the Seattle Post-Intelligencer and Portland Oregonian. One of them, more intelligent, protests the low rates charged to large industrial users.)

Regulation by measured amount is hard to expect of residential households, and therefore awkward to apply to them, since for the average person electric energy is hard to perceive. It is clearly not tangible, countable, or storable in the ways other commodities are. The meter that measures the energy is usually out of the homeowner's sight. The real alternatives therefore are restrictions on time of availability--rolling brownouts--or attempts at persuasion and education, which the 1948 rationing amounted to.

Agriculture. Because of the unusually large seasonal demands for electricity for irrigation pumps, argicultural usage was one of the main concerns of the regulations. It also proved to be one of the most complex enforcement problems. The complaints and special pleas from agricultural interests, as expressed at the Fresno hearing, were intricate but widely shared.

Farmers at the Fresno hearing complained that:[57]

--The cessation of irrigation during certain periods of the day only made matters worse,for during those periods the gound along the main channels dried out, and water was then wasted in re-absorption in the channels the next time.

--Since in the large irrigation districts the farms were often several hours in water-flow time away from the central pumps, it was not possible to control peak period usage by shutting off the main pumps. Hence water went wasted, flowing past the farms that couldn't use it and into the sea.

--Since 1947 had not required very much pumping, it was unfair to base 1948 usage on 1947.

--Since the orchards constituted long-term investments that had to be sustained, curtailment was harder on them than on the seasonal plantings. (The later provision for curtailment by operator rather than by metered point allowed farmers to concentrate their watering on orchards.)

--The poultry brooding and hatching operations in the state were almost entirely electrical and could withstand no curtailment whatsoever. Dairies also were highly mechanized, and the supply of milk for the public health would be endangered by curtailments.

--Because electric pumping had grown more common over the years, and because of the drought, water tables had dropped. Hence more electrical energy was required than before for the same amount of irrigation from wells.

--The short notice actions of PG&E caused a wastage of water and manpower in turning the water on and off.

There is in the files of the PUC a handwritten letter "By An Average Orchard Farmer," sent in early March, that epitomizes the puzzlement and distress of the farmers. In part it reads as follows:[58]

> For sixteen years I have been paying a demand charge of $40.38 for my 7 1/2 hp pump and $52.50 for my 10 hp pump. This charge was just for the privilege of being connected to the company lines and I paid it even when my ditch water was sufficient and I never used the pumps; they were there for just in case of an emergency. Now the emergency for which I have been paying for all these years has arrived. Instead of getting the protection, the company tells me to cut my pumping by 10%...
>
> If the power shortage is so acute as to make it necessary to ruin many of the farmers in this valley, then why may I ask are lodges, clubs, athletic events, yes, and even the power club of the PG&E, which held their smoker last week from 5PM till after midnight in a very large and well lit hall, allowed to take place?

The fact remains that the farmers did have irrigation; they were not entirely dependent on the weather. The economic impact of the drought was not uniformly severe; it varied rather widely in different places in the Valley.[59]

Not all the farmers were against PG&E. In late March the California Farm Bureau Federation sent a telegram to President Truman, urging him to make the Bureau stop quibbling over the Shasta contract. A spokesman for the Federation also contended that the Bureau was sacrificing the financial interests of its water users to pursue its own ambitions in electric power development.[60]

Industry. As might be expected, industry presented a greater variety of special cases than did agriculture.[61]

Cutter Laboratories testified that because of the organisms under refrigeration or incubation in their facilities (some of the projects were under Federal contract), the company could not afford any curtailment whatsoever. A similar plea was made by the California Brewers Institute for its vast quantities of beer in fermentation.

The California Bakers' Association noted that most baking was done during off-peak hours and that bread was essential to community health.

General Electric cut back by closing its electric bulb plant on Mondays and two other plants on Fridays.[62] One presumes that what GE lost on the light bulb market it made up by selling generators. The Enterprise Engineering Co. of San Francisco reported sales of generators of up to 5,00 KW to irrigation districts.[63]

The Canners' League of California testified that monthly comparisons with 1947 were unfair because various crops would come in earlier or later in 1948 than they had in 1947. The League also argued that the fresh food market could not possibly absorb the huge amounts of produce that had been grown just for canning; no delay in canning was possible.

Chanslor-Canfield Midway Oil Co. testified that all of its oil pumping was done electrically, and moreover that all of its oil went to PG&E for fuel.

Union Ice Co. asked for permission to distribute an overall curtailment among its many plants according to its own priorities. The company emphasized that the ice was used almost entirely for the preservation of food and hence was essential to the public health and safety. Union was willing to accept a continous percentage curtailment--they could shut down a few machines--but not willing to accept temporary complete cutoffs, which would destroy the quality of all the ice being made.

The opposite problem was presented by sawmills and some steel mills--they could accept a temporary shutdown, but to be in operation at all they had to be in complete operation.

The appliance business was hard hit, at least according to Business Week:[64]

> In Northern California, the mass market for 220-v appliances collapsed overnight. Manufacturers report cancellations of orders for thousands of units planned for installation in apartment houses

and large-scale housing developments. Hastily they have re-oriented their distributors to a canvass of the replacement market.

The California Association of Concrete Pipe Manufactures asked to be exempted on the argument that the pipe they produced was needed to save water and power in irrigation projects.

The drought and other circumstances left the slaughterhouses in a sudden rush of business. The livestock farmers could not feed their cattle, could not get emergency rates from the railroads to ship the cattle to lands out of state, and hence decided to slaughter their livestock for market early. The Western State Meat Packers Association reported that business in California slaughterhouses increased 67% in one week; they said they could ill afford a curtailment of operations.

These objections and special pleas did not add up to a general opposition to PG&E; they added up to something more like self-interest. The California Manufacturer's Association, for example, petitioned for revision of the arbitrary curtailment procedures used by the utility and also urged that the Bureau of Reclamation be compelled to sell its power to PG&E on the terms PG&E proposed.

Commerce. Some groups in the world of commerce undertook voluntary cuts in the early phases of the shortage, apparently to help ward off the possibility of formal restrictions. In the middle of February the California Theater Association announced voluntary cuts in marquee and sign lighting by its members.[65] In early March the Retail Dry Goods Association circulated a notice among its members urging various conservation measures on them.

At the March 11 hearing, commerce seemed particularly upset about the restriction on signs and show window lighting. Most stores and associations offered in their testimony to cut back their interior lighting instead. A spokesman for several jewelry stores said the regulations caused them a 70% loss of business. A witness for the Market Street Association compared the functions of the show

window lights with the functions of the farmer's pump--both bring sustenance and both depend on electricity. The large department stores of the Retail Dry Goods Association expressed a more noble and civic-minded attitude, but one wonders as did the smaller stores if established reputations and large advertising budgets made that sacrifice easier.

The neon sign industry protested that it was being shut down completely, not just curtailed. Local outdoor advertising companies, similarly blacked out, offered to cut their wattage by 70% (using smaller bulbs for shorter hours) and to carry on every billboard a strip advertisement urging energy conservation. This offer was not taken up by the Commission. Larger outdoor advertisers, like Foster & Kleiser, did not show up at the hearing, for their markets in other regions could sustain them. Foster & Kleiser is among those who made offers of cooperation in Seattle.

Summarizing the effect on both industry and commerce in its report on the hearings, the Commission conceded that

> Evidence was received showing that a large number of persons had been laid off temporarily from their employment as a result of reduction of business activity flowing from the inadequate electrical power and energy supply....Evidence was received showing that a number of businesses were suffering sharp curtailment of financial return because of the reduced supply of electrical power....66

Figure 8 lists several, but by no means all, of the firms that testified or submitted statements at the March 11 hearing. It is, clearly, a rather diversified list of interest groups.

FIGURE 8

SAMPLE LIST OF FIRMS AND ASSOCIATIONS APPEARING AT HEARING ON MARCH 11, 1948, in SAN FRANCISCO

American Can Co.

American Home Foods, Inc.

American Veterans Committee

Auto-Lite Battery Corporation

Beech-Nut Packing Company

Calaveras Cement Company

California Council of the CIO

California Outdoor Advertising Company

California State Brewers Institute

Caterpillar Tractor Co.

Chemical Pigment Company

Dairy Institute of California

Radio Diablo, Inc.

Employing Printers Association

Fairmont Laundromat

Far West Baseball League

Florsheim Shoe Company

General Metals Corporation

Glass Container Manufacturers Association

Gold Mining Association

Grayson Shops

Grosjean Rice Milling Company

Hastings Clothing Company

International Association of Machinists

International Brotherhood of Electrical Workers

Lerner Shops

Liquid Ice Company

Lockheed Aircraft Company

Marchand Calculators

Marine Magnesium Products Corp.

Moore Dry Dock Company

National Lead Company

National Motor Bearing Company

National Neon

Neon Sales and Service Company

Northern California Bakers' Association

Pacific Fruit Express Company

Pacific Vegetable Oil Corporation

R&S Food Mart

Retail Merchants, Inc.

Richmond Chamber of Commerce

San Jose Baseball Club, Inc.

Santa Clara Farm Bureau Federation

Sherwin-Williams Paint

Shipfitters and Helpers Local No.9

Commandant, Twelfth Naval District

United Iron Works

Vendorlator Manufacturing Company

Vulcan Steel Foundry

West Coast Advertising Company

Western Die Casting Company

Western States Meat Packers Association, Inc.

Western Union Telegraph Company

Western Waxed Paper Company

Zukor's of San Francisco

SOURCE: California Public Utilities Commission
Hearing Exhibits & Transcripts
Case No. 4939

Labor. Unemployment in some form hit thousands of workers during the shortage. The numerical estimates one can find now vary--2,000 in one steel plant; 1,800 brewery workers; 55,000 migrant farm workers; 15,000 workers in the metal trades. For these people the emergency meant being turned away from work on Monday morning because of a weekend call from PG&E, or being rescheduled for a four day week, or being laid off completely. In any case, it meant for them a smaller check to take home.

Labor organizations were overwhelmingly against PG&E throughout this episode, as they were generally at other times.

The California Council of the CIO started criticizing the company late in 1947, after the layoffs at the chemical companies, and it filed a formal criticism at that time with PUC. A Council spokesman asserted at the March 12 hearings that

> PG&E hid the imminence of the power shortage until it was upon us. Now, it slashes about, cutting industrial and commercial uses unintelligently and indiscriminately.

In March 1948 Warehouse Local No. 6 of the CIO-ILWU asserted that "The crisis...will continue for at least another three years unless PG&E's power dictatorship is terminated forthwith."[67] The California State Federation of Labor had this to say:

> The next time PG&E cries duplication to Congress in order to stop the development of public power in our State, we predict a horse laugh will go up in California that will be heard in Washington without the aid of ear trumpets. [68]

Municipalities. There was generally good cooperation from the City of San Francisco and other municipalities.

On February 11 Mayor Robinson of San Francisco sent a memorandum to all city departments, urging them to curtail decorative lighting and to change shifts away from the 4-8 P.M. peak usage period. During the brownout, the police were alerted to the greater likelihood of street crimes. The electric trolleys were rescheduled at the PUC's request to stop only at every other stop.

The cities of Palo Alto and Alameda, which purchased power from PG&E for resale to their own customers, reported reductions of up to 15% during the curtailment period.[69] The Berkeley City Council voted in early February to cut street lighting in Berkeley by half.

Municipal recreation organizations, however, generally objected to the restrictions on night lighting. They asked for curtailments on a seasonal, rather than monthly, basis. (The extra hour of daylight must have helped them, though.)

The most interesting municipal complaint came not from Northern California but from Los Angeles. The City of Los Angeles complained about the restrictions on Dow Chemical. Dow supplied the chlorine Los Angeles needed in a major sewage plant to keep several miles of polluted beachfront open, in compliance with an order of the state health authorities. The Department of Water and Power in Los Angeles arranged to deliver to PG&E as much power as was necessary to produce the needed chlorine.[70]

Conclusion

The energy shortage of 1948 arose out of the combination of several factors: unexpected increases in damand, delays in supply, bad weather, and political complications. No one of the constraints adequately explains, or could have caused, the crisis. Demand was curtailed through emergency rationing and the

imposition of daylight saving time. Supply was expanded by purchase, by hastened construction, and by changed circuit parameters. The social impact of these moves were quite complex and diverse.

What can the experience of Central California then tell us now? Drawing lessons from one historical example is fraught with limitations but a few general points may safely be emphasized.

The California experience revealed, most importantly, a great complexity of usages of electricity. Just as PG&E faced technological constraints in the production of electricity, so too every user had his own constraints, on his own ways of using electricity. The neon sign industry lost heavily, but the manufacturers of small generators gained. Saw mills can shut down completely for a while but they can't shut down partially; ice companies can shut down partially but they can't shut down completely,ever. Well-known firms can go without billboard advertising if they have to, but companies that sell billboard advertising have a harder time doing that. Electricity is not always used just for current operations; sometimes it is needed literally to protect capital investments, as was the case for the orchard farmers in 1948. Local companies may be affected more than branch operations. We have tied all these combinations together with copper wire; it would be naive not to expect complications.

The shortage of 1948 foretold an important aspect of the complexity, namely, that the causes of the shortage and the effects of the shortage will themselves be interactive. The drought that contributed to the electricity shortage also contributed to increased demand for electricity in irrigation pumping plants and in slaughterhouses. The curtailment of electric power reduced the amount of pumping for oil for delivery to the generators. As fuel oil is rationed now, it should not be surprising if the sales of electric heaters increase, drawing ultimately on the same oil reserves. There has been the temptation to take the difference between supply and demand as given

in one direction
and go/from there to derive a policy, or a predicted impact, but that is too simple.

A further complication experienced during the 1948 shortage will surely plague us again. From what base of "normal" or "previous" use are the reductions to be made? The history of the demand for electric energy is now, as it was then, a sharply rising curve with many short-term fluctuations. It is hard to imagine coming up with a base for comparisons that wouldn't discriminate against somebody. Seasonal industries regarded month-by-month comparisons as a strait jacket. Firms that had added plant since 1947 were plainly hurt by reductions based on 1947 usage. Since the shortage was expected to last more than one month, obviously "the previous month" couldn't be used as a base. Expected usages, the base from which reductions were really sought, were too difficult to calculate with any ease or conviction. There seems to be no simple answer.

A major job for the present, then, must be to think about what complications will emerge now. We use electricity in many ways that were not as important, socially or electrically, in 1948. These new / possibilities are easy to generate:

--businesses unable to operate without their computers,

--industries wanting to turn off their pollution control equipment to save electricity,

--a city without television,

--particle accelerators turned off and the physicists left without jobs, and even

--housewives frustrated over manual can openers.

It is not possible here to list the new uses, let alone weight their social importance. But this job must be done, more thoroughly than it has been done to date.

Of course, many of the usages and complications would still be the same as they were in 1948. The downtown merchants in Portland have, judging from a few newspaper reports, acted about as their counterparts in San Francisco did a generation ago. But quantitatively more would be at stake now: more traffic is governed by the same downtown signals, more aluminum is being produced, and more irrigation water is being pumped. In the case of PG&E's service area, the overall quanitities of electricity are about five times what they were in 1948.

Unfortunately, having more electricity to use has not made us feel we have more electricity to spare. A 10% cut in the use of electric home appliances would seem as difficult now as it did in 1948; a 20% curtailment of street lighting would raise as big a fuss now as it did in 1948--even though in both cases we would be left with more than we had in 1948. Convenience has become necessity; our expectations and our commitments have gone up. The problem is that simple, and that difficult.

How to change expectations, how to change behavior, is a problem that would be encountered in both a short-term rationing of electricity and in a general movement toward a steady-state level of future use. The problem is encountered, in fact, in many other policy problems concerning energy and the environment--such as the recycling of resources or the easing of traffic congestion. The problem needs to be addressed directly.

Considering 1948, for example, it would be wrong to conclude that voluntary curtailment does not or cannot work. It would be closer to the mark to conclude only that those public and utility officials did not, with their speeches, generate enough public awareness and cooperation. What would have happened if PG&E had been able to reach millions of people by television, as its conservation ads do now? What would have happened if the Commission had taken up that offer of billboard space? Would a telephone campaign have worked better?

The point is that the problems of communication, education, and persuasion need to be given strong emphasis somewhere, alongside the technical and economic reports. The enormous machinery in this country that serves to stimulate consumption should not merely be turned off, but turned around. For example, television advertisements and brochures need to be designed for maxiumum conservation impact. Perhaps new ways could be found of helping laymen to understand the physical units of electricity.

The search for answers will not be simple, of course, but it must be made. The Hawthorne researchers discovered accidentally how to turn down the lights and get people to like it; surely we could do so deliberately.

These lessons, if such they are, have necessarily been put in rather broad terms. With only one example at hand one can at best infer some new directions, not draw the final detailed conclusions. That would require comparison of many historical situations, which we may still hope for. Pointing in new directions, extending and stretching the present discussions, is all that was here intended. Analyses of the energy situation must be broad scale. Simple extrapolations or studies of one particular technology, while a necessary beginning, will not of themselves suffice.

A review of the economic and technical facts of 1948 shows of course that they are in striking contrast to the world of today: there now are more people, more commitments to electricity, and bigger technologies. A review of how the situation was handled socially, however -- how it was thought through -- makes it seem eerily familiar. The magazine articles, the political strategems, and the staff minutes all seem indistinguishable in structure and depth from their modern counterparts. Less kindly put, the modern version appear no more

advanced. "Progress," muses Robert O'Brien nowadays, "is the art of making the same mistake only once every generation."

# # #

Footnotes

1. California Public Utilities Commission, Report on A Power Survey of the State of California, Special Study No. 696, (mimeographed: San Francisco, 1949.) (Hereinafter CPUC, 1949 Report), Table 6

2. Gramm, Warren S., Electric Power & Development of Northern California, report prepared for the California Assembly Interim Committee on Conservation, Planning and Public Works. Published by the California Assembly, May 1957, p. 34

3. CPUC, 1949 Report, Table 6

4. Gramm, p. 36

5. CPUC, 1949 Report, Table 6

6. Ibid.

7. Gramm, p. 36

8. Gramm, p. 39

9. California Public Utilities Commission Press Release, March 17, 1948

10. "California Shortage", Newsweek, March 29, 1948, p. 60

11. "5,053,300,00 Kwhr," Electrical World, September 20, 1947, p. 4. In the years 1947 and 1948 shortages were also experienced in Florida, New Hampshire, Texas, New York, and elsewhere. See also "The Power Famine Arrives," New Republic, September 8, 1947; and "U.S. Power Shortage Looms," Business Week, August 9, 1947.

12. Pacific Gas & Electric Company, Annual Report, 1946, p. 5

13. Gramm, p. 57

14. (No footnote 14 exists)

15. PG&E Progress, March 1948, p. 2, and April 1948, p. 7

16. O'Brien, Robert P., testimony February 24, 1948. Transcript of hearing held by the California Public Utilities Commission, "Investigation Upon the Commission's Own Motion Into the Availability of and Demands for Electricity in Northern and Central California and the Need for Emergency Rules Respecting Use and Service of Such Electricity." Case No. 4939 (Hereinafter CPUC, Case No. 4939)

17. CPUC, Case No. 4939, transcript of hearings on March 12, 1948, p. 19.

18. U.S. Congress, House, Committee on Appropriations, Hearings, "Interior Department Appropriations Bill for 1947," USGPO, 1946, p. 630

19. "Power & Weather," San Francisco Chronicle, February 4, 1948, p. 1

20. O'Brien, testimony on February 24, 1948, Case No. 4939

21. These regulations together comprised Exhibit A at the February 24, 1948, hearings, CPUC, Case No. 4939. They were made effective by the "Interim Opinion and Order" of the CPUC, Case No. 4939, February 24, 1948.

22. Ziff, Joseph, in a statement for the Bay Cities Metal Trades Council at the March 11, 1948, hearings, CPUC, Case No. 4939. Also Barnes, Harry, in a statement for the Madera Irrigation District. Also several other statements at that hearing.

23. O'Brien, personal communication.

24. "Drastic Dimout in Effect," Chronicle, February 26, 1948, p. 1

25. O'Brien, personal communication

26. Ibid.

27. "Drought in California Brings Compulsory Rationing Threat," Electrical World, February 28, 1948, p. 54.

28. CPUC, Case No. 4939, "Second Interim Opinion," March 16, 1948. Also listed as Decision No. 41309

29. CPUC, Case No. 4939, Emergency Regulation EPD-1, March 16, 1948

30. "Daylight Saving," Chronicle, March 9, 1948, p. 1

31. CPUC, Minutes of Emergency Power Director's Meeting for Organizing Power Supply Group and Field Engineering and Compliance Group, March 17, 1948. File No. S-685

32. Ibid.

33. See "Power Supply," Chronicle, March 27, 1948, p. 1, and "Last of State Power Curbs Will End Tonight," Chronicle, April 30, 1948, p. 17

34. O'Brien, personal communication

35. CPUC, Case No. 4939, "Emergency Regulation EPD-4," May 1, 1948

36. CPUC, 1949 Report

37. Ibid.

38. "The Winter Emergency," Chronicle, February 23, 1948, p. 1

39. CPUC, Case No. 4939, correspondence among utilities, Governor Warren, and Southwest Power Interchange Committee

40. "The Winter Emergency," Chronicle, February 23, 1948, p. 1

41. CPUC, Power Conservation Program, Bulletin Nos. 1, 3, 5. Minutes of the Meetings of the Power Supply Committee, March 22, April 12, April 26, 1948. Mimeographed. File No. S-685

42. Pacific Gas & Electric Company, Annual Report for 1948, p. 5

43. Footnote 43 does not exist

44. O'Brien, testimony on February 24, 1948, Case No. 4939

45. O'Brien, personal communication

46. "California and Nevada Keep Daylight Time," Electrical World, September 18, 1948, p. 5

47. Pacific Gas & Electric Company, Annual Report for 1947. This development did not, apparently, dampen the company's 1947 optimism.

48. CPUC, Case No. 4939, copy of letter

49. CPUC, Case No. 4939, correspondence between Governor Warren, Commissioner Mittelstaedt, and Secretary Krug

50. Coleman, Charles M., PG&E of California, (New York: McGraw-Hill, 1952). Also McMasters, personal communication

51. PG&E Progress, November 1946; February and September 1947

52. "The California CIO Fears Power Famine," New Republic, September 8, 1947, p. 13

53. CPUC, Case No. 4939, correspondence between James Black and Richard Boke.

54. "U.S. Power Shortage Looms," Business Week, August 9, 1947, p. 17

55. U.S. Congress, House, op. cit., p. 317

56. Chronicle, March 26, p. 18; March 30, p. 12; April 16, p. 20

57. Summarized from several statements presented at the March 4 and 11, 1948, hearings. Case No. 4939. Included are statements by the California Poultry Council, the Madera Irrigation District, the James and Tranquility Irrigation Districts, the California Farm Reserve & Legislative Committee, and the East Contra Costa County Irrigation District

58. CPUC, Case No. 4939, letter from Mr. Bernard Rocca

59. Stanton Delaplane wrote a series of several articles for the Chronicle in March on the situation in the Central Valley.

60. Abel, Edson, "The Central Valley Project and the Farmers," California Law Review, October, 1950, p. 653ff.

61. Summarized from several statements presented at the March 11, 1948, hearing. CPUC, Case No. 4939.

62. "Skip-Stop Trolley Service Will Start in a Few Days," Chronicle, March 9, 1948, p. 19

63. "California Rapidly Adjusts to Power Rationing," Electrical World, March 27, 1948, p. 82

64. "Drought Brings Power Cut," Business Week, March 20, 1948, p. 21. According to one report, appliance sales in Oregon are not down appreciably. See "Yule Season May be A Little Dark This Year," Portland Oregonian, October 21, 1973, p. 25

65. "Warren Urges Voluntary Reductions," Chronicle, February 21, 1948, p. 3

66. CPUC, Case No. 4939, "Second Interim Opinion."

67. "Daylight Time Bill Signed by Warren," Chronicle, March 11, 1948, p. 1

68. Statement at March 12, 1948, hearing, p. 297. CPUC, Case No. 4939.

69. CPUC, Power Conservation Program, Bulletin No. 3. Minutes of the Power Supply Committee, April 12, 1948. Mimeographed, File No. S-685

70. O'Brien, personal communication. Also "Power Sales to Chemical Companies Are Reduced, " Electrical World, August 30, 1947, p. 36

References

Articles from: Business Week, The San Francisco Chronicle, Electrical World, Fortune, PG&E Progress, New Republic, Newsweek

Black, James B., "The Central Valley Project," based on testimony given to Congress 1944-1945, published by Pacific Gas & Electric Company

California Law Review, October, 1950, special issue on the Central Valley Project

California Public Utilities Commission; "Investigation upon the Commission's Own Motion to Inquire into the Availability of and Demands for Electricity in Northern and Central California and the Need for Emergency Rules Respecting Use and Service of Such Electricity," Case No. 4939. Four files and transcripts of hearings available through the California Public Utilities Commission.

California Public Utilities Commission, Office of the Emergency Power Director, Power Conservation Program, Bulletin Nos. 1-5 (Mimeographed: San Francisco, 1948) File No. S-685

California Public Utilities Commission, Report on a Power Survey of the State of California, Special Study No. 696 (Mimeographed, San Francisco, 1949)

Coleman, Charles M., PG&E of California, (New York: McGraw-Hill, 1952)

Collins, James H., "California Bursts Its Utility Buttons," Public Utilities Fortnightly, March 17, 1949, p. 333

Conant, Jane Eshleman, "The Shasta Power Controversy," Public Utilities Fortnightly, July 1, 1948, p. 11

Geering, G.P., "How the Pacific Gas & Electric Company Handled the Water Shortage of 1924," unpublished term paper in Electrical Engineering, U.C. Berkeley, April 1925

Gramm, Warren S., Electric Power & Development of Northern California, prepared for the California State Assembly's Interim Committee on Conservation, Planning & Public Works; published by the California State Assembly, May 1957

McMasters, Harry L., Editorial Supervisor, PG&E. Personal communication, March 14, 1973

O'Brien, Robert P., Emergency Power Director during the crisis; retired Vice President, Southern California Edison Company; Consulting Engineer, Utility Regulation. Personal communications.

O'Brien, Robert P., "What Is The Picture for Electric Power Supply?" California-Magazine of the Pacific, March, 1949, p. 62

Pacific Gas & Electric Company, Annual Report, years 1939-1949 (San Francisco)

U.S. Congress, House, Committee on Appropriations, Hearings, "Interior Department Appropriations Bill for 1947," (Washington, D.C.: USGPO, 1946)