

The California Energy Crisis and Cogeneration Investment Opportunities for Office Landlords

By

Gregory L. Hammond

B.A. Organizational Behavior
Brown University, 1980

Submitted to the Department of Architecture
In Partial Fulfillment of the Requirements for the Degree of

Master of Science in Real Estate Development

at the

Massachusetts Institute of Technology
September, 2001

© 2001 Gregory L. Hammond
All rights reserved.

The author hereby grants to MIT permission to reproduce and to distribute publicly paper and electronic copies of
this thesis document in whole or in part.

Signature of Author:

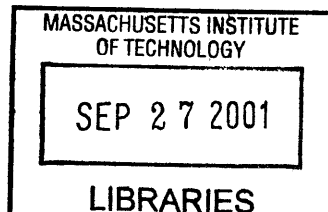
Gregory L. Hammond
August 3, 2001

Certified by:

Sandra Lambert
Lecturer, Department of Urban Studies and Planning
Thesis Supervisor

Accepted by:

William C. Wheaton
Chairman, Interdepartmental Degree
Program in Real Estate Development



ROTCH

Handwritten signature or scribble.

The California Energy Crisis and Cogeneration Investment Opportunities for Office Landlords

By

Gregory L. Hammond

Submitted to the Department of Architecture on August 3, 2001
In Partial Fulfillment of the Requirements for the
Degree of Master of Science in Real Estate Development

ABSTRACT

For the past eight months, California has been beset by an energy crisis. An inadequate supply of electricity has not been able to keep up with the growing demand. Vital transmission lines are operating at or near capacity. The installation of cogeneration systems into office buildings can play an important role in the overall solution. Cogeneration is a form of on-site generation that can provide electricity to office landlords and tenants that is less costly and more reliable than that provided by the utilities. There are several ways that office cogeneration systems can ease the pressure on California's electric generation and transmission infrastructure.

First, office buildings consume 26% of all electricity nationwide. They place an equally great demand on California's generating capacity. With widespread application, the siting of cogeneration systems in office buildings can reduce the demand placed on California's centralized power plants (CPPs). Reducing the demand for electricity that is centrally generated and delivered via transmission lines reduces the risk of blackouts and the cost of wholesale and retail electricity.

Second, because transmission lines are already operating at or near their capacity, it will be problematic to deliver the new centralized generation capacity that is coming on-line. It will be many years and billions of dollars before the transmission lines are fully upgraded. On-site cogeneration reduces the electrical congestion on these power lines, enabling more of the new centralized generation to get delivered.

Third, office cogeneration systems can be deployed in one-fifth of the time it takes to place a large CPP into operation. The quicker more generation can be added, the sooner a healthy supply/demand balance can be struck. Because of their small-scale and relatively simple component parts, office cogeneration systems can be completely permitted, installed and in-operation within 90 to 180 days. By contrast, it takes up to two and one-half years to permit, construct and place a large CPP into operation.

When fuel such as natural gas is combusted at a CPP, only 33% of the energy that is released via the combustion process actually reaches the remotely located end-users (e.g., homes and businesses) in the form of electricity. The conversion efficiency of an office cogeneration system is 75%, twice that of the CPP. Consequently, a cogeneration system can produce the electricity needed by a given office building while using only half the amount of fuel that a CPP would require. As these office cogeneration systems are located on-site, not only is the cost of transmitting electricity over long distances eliminated, so are the expenses associated with the maintenance and repair of the power grid. The fuel and transmission cost savings are what primarily enable office cogeneration systems to deliver electricity to office landlords and tenants at a fraction of the cost of power provided by the CPPs. The resultant price differential is what creates the investment opportunity for office landlords.

Thesis Supervisor: Sandra Lambert

Title: Lecturer, Department of Urban Studies and Planning

TABLE OF CONTENTS

<u>ABSTRACT</u>	3
 <u>CHAPTER 1 – INTRODUCTION</u>	
Overview.....	9
History of the Electricity Generation and Transmission Industry.....	10
Current Profile of California’s Electricity Generation Industry.....	12
California Deregulation and Electricity Generation.....	13
Deregulation.....	13
Generation.....	15
Transmission.....	15
Distribution.....	16
Competition Transition Charge, Stranded Investments and Retail Rate Freezes.....	16
 <u>CHAPTER 2 - THE CALIFORNIA ENERGY CRISIS</u>	
The Initial Stages and Subsequent Economic Fallout.....	18
Investor-Owned Utilities and the State of California.....	19
Pacific Gas & Electric.....	19
Southern California Edison.....	19
San Diego Gas & Electric.....	19
State of California.....	19
Cost to Businesses.....	20
Retail Electricity Costs.....	20
Rolling Blackouts.....	20
Causes of the California Energy Crisis.....	21
Deregulation as a Construct.....	21
Market Power.....	22
Acute Supply / Demand Imbalance.....	22
Demand.....	24
Population Growth.....	24
Higher Temperatures.....	24
Retail Electric Rate Freeze.....	24
Supply.....	24
In-State Generating Capacity.....	24
Permit Process.....	24
Reduced Hydroelectric Generation.....	25
Reduced Imports.....	25
Power Plant Outages.....	26
Electric Transmission Congestion.....	27
Natural Gas Transmission Congestion.....	27
Long Term Contracts and Forward Markets.....	27
Wholesale Price Caps.....	27
Credit Issues for the Investor-Owned Utilities.....	27
Blackouts.....	28
How Blackouts Are Orchestrated.....	28
Stage 1 Emergency.....	28
Stage 2 Emergency.....	28
Stage 3 Emergency.....	28
Cost To Businesses in the Aggregate.....	29

How Many Years Will Blackouts Persist.....	30
Retail Electricity Prices.....	32
Cost to Businesses in the Aggregate.....	33
Cost to Individual Office Tenants.....	33
Loss-Related Surcharges.....	34
How Many Years Will Retail Rates Remain Elevated and Surcharges be Applied.....	35
Summary.....	35

CHAPTER 3 – COGENERATION INVESTMENT OPPORTUNITIES FOR OFFICE LANDLORDS

Introduction.....	37
Technical Potential for CHP Applications in the Office Sector.....	39
Fledgling Industry.....	40
CHPs Role is Solving the California Energy Crisis.....	40
Investment Opportunity.....	41
Fuel and Transmission Savings.....	41
Loss-Related Surcharges.....	42
Early Industry Participants.....	42
Landlords.....	43
Arden Realty.....	43
Equity Office Properties.....	43
Hines.....	43
CalPERS.....	43
3 rd -Party CHP Developers.....	43
RealEnergy.....	44
Texas Utilities.....	44
Enron.....	44
Interviews with Office Landlords and 3 rd -Party CHP Developers.....	44
Basic CHP Functions.....	45
Hours of Operation.....	45
Generation Capacity.....	45
System of Choice.....	45
Owning & Operating vs. Outsourcing the CHP Functions.....	47
3 rd -Party CHP Developer.....	47
Landlord Owns and Operates CHP.....	48
Gross Lease.....	48
Triple-Net Lease.....	48
Fully Serviced Lease.....	48
Benefits to Office Tenants.....	49
Lower Electricity Costs.....	49
Improved Power Reliability.....	50
Circumvention of Loss-Related Surcharges.....	50
Benefits to Landlord.....	50
Capturing the Price Differential between CHP- and IOU-Provided Electricity.....	50
Reliable Power Rent Premium.....	51
Tenant Retention and Attraction.....	51
Selling Excess Power Back to the Grid.....	51
Lower Greenhouse Gas Emissions.....	51
Business Risks and Mitigation Strategies.....	51
Natural Gas Price Volatility.....	52
Natural Gas Infrastructure.....	52

Re-Regulation.....	52
Decline of Retail Electricity Prices.....	52
Financing Costs.....	53
Technological Obsolescence.....	53
Local Emissions.....	53
System Reliability.....	53
Financial Strength of 3 rd -Party Developer.....	53
Targeting Markets for CHP Applications.....	54
Landlord.....	54
3 rd -Party CHP Developer.....	54
Stand-By Fees and Back-Up Power.....	54
Exit Fees.....	55
Interconnections.....	56
Landlords and Older Buildings.....	57
CHP Markets in the Short- and Mid-Term.....	57
Deregulation.....	58
High Retail Electricity Prices.....	59
Constrained Supply Relative to Demand.....	60
Technical Potential for Office CHPs.....	61
Summary.....	62
CHP Markets in the Long-Term.....	62
Deregulation.....	63
National Energy Policy.....	66
Kyoto Protocol.....	66
What's Old Is New.....	68
Conclusion.....	68

APPENDICES

Appendix 1 Glossary.....	69
Appendix 2 Chronology of California Energy Crisis.....	74
Appendix 3 Assumptions for Summer Reserve Margin (2000-4) Calculations.....	77

<u>BIBLIOGRAPHY</u>	79
---------------------------	----

<u>FOOTNOTES</u>	90
------------------------	----

LIST OF EXHIBITS

Exhibit 1 Current Profile of California's Electricity Generation Industry.....	13
Exhibit 2 Service Territories of California's Largest IOUs.....	14
Exhibit 3 Bundled Services Provided by IOUs.....	15
Exhibit 4 Flow of Electricity and Attendant Buy / Sell Transactions.....	16
Exhibit 5 Wholesale Electricity and Natural Gas Prices During First Years of Deregulation.....	18
Exhibit 6 Total Losses Incurred by the IOUs and the State of California as of July-01.....	19
Exhibit 7 Frequency of Stage 1, 2 and 3 Emergencies.....	20
Exhibit 8 Reserve Margin in 1994.....	23
Exhibit 9 Reserve Margin in Aug 2000.....	23
Exhibit 10 States in which Hydroelectric Comprises 30% or More of State's Total Generation... 25	
Exhibit 11 Fastest Growing State Populations (%).....	26
Exhibit 12 Regression Analysis Correlating Calif. Gross Output with Electricity Consumption.. 29	
Exhibit 13 Summer Reserve Margin (2001 – 2004).....	31
Exhibit 14 PGE's Current and New Rates.....	32

Exhibit 15	SCE's Current and New Rates.....	33
Exhibit 16	Diagram of Combined Heat and Power (CHP) System.....	37
Exhibit 17	Permit and Construction Time for CHP Systems vs. Large, Centralized Power Plant..	41
Exhibit 18	Price Differential Creates Investment Opportunity.....	42
Exhibit 19	Primary Fuel Sources for CHPs.....	46
Exhibit 20	Deregulated States.....	58
Exhibit 21	States with the Ten Highest Retail Electricity Rates.....	59
Exhibit 22	States with Ten Lowest per Capita Generating Capacities.....	60
Exhibit 23	States with Highest Technical Potential for Office CHPs.....	61
Exhibit 24	Inefficiency of Investor Owned Utility Power Plants.....	64
Exhibit 25	Energy Intensity: Primary Energy Consumption (BTUs) per \$1 of GDP.....	65

LIST OF TABLES

Table 1	Blackout Dates, Duration and Total Power Loss.....	29
Table 2	Total GSP Loss Expected from Prospective Summer-01 Blackouts.....	30
Table 3	Experts in Regulatory and Energy Economics.....	32
Table 4	Conversion Efficiency of Various CHP Systems.....	37
Table 5	Technical CHP Potential for Various Commercial and Institutional Building Uses....	39
Table 6	Primary Driver for Small-Scale CHPs.....	46
Table 7	Allocation of Electricity Cost Savings Under a Fully Serviced Office Lease.....	49
Table 8	Largest Office Markets in the U.S.	62

The California Energy Crisis and Cogeneration Investment Opportunities for Office Landlords

CHAPTER 1 - INTRODUCTION

OVERVIEW

In mid-1998, California became the first state in the U.S. to deregulate its electric markets. Two and one-half years later (Jan-01), California became embroiled by an energy crisis that continues to this day. Rolling blackouts have interrupted the daily operations of businesses, causing millions (and possibly billions) of dollars in reduced output. Recent rate increases could result in output declining by an additional \$530 million per year in the Bay Area alone. Two of the state's three largest utilities are in precarious financial condition, incurring \$9.5 billion in losses. One of them, Pacific Gas & Electric, has already filed for bankruptcy. The state has also incurred \$7.5 billion in losses from stepping into the beleaguered utilities' shoes to buy electricity from power generators and wholesalers that were no longer willing to sell electricity to them.

The purpose of this thesis is to determine if California's energy crisis has created economic conditions and incentives for office landlords to invest in on-site generations systems to protect their tenants against blackouts and to provide them with less costly electricity. The focus will be on cogeneration, a type of on-site generation in which two forms of usable energy (heat and electricity) are produced from one fuel source. Because heat and power are produced, cogeneration systems are commonly referred to as combined heat and power systems (CHPs). CHPs exhibit great promise given their tremendous operating efficiencies, small-scale, short permitting and installation periods, substantial track record, reliability, and the presence of 3rd-parties poised to develop CHPs in office buildings.

To make these assessments, this thesis has been structured to examine the following critical questions:

- What are the root causes of the energy crisis? Was it just deregulation or did other factors contribute more to the crisis?
- What has been the economic fall-out? Do these economic consequences create market opportunities for CHPs?
- Will the root causes and economic consequences persist long enough so that investments in CHPs will result in an attractive return on investment?
- If market opportunities for CHPs have been created in California, do they exist in other states?
- What are the long-term prospects for CHPs? Are there any macro-forces at play that may create a national market for CHPs over the long-term?

The discovery process associated with examining these questions is filled with technical terms, acronyms and references to electricity industry players. To help keep track of all of them, a glossary is attached in Appendix 1. To put deregulation and its participants into context, a brief history of the electricity generation and transmission industry follows. It includes a snapshot of what the California electricity industry looks like today.

HISTORY OF THE ELECTRICAL GENERATION AND TRANSMISSION INDUSTRY

In 1879, Thomas Edison invented the incandescent light bulb. In 1881, he opened the world's first central electric power plant, located in New York City. Many civic leaders saw that electricity could greatly improve the quality of life for Americans¹. The quicker it could be disseminated amongst the masses the better. However, large-scale deployment was no simple task for power entrepreneurs. Convincing residents and businesses of the value of having electricity was a tall order. Televisions, computers and electrical kitchen appliances had yet to be invented, so there wasn't a clear connection that could be made in the minds of these end-users.

From the beginning, the electricity business has been a capital intensive one. A great deal of money had to be invested in generating-equipment and electrical lines for distributing the power. A large amount of this money would have to come from lenders and investors. Given the uncertainty related to when and how many end-users would sign-up for electricity, revenues from generation and distribution could be sporadic, increasing the risk that the power entrepreneur would not be able to make its debt and equity payments. The greater the perceived risk of non-payment, the higher the interest rate and return-on-investment that lenders and investors would respectively demand. The higher these rates were, the greater the cost of electricity would be for end-users, and the slower the pace of mass deployment. This was contrary to the desires of civic leaders.

Many cities decided to deal with this impasse by establishing their own municipal power departments. City funds would be used to develop and promote the power infrastructure. The Los Angeles Department of Water and Power is a good example of a municipal utility. Other cities wanted the development of electric generation and distribution to be accomplished with private money. Their solution was to provide power entrepreneurs with an exclusive service territory in which no other power provider would be allowed to compete. With this exclusive right, power entrepreneurs had a more convincing story to tell investors and lenders. While it would still take a while for households and businesses to embrace electricity, when they did there would be only one supplier that they could buy from. For lenders and investors who saw the potential in electricity, this monopoly arrangement was sufficient to reduce their concerns over non-payment. This was the genesis of investor-owned utilities (IOUs). Debt and equity money started to flow, and so did electricity. With success and profits, power entrepreneurs secured more and more exclusive service territories. In some cases, their domain covered a large part of entire states. Good examples include ConEdison in New York and Pacific Gas & Electric in California.

The potential for IOUs to overcharge their customers given their monopoly power was not lost on civic leaders. The mechanism that ultimately emerged and was implemented by virtually all of the states between 1907 and 1922 was a public service commission that regulated each IOU². These commissions had to approve the retail electric rates that each IOU charged its end-users, and any plan of action that each IOU wanted to implement in order to add generation capacity or major debt. The retail rates allowed by the commission could only be high enough to cover all of the IOU's costs and provide a fair rate of return on its invested capital. Commissioners were often appointed by the governor and in some states they were elected. The public service commission formed in California is called the California Public Utilities Commission (CPUC).

Though the goal of distributing electricity throughout America has long since been met, the regulated monopoly model has largely remained in-place and unchallenged for the past seventy-five years. The first glimmer of change came in 1978 with the passing of the Public Utility Regulatory Policies Act (PURPA) by federal legislators. While this Act did not threaten the monopoly status of the IOUs, it did allow private non-IOU generators to build cogeneration plants and not be entirely subject to the rate-of-return regulations imposed by the public service commissions. These cogenerators were called “qualified facilities” (QFs). To qualify for the regulatory exemptions, they had to achieve generation efficiencies that were at least 50% greater than the average IOU power plant. When the QFs sold their power to the IOUs, the rates they could charge were subject to regulation. QFs could also sell their power to non-IOU entities and were able to charge these customers whatever rate the market would bear. PURPA was the first step towards being able to sell all generated electricity based on its market value.

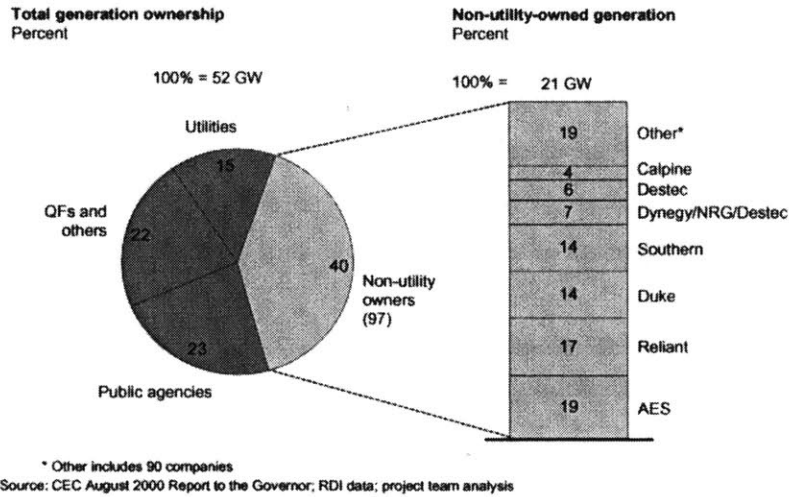
In 1992, the federal Energy Policy Act created a new category of electric generators, “Exempt Wholesale Generators” (EWGs). As the name implies, these power providers are free to generate and sell electricity at its wholesale market price. Six years after the Energy Policy Act was enacted, California became the first state in the nation to completely deregulate its electric market, initiating the process that would create competition amongst electricity wholesalers and retailers.

CURRENT PROFILE OF CALIFORNIA’S ELECTRICITY GENERATION INDUSTRY

Exhibit 1 depicts the current profile of California’s power generating industry. Each of the generator-types described above are included. Municipal utilities are among those entities identified as public agencies. They account for 23% of California’s in-state generating capacity. IOUs are identified as utilities. They currently provide 15% of California’s in-state generation capacity. Prior to deregulation IOUs accounted for 55%. Companies such as Calpine and Reliant purchased the power plants that the IOUs sold due to deregulation. These companies are identified as Non-utility owners, producing 40% of California’s in-state electricity generation. QFs, EWGs and other generators are combined and identified in Exhibit 1 as QFs and others. Together they account for 22% of California’s in-state generating capacity.

Exhibit 1

Current Profile of California's Electricity Generation Industry



Source: "The Bay Area – A Knowledge Economy Needs Power". McKinsey & Company Report. April 2001.

CALIFORNIA DEREGULATION AND ELECTRICITY GENERATION

DEREGULATION

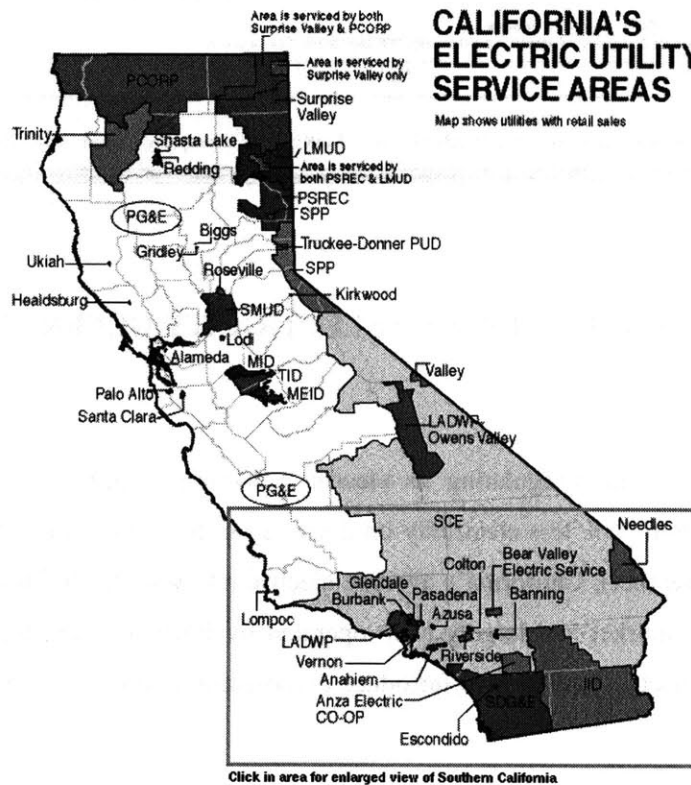
The rationale for California deregulating its electric market was quite simple. Though California's residents consumed about 35% less electricity on a per capita basis than the U.S. average (in part due to the state's moderate weather), California's average electric rate was the 10th highest in the country³. As California's electricity market had largely been operated by IOUs as regulated monopolies, the logical strategy for reducing electric rates was to introduce competition into both the wholesale and retail power markets.

The first step taken was to open-up the wholesale electric markets. This process was actually initiated by the Federal Energy Regulatory Commission (FERC) which passed two regulations in 1996 that allowed for wholesale trading of electricity between the electricity generators (sellers) and the wholesale buyers irregardless of where in the U.S. the parties were located. This meant that wholesalers like Enron and Green Mountain Energy could scour the country looking for the most competitive electric rates that they, in turn, could pass along to their customers which include both IOUs and end-users such as homes and

businesses. In doing so they could garner a larger share of the retail electricity market. The second step taken was to open up the retail electric markets to competition. *The Electric Utility Industry Restructuring Act* became law on September 23, 1996. This law enabled retail customers to purchase electricity from any wholesaler or IOU they chose. Retail customers with large enough energy demands (e.g. manufacturers) could even purchase power directly from the generators. Now, wholesalers could buy from whomever they wanted, and so could the end-users. In order for these laws to be put into practice, the electricity market had to be physically restructured as well. As shown on Exhibit 2, the largest IOUs in California are Pacific Gas & Electric (PGE), Southern California Edison (SCE), and San Diego Gas & Electric (SDGE). Seventy-five percent of California's electricity is provided by these three IOUs⁴.

Exhibit 2

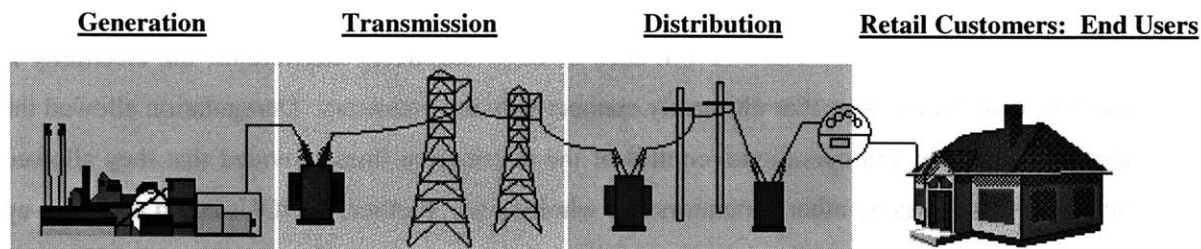
Service Territories of California's Largest IOUs



Source: California Independent Service Operator (CAISO)

Prior to deregulation each of these IOUs provided their customers with the following bundle of services (Exhibit 3). Generation is where the electricity is produced. Transmission lines are likened to highways as they are the major pathways over which electricity travels. Distribution lines are analogous to streets, roads and alleys on which electricity travels to reach its final destination.

Exhibit 3 Bundled Services Provided by IOUs



Source: California ISO

GENERATION

To encourage wholesale competition each of these IOUs was required to divest itself of at least 50% of its power plants that used fossil fuels as their feedstock. Most of the total generating capacity was acquired by a few non-utility owners domiciled outside of California. With this requirement, the IOUs became both generators and wholesalers. Each could sell electricity to its retail customers that was generated directly by one of its own remaining plants, or it could resell electricity that it had purchased from any number of other power generators or wholesalers in the wholesale market (Exhibit 4). As long as these other power generators and wholesalers were able to physically and economically deliver the electricity, it did not matter where in the country they were located. However, in order to keep the IOUs from dominating the wholesale markets with their buying power, and to encourage new generators and wholesalers to enter into the power market, the IOUs were barred from purchasing wholesale electricity on long- or medium-term contracts. Rather they were confined to making their purchases on three spot markets: the day ahead, the day of, and the real time market.

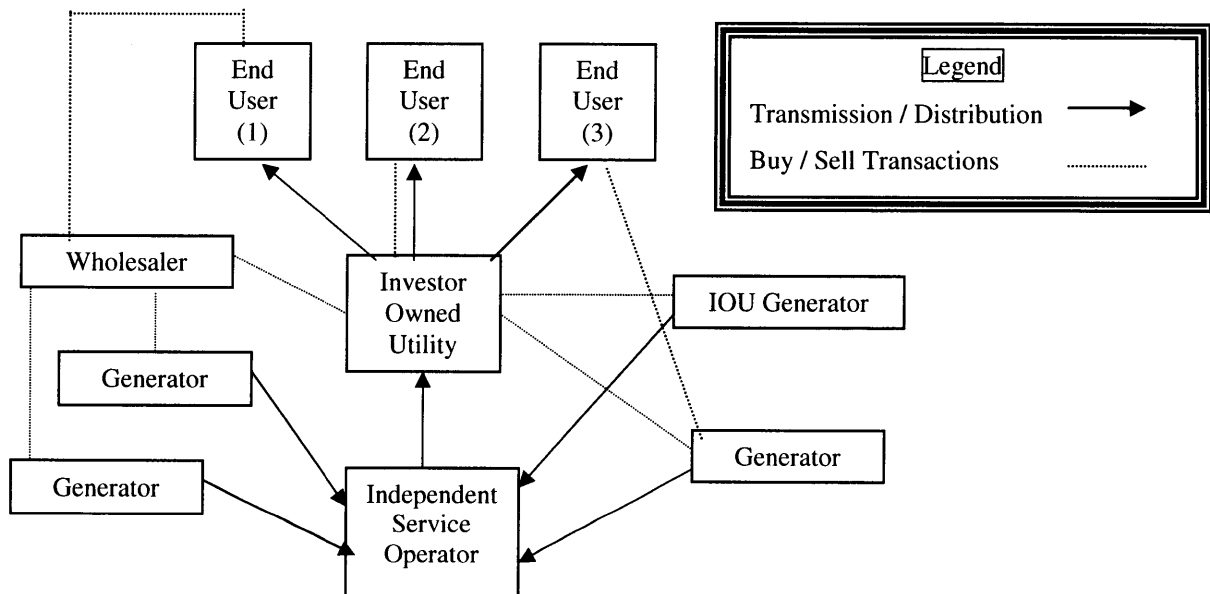
TRANSMISSION

There are approximately 12,500 miles of transmission lines in California draped along transmission towers that carry the electricity that is produced in- or out-of-state to primary substations located up and down California. Collectively, these transmission lines form what is commonly known as the power grid. The transmission lines are owned by the IOUs. Deregulation also required the IOUs to give control of the transmission lines to the California Independent System Operator (ISO), the entity created to manage the flow of electricity on the power grid and to provide non-discriminatory access to the grid to all generators and wholesalers. Had this not been an additional requirement of deregulation, then each IOU could have kept other generators and wholesalers from being able to deliver power to their customers.

DISTRIBUTION

The distribution lines carry electricity from the primary substation to additional remote substations that are located closer to clusters of end-users. From each of these secondary substations, the electricity is carried along more distribution lines that ultimately connect with the end-users. Deregulation allowed the IOUs to maintain ownership and operational control of the distribution lines provided that they allowed unfettered access to these lines by other generators and wholesalers. Further, the IOUs could not mark-up the cost of their competitors' power that was being delivered over their distribution lines as this would have enabled the IOUs to quash the competition with excessive mark-ups.

Exhibit 4 **Flow of Electricity and Attendant Buy / Sell Transactions**



Source: Thesis Author

COMPETITION TRANSITION CHARGE, STRANDED INVESTMENTS AND RETAIL RATE FREEZES

The prescribed transition period to complete the deregulation process was four years, beginning on April 1, 1998 and ending on March 31, 2002. During this period of time the IOUs were allowed to charge all customers a competition transition charge to accelerate the recovery of stranded investments. These were unprofitable investments primarily made into nuclear and renewable energy power plants that the IOUs may not have made had the CPUC not legally required them to do so. These investments were originally financed by the IOUs based upon assurances from the CPUC that repayment of the debt could be made

through future electricity sales⁵. Because these power plants could not provide electricity at competitive rates in a deregulated environment, they would ultimately be stranded. Since the CPUC's assurances of debt repayment could not be maintained in a deregulated market, the recovery of stranded investments had to occur during the 4-year transition period via the competition transition charge.

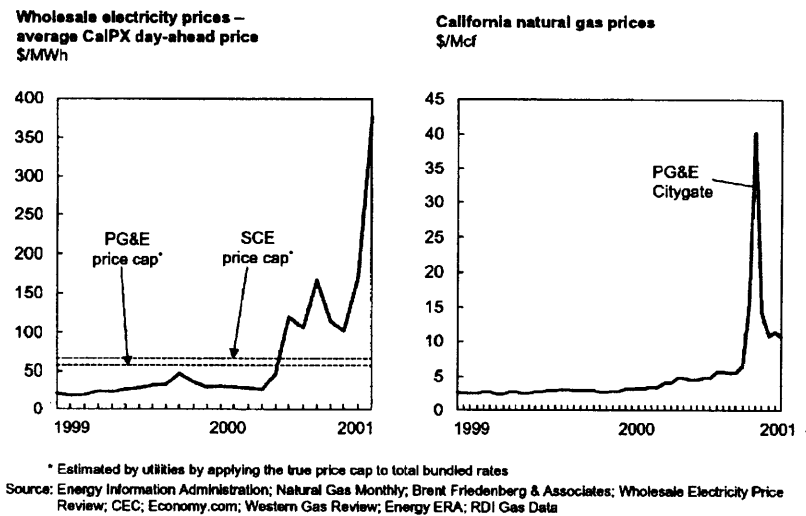
To provide for the competition transition charge, the CPUC froze retail rates at their relatively high 1996 levels. The expectation was that the profits from the spread between the then prevailing high retail rates and low wholesale rates would ensure that the IOUs would be able to pay-off all of their stranded investments by the end of the four-year transition period. This would place the IOUs on competitive footing with new entrants into California's electricity markets. Retail rates for each IOU were to remain frozen until the earlier of (a) March 31, 2002 or (b) when the given IOU had paid off its respective stranded costs. The only exception to the rate freeze was a one-time 10% rate reduction provided only to residential and small commercial customers on January 1, 1998.

CHAPTER 2 – THE CALIFORNIA ENERGY CRISIS

THE INTIAL STAGES AND SUBSEQUENT ECONOMIC FALLOUT

During the first two and one-half years of deregulation (Jan-98 through May-00) things went as expected. Wholesale prices dropped by roughly 50% from their pre-deregulation levels from an average of \$65 per megawatt-hour to \$32 MWh⁶. The retail rates that had been capped for four years were well above these wholesale electricity rates (Exhibit 5). The IOUs were capturing the spread between the wholesale and retail rates, enabling them to pay-down some of their stranded costs.

Exhibit 5 Wholesale Electricity and Natural Gas Prices During the First Years of Deregulation



Source: "The Bay Area – A Knowledge Economy Needs Power". McKinsey & Company Report. April 2001.

However, by Jun-00, wholesale electricity prices exceeded the retail price caps set for the IOUs. By the end of 2000, wholesale electricity prices had quadrupled (Exhibit 5). During 2001, wholesale electricity prices climbed even further, much of this increase due to natural gas prices increasing by six-fold. Thirty-seven percent of California's in-state generation comes from natural gas fired power plants. Wholesale electricity prices continue to remain well above retail prices. The two largest IOUs, Pacific Gas & Electric (PGE) and Southern California Edison (SCE) have incurred tremendous losses due to collecting less from their retail customers than they were paying for wholesale electricity. SDGE's losses from

under-collections were relatively small. Because SDGE had paid-off all of its stranded costs by July-99, its retail rates were unfrozen pursuant to the terms of deregulation. This gave SDGE the latitude to raise its rates, passing along the costs of wholesale electricity to its customers. The economic fallout that has plagued the IOUs, the State of California, and businesses in California since the onset of this crisis is summarized as follows.

INVESTOR-OWNED UTILITIES AND THE STATE OF CALIFORNIA

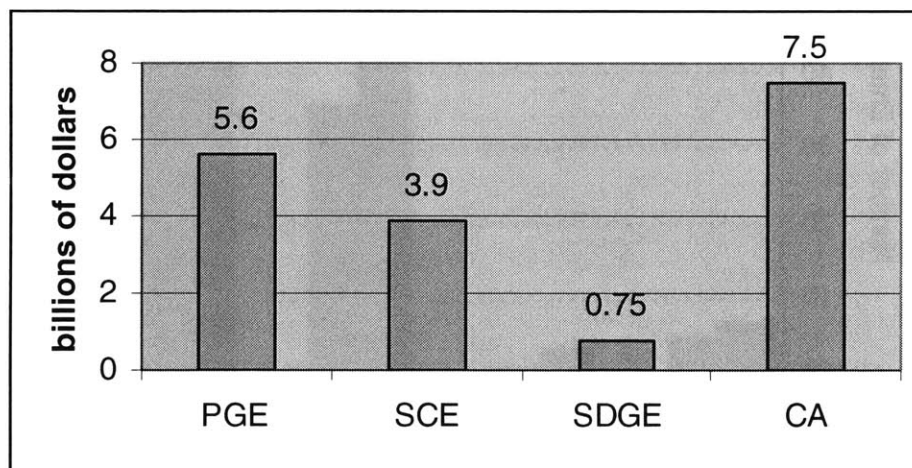
Pacific Gas & Electric. PGE has amassed \$5.6 billion in losses due to under-collections and declared bankruptcy, seeking Chapter 11 protection from its creditors. Several credit rating agencies reduced PGE's corporate bond rating to junk bond status.

Southern California Edison (SCE). SCE has lost \$3.9 billion in under-collections. SCE's corporate bond rating was also reduced to junk bond status.

San Diego Gas & Electric (SDGE). SDGE has amassed \$750 million in under-collection losses. Of the three IOUs, it has remained in relatively good financial condition.

State of California. California's Department of Water Resources was authorized by emergency legislation to purchase power on behalf of the cash-strapped IOUs. It has spent more than \$7.5 billion since Jan-01⁷. These expenditures equate roughly to \$1.2 billion per month.

Exhibit 6 **Total Losses Incurred by the IOUs and the State of California as of July -01**



Sources: The Utility Reform Network; San Francisco Chronicle

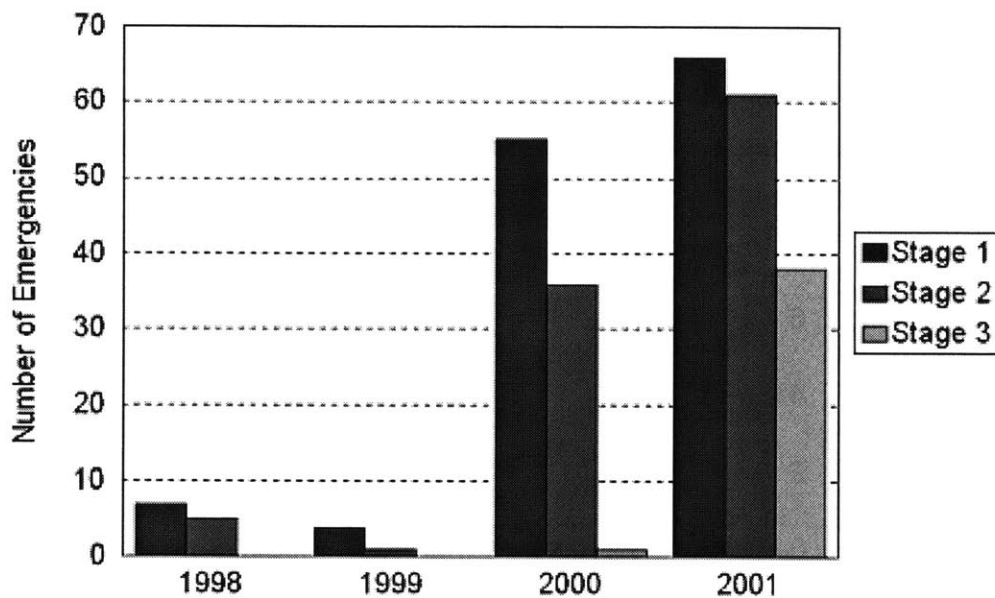
COST TO BUSINESSES

Retail Electricity Costs. Deregulation was expected to result in retail rates decreasing by 20% by 2003⁸. Instead, rates for commercial customers of PGE and SCE have risen by 35% to 40%. It is possible that these rates could increase by another 10% when the retail rate freeze is lifted on April 1, 2002. It is estimated that a 50% rate increase will reduce the output of Bay Area businesses alone by \$530 million for each year that rates remain at this level.

Rolling Blackouts. In 2000, there was only one Stage 3 emergency declared by the California ISO (Exhibit 7). During the first five months of 2001, however, there were thirty-eight. This number is expected to increase significantly during the summer months ahead. More of the blackouts have occurred in Northern California where supply shortages are more frequent than in Southern California. It is estimated that the Bay Area blackouts which occurred in Jan-01 and Mar-01 cost businesses \$45 million and \$94 million in reduced output. Output reductions due to blackouts projected for the summer of 2001 range from \$960 million to \$4.8 billion. A chronology is provided giving a more detailed account of how the energy crisis unfolded (Appendix 2).

Exhibit 7

Frequency of Stage 1, 2 and 3 Emergencies



Source: California Independent System Operator

CAUSES OF THE CALIFORNIA ENERGY CRISIS

The root causes of the California energy crisis and the resultant economic conditions are creating the potential investment opportunities in CHP generation. The longer that these conditions continue to exist, the greater the return on investment will be. Determining whether these primary causes and resultant conditions are likely to persist over an extended period of time or dissipate relatively quickly will be paramount to any investor.

DEREGULATION AS A CONSTRUCT

Some believe that deregulation is the primary cause of the California energy crisis. To assert that the electricity generation and transmission industry cannot function properly outside a regulated environment is to ignore the evidence. It was once thought that other industries could not function effectively in a deregulated environment. Examples include interstate rail freight, interstate trucking, gas transmission, airline travel and long distance telephone service. Contrary to conventional wisdom, when each of these industries was deregulated the quality of service increased while the cost of service dropped in real terms by 27% to 57%⁹. When Margaret Thatcher deregulated United Kingdom's electricity markets in 1989, there was a great deal of opposition. Within six years retail rates in the U.K. dropped 15% to 20%¹⁰. The Pennsylvania-New Jersey-Maryland (PJM) market was deregulated at about the same time that California was. During the same one-year period in which California's wholesale electric prices went from \$32 per MWh (in 1999) to \$118 (in 2000), those in the PJM market went from \$28 to \$34 (Exhibit 15)¹¹. In large part this is due to the latter having a healthy reserve margin of 17%¹². From 1999 to 2000, wholesale electricity prices in the UK actually decreased from \$38 per MWh to \$34¹³. The PJM and UK markets demonstrate that a deregulated electricity industry can thrive over the short- and long-term.

As will be shown on the following pages, the design flaws in California's deregulation (i.e., retail price caps and wholesale spot market purchases) did not get exposed until total supply approximated total demand. Had a healthy balance between the supply of and demand for electricity been maintained, wholesale prices would still be well below the frozen retail rates and the IOUs would still be paying down their stranded costs. Had retail prices remained well above wholesale prices, requiring the IOUs to buy all of their power on the spot market would not have become an issue. Further, attempts to stem the IOUs' flow of losses with post-facto wholesale price caps would not have been necessary. While the design flaws have amplified the crisis, they are not the primary cause.

MARKET POWER

A lot has been made about market power and the high wholesale prices charged by a few non-utility owners that purchased most of the IOUs' largest power plants. In reality, these companies control only 33% of California's in-state generation capacity (Exhibit 1). There are two reasons that they have been able to command such high prices. First, supply basically equaled demand. Second, they purchased many "peaker-plants" from the IOUs along with the baseload plants¹⁴. Peaker-plants only operate during peak periods when demand and price are at their greatest.

ACUTE SUPPLY / DEMAND IMBALANCE

Most industry experts point to an acute imbalance between the existing supply of and demand for electricity in California as being the primary reason for its energy crisis. As pointed out by the Cambridge Energy Research Associates, for California to achieve an appropriate balance, it must have a minimum reserve requirement of 15% to 20%¹⁵. The reserve margin is the amount by which available supply must exceed peak demand. As in many states, peak demand in California occurs during summer afternoons when air-conditioners are used the most. The 15% to 20% reserve margin provides a cushion against unpredictable changes in supply and demand. Unexpected changes in supply result from e.g., power plants going off-line due to equipment failure and lower than normal amounts of power being imported into California from nearby states. Unexpected changes in demand are primarily weather related.

Balance existed in 1994 when supply exceeded peak demand by about 26% (Exhibit 8)¹⁶. IOUs, public agencies (e.g., municipal utilities), QFs, EWGs and other generators in California provided about 55 gigawatts (GW) of in-state generating capacity. Another 10 GW came from states such as Arizona, Oregon and Washington. Actual peak demand was approximately 48 GW.

Note: 1,000 watts is the approximate amount of electricity consumed by one home.

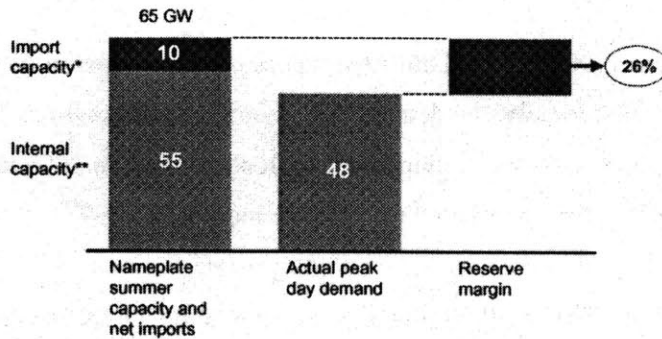
A kilowatt equals one thousand (10^3) watts.

A megawatt equals one million (10^6) watts.

A gigawatt equals one billion (10^9) watts.

Exhibit 8

Reserve Margin in 1994



* Firm transmission capacity contracted (net of export), forecast in 1993 for 1994
 ** Actual summer peak capacity for CANV subregion (Nevada has no generation capacity within the CANV subregion)
 Source: FERC; NERC ES&D database; CalSO; project team analysis

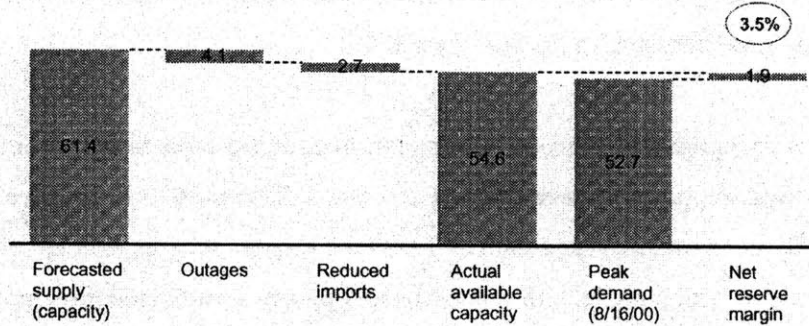
Source: "The Bay Area – A Knowledge Economy Needs Power". McKinsey & Company Report. April 2001.

By the summer of 2000, the reserve margin had shrunk to 1.9 GW or 3.5% (Exhibit 9)¹⁷. This slim margin left little room for contingencies such as power plant shutdowns and lower-than-expected imports. It also sent a very loud and clear message to all electricity generators that there was a buyer for virtually every megawatt of electricity that they could produce. As a result, wholesale electricity prices went skyward. There were several major factors contributing to this supply and demand imbalance.

Exhibit 9

Reserve Margin -- August 2000

Reserve margin – August
 GW



Source: Press releases; CalSO; WSCC; NERC; FERC; RDI PowerDat; project team analysis

Source: "The Bay Area – A Knowledge Economy Needs Power". McKinsey & Company Report. April 2001.

Demand. Part of the supply / demand imbalance has been due to higher than normal levels of demand. The following are three of the most significant factors contributing to increased demand.

Population Growth. From 1990 to 2000 California's population had grown by over 4 million people, more than any other state. Historically, the demand for electricity had grown at 2% per year. However, in 2000, this growth rate doubled to 4%¹⁸. Further, peak load demand in 2000 increased by 8% during the months of May through September relative to the same months in 1999¹⁹.

Higher Temperatures. From 1998 to 2000, the average June temperature increased by 4 degrees each year. Average summer demand during these years increased 7% per year in part due to the increased use of air-conditioners²⁰.

Retail Electric Rate Freeze. As part of California's deregulatory legislation, the retail rates charged to end-users such as residences and businesses were frozen at their 1996 levels. Retail rates could not be adjusted to reflect the cost of skyrocketing wholesale prices. Consequently, there was no price mechanism to dampen the end-users demand.

Supply. Part of the supply / demand imbalance has been due to lower than normal levels of supply. The following are ten of the most significant factors contributing to reduced supply.

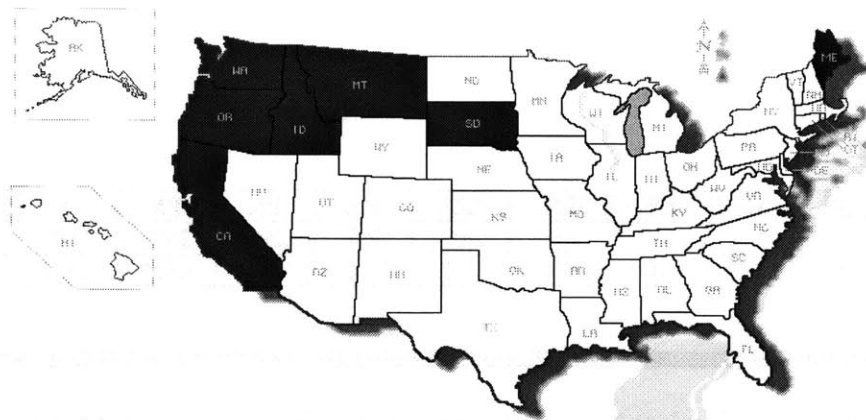
In-State Generating Capacity. From 1994 to 2000, in-state generating capacity had actually decreased from 55 GW to 54 GW²¹. Despite the continued migration of new residents into California, the growth of digital-economy companies, and the decommissioning of some power plants, not a single significant power plant had been built in the past decade²².

Permit Process. An exceptionally onerous power plant permitting process played a major role. By the book, the process was supposed to take thirteen and one-half months²³. In practice, it took twenty months on average. By comparison, states such as Texas the process took an average of seven months. Generators had to contend with a phalanx of numerous and poorly coordinated governmental agencies, including the California Public Utilities Commission (CPUC), the California Energy Commission (CEC), Federal Energy Regulation Commission (FERC), the Western Systems Coordinating Council (WSCC), the California Independent System Operator (ISO), local air quality management districts, and local governmental agencies²⁴. In addition, generators had to contend with the strictest air-quality regulations in the U.S., Not-In-My-Backyard-ism, and well-coordinated environmental groups.

Reduced Hydroelectric Generation. Thirty-nine percent of the electricity which California generates in-state is hydroelectric (Exhibit 10). This is among the highest hydroelectric dependencies in the U.S. It is also the only feedstock for electrical generation that is vulnerable to the vagaries of the weather. Reduced rainfall in 1999 meant lower reservoirs. Higher summer temperatures meant greater evaporation rates, reducing reservoir levels even further. Collectively, there was less water available for power generation.

Reduced Imports. California receives about 18% of its electricity from nearby states²⁵. About 9% comes from the Pacific Northwest, 7% comes from the Southwest, and 2% comes from other states. Imports from these states during the summer months were down over 50% from their 1999 levels²⁶. Southwestern states also experienced a very hot summer in 2000 and consequently had less available power to export. Imports into California from Pacific Northwest states were down significantly because of their own exceptionally low rainfall and dependency on hydroelectric power. Idaho, Washington and Oregon respectively derive 93%, 85% and 83% of their total in-state electricity from hydroelectric sources (Exhibit 10). In 2000, run-off volume in the Pacific Northwest was down about 8% from its 30-year average and hydroelectric generation was down 7% from its 30-year average²⁷.

Exhibit 10 States in which Hydroelectric Comprises 30% or More of State's Total Generation



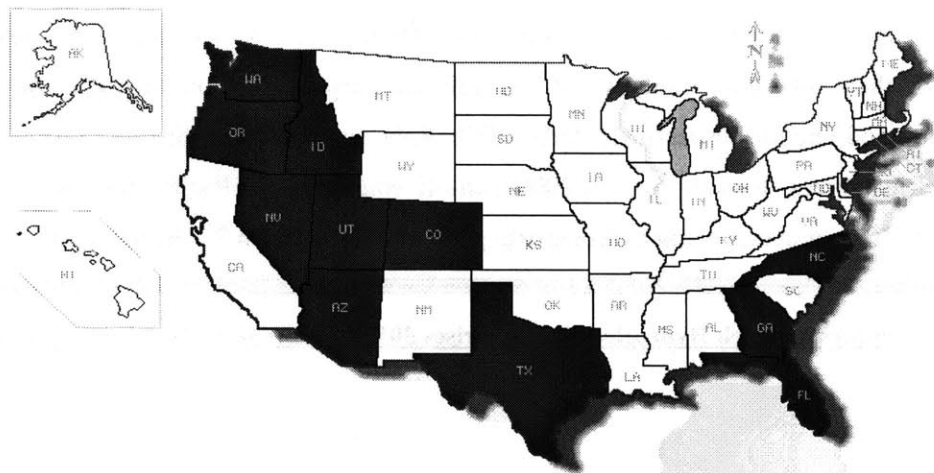
8-4-01

State	ID	OR	WA	MT	SD	CA	ME
% of Total	93%	85%	83%	68%	58%	39%	38%

Source: Energy Information Administration, U.S. Department of Energy

Additionally, population growth in the Pacific Northwest and Southwest over the past decade was significant, requiring that more of the total electricity generated in these states stay at home. Of the eleven states with the highest percentage increases in population from 1990 to 2000, seven of them were Pacific Northwestern or Southwestern states (Exhibit 11)²⁸. Arizona, Washington and Colorado were among the top eight states with the greatest population growth in absolute terms with respective increases of 1,465,000; 1,027,000; and 1,007,000 new residents.

Exhibit 11 **Fastest Growing State Populations (%)**



8-4-01

State	NV	AZ	CO	UT	ID	GA	FL	TX	NC	WA	OR
Change (%)	66%	40%	31%	30%	29%	26%	24%	23%	21%	21%	20%
Change (000)	796	1,465	1,007	510	287	1,708	3,044	3,865	1,421	1,027	579

Source: 2000 U.S. Census

Power Plant Outages. Unplanned outages are usually the result of equipment failure or the unavailability of emission credits which some plants must obtain in order to operate in California. Planned outages occur so that routine maintenance and repair can take place. Due to greater demand, lower in-state supply and reduced imports, power plants in California had to operate for longer periods of time without routine maintenance. Equipment failure became more frequent as deferred maintenance accumulated, resulting in much higher levels of forced outages in the summer and fall of

2000 relative to 1999²⁹. When the IOUs owned and operated all of the power plants, coordinating planned outages amongst themselves was relatively simple and matter-of-course. By contrast, the lack of coordination between the ninety-seven new owners of the power plants formerly owned by the IOUs exacerbated the outage problem.

Electric Transmission Congestion. In 2000, the primary high voltage transmission line connecting Southern to Northern California, Path 15, was congested 50% of the time³⁰. This reduced the flow of surplus power from the south, particularly from the Los Angeles Department of Water and Power, a municipal utility that was not subject to deregulation. In 1999, Path 15 was congested only 28% of the time.

Natural Gas Transmission Congestion. Constraints in the transmission of natural gas into and throughout California resulted in wholesale gas prices in California increasing by six-fold while increasing by only two-fold in the rest of the country³¹.

Long Term Contracts and Forward Markets. Deregulation prohibited the IOUs from buying power with long term contracts. They were limited to buying on three spot markets. Without mid- and long-term procurement contracts which ensured predetermined revenue streams to the generators, there was too much uncertainty for the generators to invest in the development of new power plants in California.

Wholesale Price Caps. California imposed price caps to stem the losses that the IOUs were incurring. The unintended consequence of the price caps was that in-state generators started to export power to other states where wholesale prices were greater than the price caps, further depleting California's reserve margin³².

Credit Issues for Investor-Owned Utilities. Retail price caps and the inability to enter into long-term contracts put the IOUs in a lose-lose situation. With each day that the IOUs' huge under-collection losses mounted, generators became increasingly reluctant to sell electricity to them due to the elevated risk of non-payment. Supply suffered until the generators were ordered by the U.S. Secretary of Energy to sell electricity to the IOUs. Subsequently, the State of California stepped-in to buy power on behalf of the IOUs, easing the credit concerns of the generators. To date, California has spent approximately \$7.5 billion on electricity³³. This amount shall continue to rise given the wholesale electricity contracts which the State entered into with terms that extend through 2021.

BLACKOUTS

Business losses from blackouts can total billions of dollars. The longer each blackout lasts, the more frequently they occur, and the longer that they persist (months or years), the greater business losses will be. Quantifying these variables to gauge whether office tenants will pay a rent premium for reliable power is critical to the landlord's decision to invest in CHPs or not.

How Blackouts Are Orchestrated. To understand how California companies are financially impacted by blackouts, it will be useful to understand how blackouts are literally orchestrated by the California Independent System Operator (ISO). When the reserve margin falls below a certain level, the California ISO declares an emergency. What determines whether a Stage 1, 2 or 3 is declared is the extent to which the reserve margin has dropped³⁴.

Stage 1 Emergency. When the reserve margin falls below 7%, all electricity consumers are asked to voluntarily reduce their power consumption as much as possible by e.g., turning-off lights, appliances and office machinery.

Stage 2 Emergency. When the reserve margin falls below 5%, power may be interrupted to some heavy commercial and industrial users such as oil refineries. These interruptible customers have special contracts with power providers which gives them discounted rates in exchange for agreeing to curtail their power during Stage 2 emergencies.

Stage 3 Emergency. When the reserve margin is expected to fall below 1.5% within a 2-hour period, coordinated blackouts may be implemented. To avert blackouts, the ISO feverishly attempts to locate last-minute sources of imported power. In some instances the ISO will halt the huge state-owned pumps which push water down the California Aqueduct from Northern to Southern California, reducing demand by 300 MW.

When rolling blackouts are implemented, the ISO directs each utility to suspend the delivery of a certain amount of electricity (e.g. 1,000 megawatts). PGE, the utility which covers most of Northern California has divided its 4.5 million customers into 14 "blocks" each representing about 550 megawatts of power. Power to each block is cut for about 60 to 90 minutes at a time³⁵. Then the blackout rolls to the next block until the stress on the grid has been relieved. To lessen collateral business losses such as equipment damage and data loss, the IOUs provide advance warning to those businesses that will likely be affected.

In 2001, there have so far been thirty-eight Stage 3 emergencies and seven blackouts (Table 1). The total loss of power has been 11,089 megawatt-hours.

Table 1 Blackout Dates, Duration and Total Power Loss

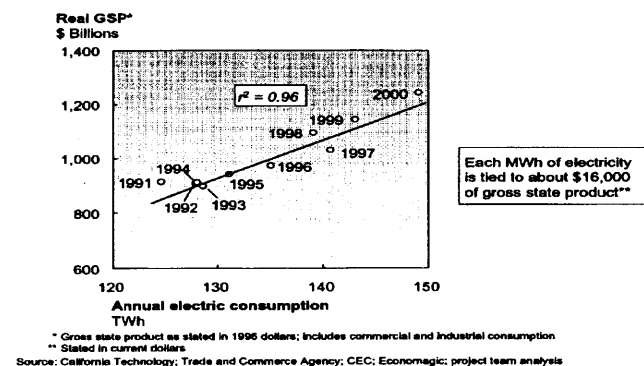
Date	Jan-17	Jan-18	Jan-21	Mar-19	Mar-20	May-7	May-8	Total
Megawatt-hours	1,017	1,808	101	4,060	1,810	1,500	800	11,089
Total Hours	3	3	1	6	6	3	2	24

Source: California ISO

Cost to Businesses in the Aggregate. Despite their infrequency, blackouts can cost businesses billions of dollars due to lost productivity, idled workers, lost data, damaged equipment, product damage, reduced customer satisfaction, and reduced competitiveness. In Northern California, Bay Area technology companies have been particularly impacted. According to the Silicon Valley Manufacturers Group, an industry association of 195 high-tech luminaries such as Intel and Adobe Systems, the blackouts that occurred in Jan-01, idled 100,000 workers and cost tens of millions of dollars³⁶.

How much individual businesses have lost is a function of which of the seven blackouts they were subjected to, how many 60- to 90-minute forced outages they experienced, the extent of collateral losses, and whether the outages occurred at times of high productivity. Trying to collect the relevant data from individual companies and aggregating the data to calculate total business loss would be highly problematic. An alternative method for estimating business loss is to look how much California's gross state product (GSP) is being impacted. Regression analysis that relates California's electric consumption with its GSP from 1991 through 2000 indicates that for each MWh consumed, gross product increases by \$16,000 (Exhibit 12)³⁷. The R² of this analysis is 96%. Conversely, for each MWh that is demanded but not delivered due to a blackout, GSP decreases by \$16,000.

Exhibit 12 Regression Analysis Correlating California Gross Output with Electricity Consumption



Source: "The Bay Area – A Knowledge Economy Needs Power". McKinsey & Company Report. April 2001.

The unserved demand that resulted from the Bay Area blackouts in January and March of 2001, was 2,825 MWh and 5,870 MWh respectively. Accordingly, the respective reduction in GSP was approximately \$45 million and \$94 million. During the summer-01, Cambridge Energy Research Associates (CERA) expects as many as 20 hours of extreme shortage in which demand exceeds supply by 3,000 MW³⁸, requiring the state to implement rolling blackouts. This would reduce GSP by nearly \$1 billion in revenues (Table 2).

Table 2 Total GSP Loss Expected from Prospective Summer-01 Blackouts

Unserved Demand		Blackout Hours		Lost GSP per MWh		Total GSP Loss
3,000 MW	x	20 Hours	x	\$16,000	=	\$960 million

A \$960 million reduction in GSP is considerable. However, consider that California's gross state product in 1999 was approximately \$1.229 trillion³⁹. Relative to this total, the loss of GSP is a mere .08%. Even if this GSP loss were quintupled to \$4.8 billion it would still only equate to .4% of GSP.

This is not meant to trivialize these losses particularly for those businesses that may have suffered disproportionately. But, it is reasonably consistent with the responses given in a web-based survey conducted by the Bay Area Economic Forum (BAEF) of 512 Bay Area businesses that included members of the Silicon Valley Manufacturers Group. While most of those surveyed voiced very strong concerns about the impacts of the energy crisis, particularly those regarding the reliability and price of electric power, over 71% of the respondents indicated that they had no plans for additional or alternative energy resource development in the near future⁴⁰. (Thirty-eight percent already had on-site generation that is used either for emergency back-up or to supplement the electricity they receive from the IOUs.) This muted sense of urgency could be explained by the infrequency of the blackouts, the relatively insignificant associated costs, a general expectation that new supply will be on-line soon, and that recurrent blackouts will not continue past 2001 or 2002.

How Many Years Will Blackouts Persist. If the rationale for investing in office building CHP systems is primarily to prevent business loss due to blackouts, then investors will want to know how long will blackouts continue after 2001. If it appears that the reserve margin is trending upward and will be well above 1.5% by 2002, then blackouts will not persist past 2001. By making certain assumptions about what peak demand and total available supply will be during the summer months over the next three years, a spreadsheet analysis can be constructed which estimates the reserve margin during the summer of 2001 through 2004 (Exhibit 13). Explanations for each assumption about demand growth, in-state generating capacity, imports, planned and unplanned outages are provided in Appendix 3.

Exhibit 13 Summer Reserve Margin (2001–4)

On-Line Estimates for Plants already On-Line or Under Construction

	<u>Jun</u> <u>2001</u>	<u>Jul</u> <u>2001</u>	<u>Aug</u> <u>2001</u>	<u>Summer</u> <u>2002</u>	<u>Summer</u> <u>2003</u>	<u>Summer</u> <u>2004</u>
<u>Demand</u>						
Annual Demand Growth (a)	3%	3%	3%	2%	2%	2%
Peak Summertime Demand	54.3	51.6	51.6	52.6	53.7	54.7
<u>Incremental Demand Reduction from</u>	<u>5.0%</u>	<u>0.0%</u>	<u>0.0%</u>	<u>0.0%</u>	<u>0.0%</u>	<u>0.0%</u>
<u>Rate Increases (b)</u>						
Resultant Demand	51.6	51.6	51.6	52.6	53.7	54.7
<u>Supply</u>						
In-State Capacity (c)	54.0	54.0	55.3	56.3	59.7	64.3
Planned Capacity Additions (d)	0.0	1.3	1.0	3.4	4.6	1.0
Imports (e)	3.2	2.8	1.2	3.4	3.7	3.8
Less: Planned Outages (f)	1.0	1.0	1.0	1.0	1.0	1.0
<u>Less: Unplanned Outages (f)</u>	<u>3.0</u>	<u>2.0</u>	<u>2.0</u>	<u>2.0</u>	<u>1.0</u>	<u>1.0</u>
Total Supply	53.2	55.1	54.5	60.1	66.0	67.1
Reserve Margin (#)	1.6	3.5	2.9	7.5	12.3	12.3
<u>Reserve Margin (%)</u>	<u>3.0%</u>	<u>6.4%</u>	<u>5.3%</u>	<u>12.5%</u>	<u>18.6%</u>	<u>18.4%</u>

Blackouts Likely (Reserve Margin = or < 1.5%) Maybe Maybe Maybe No No No

Source: Thesis Author

About 11,300 megawatts of in-state generating capacity will come on-line over the next three and one-half years, 3,800 megawatts of which will be put into operation in 2001⁴¹. As a result, the reserve margin should range from 3.0% to 6.4% during the summer months of 2001. Though these margins are above the 1.5% Stage 3 threshold, it's still quite possible that blackouts could occur particularly if any unanticipated contingencies occur. Recall that CERA expects up to twenty hours of extreme supply shortages. Given the increased in-state generating capacity that will likely be on-line from 2002 through 2004, the reserve margin will rise into the mid-teens where blackouts will not pose any threat. Given that blackouts should not persist beyond the summer of 2001, it makes sense that only a minority of Bay Area companies were contemplating having additional on-site generation installed.

Forecasting the reserve margin is a complex matter. Admittedly, certain variables have not been incorporated into the above analysis. For example, the power grid needs a minimum of \$1 billion worth of capacity increases and upgrades that will take five or more years to complete⁴². If the grid cannot accommodate the increased generation levels, then deliverable supply and effectively the reserve margin will not increase as projected. Similarly, the natural gas transmission pipelines that will provide the fuel used by virtually all of the new power plants are also operating at or near capacity⁴³. If they are not

adequately expanded, deliverable supply and the reserve margin will also suffer. Given all the numerous variables that need to be considered, the opinions of seven experts in regulatory and energy economics were sought (Table 3). The consensus among these experts was that blackouts should not continue past 2001.

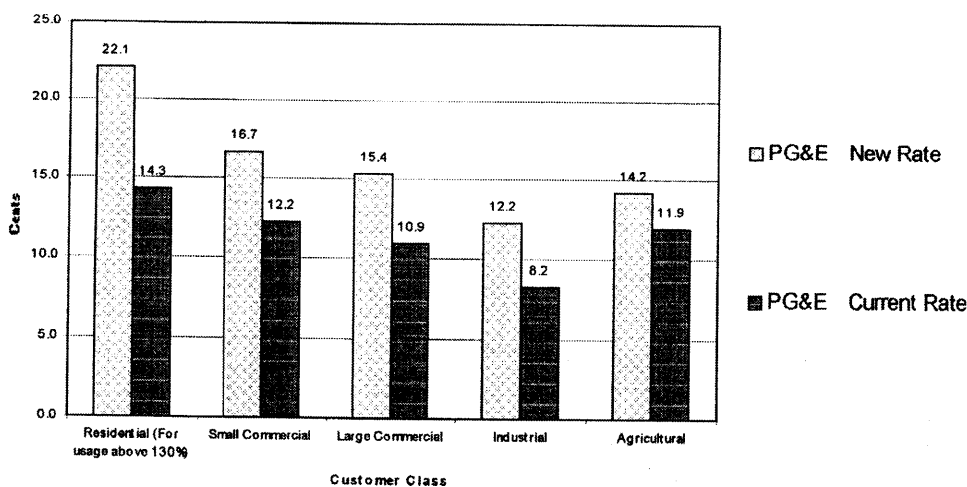
Table 3 Experts in Regulatory and Energy Economics

Name	Profile
A. Denny Ellerman	Executive Director, MIT Center for Energy and Environmental Policy Research
Paul Joskow	Director, MIT Center for Energy and Environmental Policy Research
Dan McFadden	Professor of Economics at UC Berkeley; Nobel Laureate
Ernest Moniz	Professor of Physics at MIT; Former U.S. Undersecretary of Energy
Robert Solow	Professor of Economics at MIT; Nobel Laureate
James Sweeney	Senior Fellow, Stanford Institute for Economic Policy Research
Mitch Wilk	Past President & Commissioner of the California Public Utilities Commission

RETAIL ELECTRICITY PRICES

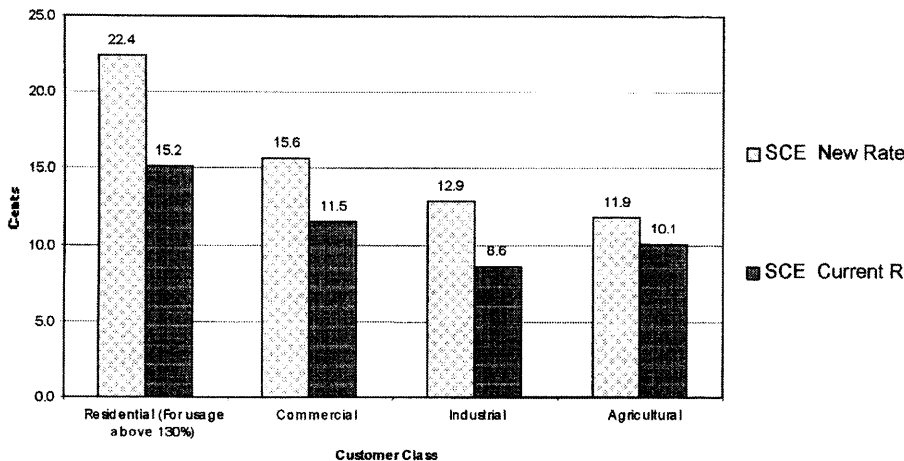
On June 1, 2001 commercial rates for SCE and PGE increased by 35.7% and 41.3% respectively (Exhibits 14 and 15). To determine if these historic rate increases and other prospective charges will create demand for CHPs that can provide office tenants with lower-cost electricity, it will be useful to determine how these cost increases impact California businesses and office tenants, and how long these cost increases will persist.

Exhibit 14 PGE's Current and New Rates



Source: California Public Utilities Commission

Exhibit 15 **SCE's Current and New Rates**



Source: California Public Utilities Commission

Cost to Businesses in the Aggregate. On April 1, 2002 the retail rate freeze will be lifted, enabling PGE and SCE to pass-on the cost of wholesale electricity to their retail customers. If this results in commercial rates increasing by another 10% up to 50%, then it is estimated that output for Bay Area businesses will decrease by \$530 million for each year that electricity rates remain at this level⁴⁴. Such losses are considerable. But, as with blackout-related losses, these rate-related losses amount to a mere .043% of California's total GSP. If they were quintupled to account for output reductions in the remainder of the State, these losses would still only equate to .215%. While such losses in the aggregate may not be of great consequence, the losses incurred by individual office tenants might. If the losses are high, office tenants will have to choose whether to conserve energy or absorb the increased cost of electricity. Naturally, they will opt for the alternative that reduces profits the least.

Cost to Individual Office Tenants. Office tenants can conserve energy by reducing their lighting levels and raising their thermostats from, e.g., 70 to 75 degrees. Lighting and heating-ventilation-&-air-conditioning account for 66% of peak load demand in a typical office building. These and other conservation efforts have already resulted in California's peak load demand being reduced by 10%⁴⁵. How long will such conservation measures continue given that they may adversely affect productivity and profitability? Probably, not for that long. The reality is that electricity comprises a very small portion of office tenants' total occupancy costs. For most office tenants, the cost of electricity and other costs associated with the operation and maintenance of the building are embedded in the rent. For example, a \$40 per square foot fully serviced office rent may include a \$10 per square foot operating expense

component, \$2 of which is allocable to electricity. Assuming electricity rates increase by an additional 10% to a total of 50%, then the \$2 per square foot electricity component will increase by \$1.00. Relative to the \$40 rent per square foot, this \$1.00 increase equates to 2.5%. While most office leases require the tenants to pay for increases in operating expenses and taxes, a 2.5% increase in occupancy cost is not likely to motivate many office tenants to consume less energy over an extended period of time, particularly if it negatively impacts productivity and profitability. Since absorbing the increased electricity cost is not significantly impacting office tenants, it is not likely that they would pay a premium to be in an office building with lower electricity costs. Without such a rent premium, providing office tenants with lower cost electricity would presently be a poor basis for investing in office CHPs. For such an investment to be justified, then either tenants will have to be subject to even higher IOU electricity costs and/or there must be another mechanism by which landlords can capture the price differential between IOU- and CHP-provided electricity.

Loss-Related Surcharges. As previously discussed, the reserve margin could reach the 15% to 20% range within 3 years. This is the range that industry experts believe is appropriate for California to achieve a healthy supply / demand equilibrium. As the reserve margin moves closer to this range wholesale prices should move towards their pre-crisis levels of \$32 per MWh. As wholesale prices decline, retail prices paid by the end-users should also fall so that in roughly three years businesses' electricity costs would be back to their pre-crisis levels. However, there are some complications that may result in surcharges being added to ratepayers' electricity bills, including those of office tenants.

First, the \$17.75 billion of losses incurred by the IOUs and the State of California will have to be reconciled. California recently announced its plans to sell \$13.4 billion in state revenue bonds⁴⁶. The revenue source will be a surcharge imposed upon the retail customer's electricity bill or a comparable rate increase. These bonds will consist of tax-exempt and taxable bonds, all of which will have a maturity date of 2016. In part, these bonds will pay for the \$7.5 billion to \$8.0 billion in electricity purchases that the State has already made. The balance will go towards electricity purchases that the State will pay for over the next 20 years pursuant to the 38 mid- and long-term procurement contracts⁴⁷ recently made with power generators. The State's Treasurer plans to sell these bonds in October-01. However, this date may get pushed back given the scrutiny these bonds have already been subject to. Critics are lining-up, including the State's Controller, an elected fiscal watchdog. She asserts that after accounting for a \$4.5 billion short-term loan that the Governor just arranged to buy additional near-term power, only \$1 billion will be left to pay for the 38 mid- and long-term electricity commitments. Given that these commitments are valued at \$43 billion⁴⁸ this amount appears woefully inadequate. Prospective investors, including

several multi-billion dollar bond investment funds, want assurances or guarantees that the CPUC will maintain or increase retail rates in order to pay for these bonds. The risk of non-payment is clearly on the minds of the bond investment community, demanding very high, risk premiums for these kinds of issues. Earlier this month, the parent company of Southern California Edison, had to reduce a \$1.2 billion private bond offering to \$800 million and pay a hefty 14% interest rate⁴⁹. If investors require comparable risk premiums be factored into the State's revenue bonds, the surcharges will increase accordingly. The complexities and obstacles associated with these State's \$13.4 billion revenue bonds are significant. That government officials have elected to burden the ratepayers with the State's losses as opposed to the taxpayers is revealing. From a political perspective, this appears to be the least damaging option, establishing a precedent for how the \$10.25 billion in IOU losses may be reconciled.

Second, there is also the issue of stranded costs. Once the IOUs began losing money due to under-collections, any revenues they received from their ratepayers went towards damage control. The pay-down of stranded costs was halted. Though deregulation did not guarantee the IOUs that their stranded costs would be entirely paid-off, the remaining stranded costs may still have to be accounted for.

Third, over \$1 billion needs to be spent on upgrading the grid for deferred maintenance and capacity increases. These upgrades will most certainly increase the retail price of electricity.

How Many Years Will Retail Rates Remain Elevated and Surcharges Be Applied. The magnitude of these prospective surcharges and how many years they will be imposed upon retail customers is difficult to determine at this time. The greater they are and the longer they last, the greater the prospective demand for CHPs will be. The seven experts who gave their opinions on how long blackouts would last (Table 3), were also asked to estimate how long retail electricity costs (e.g. rates and surcharges) would remain at or above their current levels. Most of the respondents believe that the ratepayers (not the taxpayers) will be saddled with the above referenced losses. Each of them indicated that there were too many unknowns (e.g. political uncertainty, and PGE's bankruptcy proceedings) to venture much more than an educated guess as to when retail costs would begin to come down. Their responses ranged from 3 years to 20 years with an average of about 10 years.

SUMMARY

Blackouts are not likely to continue past 2001. Power reliability will not be an issue for tenants except those that are particularly sensitive to any kind of power outage such as stock brokerages and 24-hour database management companies. While CHPs will provide value for these particular tenants, they are

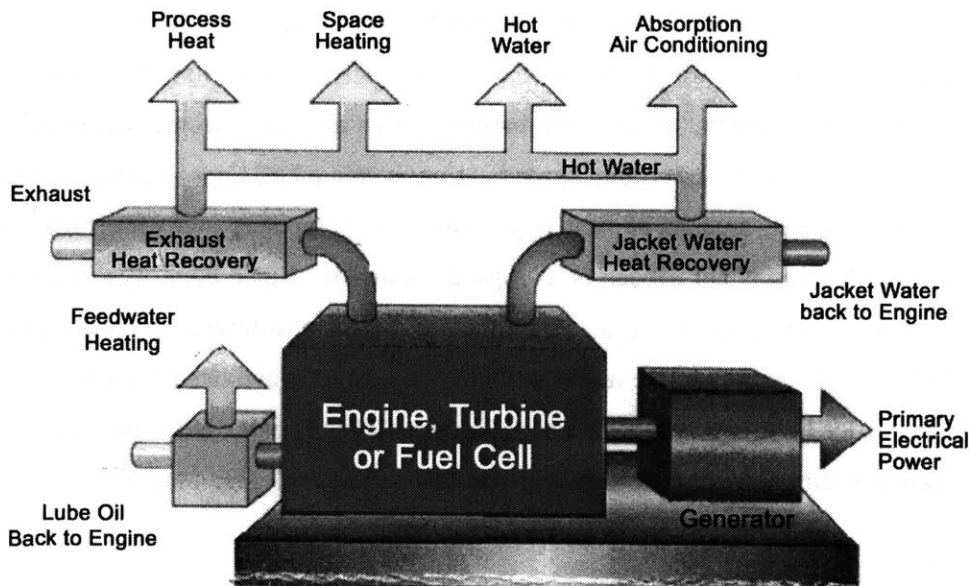
not likely to be enough to justify investment in CHPs on this basis alone. Retail electric prices should remain elevated for five or more years given the surcharges that will likely be assessed to the ratepayers. However, even at their current levels, the cost of electricity to office tenants is not great enough for most of them to demand alternative power sources such as CHPs. For investment into office CHPs to occur, the prospective loss-related surcharges will have to push the price of electricity to levels that are unacceptable to office tenants, or there will have to be some other mechanism by which CHPs can capture the price disparity between IOU- and CHP-provided electricity.

CHAPTER 3 – COGENERATION INVESTMENT OPPORTUNITIES FOR OFFICE LANDLORDS

INTRODUCTION

To understand what cogeneration investment opportunities may exist for office landlords, it will be useful to understand what distributed generation and cogeneration are and how they work. Distributed generation is electric generation that is located on or near the end-user's site. It can be small in scale, such as the portable generators that many households have in case of an emergency. It can be very large in scale, such as the enormous power plants that many industrial users have on-site. When electricity is created by combusting fuel such as natural gas, heat is also generated. Usually this heat is simply exhausted into the air. For example, in large, central power plants only 33%⁵⁰ of the energy released by the combustion process is converted into electricity. The remaining 67% is wasted. With cogeneration this waste-heat is captured to create hot water which can be used to heat a building's interior or to provide domestic hot water for bathing, cooking and washing. The production of two forms of usable energy (heat and electricity) from one fuel source (e.g., natural gas) is why this type of generation is called cogeneration or combined heat and power (CHP). A diagram of a CHP system is shown below (Exhibit 16).

Exhibit 16 **Diagram of Combined Heat and Power (CHP) System**



Source: RealEnergy

With centralized power plants (CPPs), it is not practical to capture the waste heat and transmit it over long distances to be utilized by end-users. Electricity is the only form of usable energy that CPPs can cost-effectively provide. Because CHPs generate two forms of usable energy from the same amount of fuel, they are able to convert a much higher percentage of the fuel source into usable energy than the 33% conversion efficiency of CPPs. This is illustrated in Table 4 below which lists various distributed generation systems used in commercial applications and their respective conversion efficiencies with and without cogeneration. At these elevated efficiency levels, CHPs obviate the need to consume additional electricity or natural gas to separately create interior space heating or domestic hot water. Consequently, a significant amount of both fuel and money are saved.

Table 4 Conversion Efficiency of Various CHP Systems

Technology	Efficiency without Cogeneration	Efficiency with Cogeneration
Solar	11%	11% *
Fuel Cell	40%	80%
Reciprocating Engine	35%	75%
Microturbine	27%	60%

Source: “The Market and Technical Potential for Combined Heat and Power in the Commercial / Institutional Sector”. Energy Information Administration, U.S. Department of Energy Report. January, 2000.

*Solar panels do not create any heat that can be used for cogeneration purposes.

To capitalize on the conversion efficiencies of CHP systems, the electrical and thermal demands of the commercial use must be coincidental, or close to it. For example, in a hotel, the demand for electricity and hot water are both very high in the morning and evening as guests respectively prepare to meet the day and later return from a day’s worth of sightseeing or business meetings. As both the electricity and hot water created by a CHP system can be put to good use at the same time, hotels are a very good application for CHPs. By contrast, in an office building there are high electrical demands throughout much of the day, but the need for year-round space heating in office buildings is generally not that great. In the colder months a large, amount of heat is generated by computers and office workers. In the warmer months space heating is not needed at all, space cooling is. Since there was insufficient use for the heat created by an on-site generator at an office building, there was little conversion efficiency to be gained with a CHP system. However, the recent advancements of heat-activated cooling and refrigeration systems have made office buildings very good candidates for CHP systems. Now, the electrical loads and the heating / cooling needs of the office building can be matched all year long and served by a CHP system.

TECHNICAL POTENTIAL FOR CHP APPLICATIONS IN THE OFFICE SECTOR

In 1999, the U.S. Department of Energy (DOE) prepared a report titled, *The Market and Technical Potential for Combined Heat and Power in the Commercial / Institutional Sector*. This report developed a profile of all the commercial uses (e.g. hotel and office) that could capitalize on the conversion efficiency of CHPs. Included in this profile is the need for electrical and thermal demands to be coincidental. Using this profile and an inventory of 4.5 million commercial and institutional buildings that were identified in a previous DOE report, *Commercial Buildings Energy Consumption Survey 1995*, the DOE determined the following: (1) the various types of building uses that are good candidates for CHP systems; (2) the number and geographic location of each of these building types; (3) the potential demand for CHPs (in terms of megawatts) per building type and geographic location. The building use with the greatest technical potential for CHP systems is the office building (Table 5). Across the U.S., there is 31,023 megawatts of total potential demand from the office sector of which 235 megawatts has already been installed⁵¹. The remaining potential demand is 30,788 MW. To put the 30,788 megawatts in perspective, it equates to 57% of California's total summertime peak demand of 54,300 megawatts. Across all building uses in the U.S. the remaining potential demand is 93,989 megawatts, equating to 173% of California's summer peak demand.

Table 5 Technical CHP Potential for Various Commercial and Institutional Building Uses

Building Use	# of Buildings	Total Potential (MW)	Installed CHP (MW)	Remaining Potential (MW)
Office Buildings	72,190	31,023	235	30,788
Schools	42,390	14,884	14	14,870
Hospitals	6,560	8,878	491	8,387
Nursing Homes	10,255	7,993	11	7,982
Hotels / Motels	13,665	6,703	30	6,673
Extended Service Restaurants	26,300	6,780	1	6,779
Health Clubs / Spas	7,095	3,552	164	3,388
Colleges / Universities	2,470	4,250	1,414	2,836
Correctional Facilities	2,585	2,721	135	2,586
Golf Clubs	4,855	2,208	0	2,208
Supermarkets	17,600	4,736	1	4,735
Water Treatment / Sanitary	2,610	949	141	808
Refrigerated Warehouses	1,315	792	0	792
Commercial Laundries	1,240	485	3	482
Museums	670	398	4	394
Car Washes	1,190	281	0	281
Other	N/A	N/A	2,282	N/A
Total	213,080	96,663	4,926	93,989

Source: "The Market and Technical Potential for Combined Heat and Power in the Commercial / Institutional Sector". Energy Information Administration, U.S. Department of Energy Report. January, 2000.

FLEDGLING INDUSTRY

The development of small-scale CHP systems with heat-activated cooling that are suitable for office buildings has occurred only within the last two years. Prior to the California energy crisis, there were only 52 office buildings in the entire U.S. that had CHP systems. The total generating capacity of these CHPs is 235 MW. This represents a mere .8% of the 30,788 MW total technical potential of office building CHPs (Table 5). The California energy crisis itself is only eight months old. With the national media attention that it has garnered, California has created widespread recognition that not only is its power infrastructure in dire straits, but so is much of the nation's. It is the convergence of deregulation, the recent advances in small-scale CHP technology, and the widespread generation and transmission shortfalls that is resulting in the formation of an industry of CHP vendors, contractors, 3rd-party developers and office landlords. Because such an industry is in its infancy, the amount of relevant data that can be gleaned from periodicals, studies, textbooks and interviews is quite limited. As a result this part of the thesis is exploratory in nature.

CHPs ROLE IN SOLVING THE CALIFORNIA ENERGY CRISIS

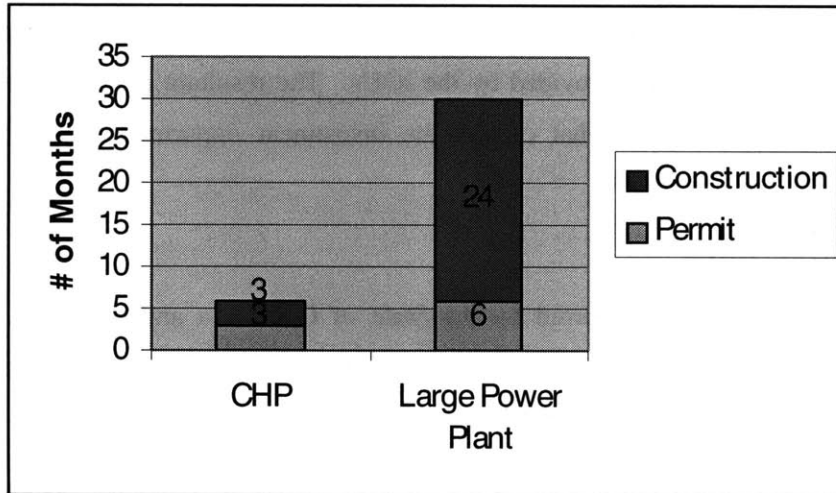
There are three reasons why office CHPs can make an important contribution to the resolving of the California energy crisis. First, office buildings consume 26% of all electricity nationwide⁵². They place an equally great demand on California's generating capacity. With widespread application, the siting of CHPs in office buildings can reduce the demand placed on California's central generation plants. This will serve to increase California's reserve margin, which in turn will help reduce the risk of blackouts and the cost of wholesale and retail electricity.

Second, because transmission lines are already operating at or near their capacity, it will be problematic to deliver any of the new centralized generation capacity that is coming on-line. It will be many years and billions of dollars before the transmission and distribution lines are fully upgraded. CHPs will reduce the electrical congestion on the grid, enabling more of the centralized generation to get delivered.

Third, office CHPs can be deployed in one-fifth of the time it takes to place a large, centralized power plant into operation. More generation can be added more quickly, enabling a healthy balance between supply and demand to be achieved sooner. Because of their small-scale and relatively simple component parts, office CHPs can be completely permitted, installed and in-operation within 90 to 180 days (Exhibit

17). By contrast, it takes up to two and one-half years to permit, construct and place a large, centralized power plant into operation.

Exhibit 17 **Permit and Construction Time for CHPs vs. Large Centralized Power Plants**



Source: California Environmental Protection Agency; RealEnergy

The generating capacity of a central power plant can range from 300 MW to 1,000 MW. The generation capacity of an office CHPs can range from 100 kW to 3 MW depending upon the size of the office building. Because this is well below the 50 megawatt threshold at which a permit from the California Energy Commission is needed, CHPs are not subject to the same permitting process that has been the bane of most large scale generators over the last decade. Although CHPs must still obtain permits from the local air-quality management district, and local zoning, planning and building departments, this process typically takes up to 90⁵³ days though by the book it can take as much as 180 days⁵⁴. Installing the CHP system takes another 90 days⁵⁵. This relatively short period of time owes to the accessibility of the rooftop where the CHP will be sited, the small scale of the CHP system, and that the major components of the system (e.g. combustion engine and generator) are pre-assembled.

INVESTMENT OPPORTUNITY

FUEL AND TRANSMISSION SAVINGS.

The California energy crisis has created a big need which office CHPs appear well positioned to help satisfy. The question is whether this need/satisfaction relationship translates into a desirable investment opportunity. As previously discussed, the delivered efficiency of electricity that is generated at a CPP and

transmitted along power lines to end-users averages about 33%. Because the conversion efficiency of CHPs (@ 75%) is basically twice that of most large, centrally located power plants, CHPs can produce the usable energy needed by an office building (heat and electricity) while using only half the amount of fuel that an IOU would. As CHPs are located on-site, not only is the cost of transmitting electricity over long distances eliminated, so are the expenses associated with the maintenance and repair of the power grid. The fuel and transmission cost savings are what primarily enable CHPs to deliver power to end-users at a fraction of the cost of power provided by the IOUs. The resultant price differential between CHP- and IOU-provided electricity is what creates the investment opportunity for office landlords (Exhibit 18).




LOSS-RELATED SURCHARGES.

Surcharges relating to (1) the losses incurred by the State of California and the IOUs, (2) stranded investments, and (3) grid upgrades that are imposed upon IOU customers will increase both the price differential and the return on investment (Exhibit 18).



Exhibit 18

Price Differential Creates Investment Opportunity

Additional Price Differential	Loss-Related Surcharges 
Primary Price Differential	IOU Electricity Rate 
Lower CHP rate due to fuel cost savings and elimination of all transmission costs.	CHP Electricity Rate 

Source: Thesis Author



EARLY INDUSTRY PARTICIPANTS

As in the evolution of any industry, a few parties decide to enter sooner than others. Among the early landlord entrants to the office CHP industry are Arden Realty, Equity Office Properties (EOP), The Hines Company, and CalPERS. All four have already installed CHPs into some of their buildings and continue to look for additional CHP opportunities within their portfolios.

Landlords

Arden Realty. Arden Realty is an office REIT and the largest office landlord in Southern California. Its portfolio consists of 143 properties that comprises 19.2 million square feet of office space. It is in the process of installing 13 office CHP systems, all of which will be in operation by the end of 2001.

Equity Office Properties. EOP is the largest office REIT in the country with a portfolio of 99 million square feet. EOP currently has CHPs operating in 3 of its office buildings and expects to have several more up-and-running by year-end.

Hines. Hines is one of the largest office-building landlords in the world. Its portfolio includes more than 660 properties valued in excess of \$10 billion, representing 212 million square feet of office, mixed-use, industrial, retail and residential properties. Hines has installed two CHPs into its office buildings, and is evaluating each of its remaining properties to determine the suitability of installing more.

CalPERS. CalPERS is the largest pension fund in the U.S. with \$158 billion in total assets including \$7.1 billion in California real estate. It is currently having CHPs installed into 3 of its office buildings.

By year-end, these landlords will have placed a total of 21 new CHPs into service, increasing the total number of office CHPs in the entire U.S. by 40%. All of this will have occurred within just one year from the onset of the California energy crisis. If these CHP installations perform as expected during their demonstration period, then more will likely follow.

It is not surprising that these landlords have taken the lead in siting CHP systems. Arden, EOP, and Hines have also been leaders in the Energy Star program sponsored by the U.S. Environmental Protection Agency. To be Energy Star certified, the office building under consideration must be in the top 25% of comparable office buildings in the U.S. in terms of energy-efficiency. There are 372 Energy Star certified office buildings in the U.S. Arden owns 80 of these buildings, while EOP and Hines respectively own 32 and 34 of them. Collectively, they own 39% of all Energy Star buildings in the U.S.

3rd-Party CHP Developers. Because landlords may prefer to outsource the ownership and operation of CHP systems in order to preserve capital for property investments, there are a handful of 3rd-party CHP developers poised to provide such services. Despite casting a wide net, only the three 3rd-party CHP

developers were identified⁵⁶. This is probably due to the short period of time in which this niche industry has been developing. All of the 3rd-parties that have been identified will operate CHP systems on behalf of their clients, but not all of them are willing to own the CHP system as well.

RealEnergy. RealEnergy is a Los Angeles-based company that provides on-site energy generation technologies to commercial properties in urban and suburban markets. It is in the process of installing CHPs in 20 office buildings, all of which should be in operation before year-end. RealEnergy was founded in 1999 and recently received equity commitments of \$50 million. This is believed to be the first major institutional investment dedicated to the installation of distributed generation systems in the U.S. The investment team was led by two Los Angeles-based companies, GFI Energy Ventures and CalPERS / Global Innovation Partners. Other investors include Griffendor, Detroit Edison, and CS First Boston.

Texas Utilities. TXU is the 9th-largest energy company in the world. In 2000, its annual revenues were \$22 billion. TXU is the 4th-largest energy provider and 3rd-largest electricity generator in the U.S. TXU is an IOU with 4 million retail customers in Texas and a domestic generation capacity of 21,000 MW. Generation capacity abroad is 9,000 MW. TXU provides comprehensive solutions to help large commercial and industrial customers manage their energy needs, including the operation of cogeneration systems.

Enron. Enron is ranked #7 in the Fortune 500. In 2000, its annual revenues were \$100.8 billion. It has four business units: Wholesale Services, Energy Services, Broadband Services and Transportation Services. Enron is the country's the top buyer and seller of natural gas and the largest wholesale power marketer in the US. It owns and operates power plants in the U.S. and abroad with a total generation capacity of 9,000 MW. Enron also operates a 25,000-mile gas pipeline system in the US. The Energy Services unit provides energy construction, engineering and consulting services to various clients including office landlords.

INTERVIEWS WITH OFFICE LANDLORDS AND 3RD-PARTY CHP DEVELOPERS

Each of the above landlords and 3rd-party developers were interviewed for this thesis as was Kevork Derderian who has been on the leading edge of energy-efficient office development in Chicago for many years. His company, prior to being sold to a REIT, owned and operated 2.5 million square feet of office space. Over the course of one or more interviews each interviewee was asked questions relating to such issues as market potential, deregulation, business value, business risks, risk-mitigation strategies, target

markets, investment criteria, and how an office CHP basically functions. Their responses have been invaluable in helping to determine whether market opportunities for office CHPs are currently being created in California and prospectively in other states.

BASIC CHP FUNCTIONS

By more than one account, there appears to be a great investment opportunity in siting CHPs in office buildings. To better understand the benefits and risks that they may create for landlords, tenants and 3rd-party developers, it will be useful to review how office CHP systems basically function.

Hours of Operation. CHPs are not intended to completely displace the electricity that a building obtains from the IOUs. Rather, they are intended to operate during periods of peak demand when IOU-provided electricity is the most expensive and the potential for power outages is the greatest. Office CHPs typically operate from 2,500 to 4,000 hours per year. This roughly equates to 10 to 15 hours per day, 5 days per week, 52 weeks per year. (A system that runs 24/7 would operate 8,740 hours per year.)

Generation Capacity. The generating capacity of an office CHP is typically designed to accommodate 20% to 50% of a building's peak load demand. The peak load demand of a typical office building is approximately 5 watts per square foot. For example, a 400,000 square foot building has a peak load demand of 2 million watts (or 2 MW). Assuming the CHP is designed to accommodate 50% of this peak demand, the CHP would have a generating capacity of 1 MW. Office CHPs can be sited on the building's rooftop in an area of 800 to 1,500 square feet⁵⁷. For example, a 1 MW system would need about 1,200 square feet of rooftop space. The minimum office building size in which a CHP is cost effective is approximately 100,000 square feet.

System of Choice. There are several types of CHP systems. As shown on Table 4, the systems with the highest conversion efficiencies are fuel cells (@ 80%) and reciprocating engines (@ 75%). Though fuel cell CHPs have a higher conversion efficiency than combustion engine CHPs, they are much more expensive and consequently are used less frequently in office buildings. Fuel cell CHPs cost about \$4,100 per kW while combustion engine CHPs are \$900 per kW⁵⁸. The generation capacity of the CHP system needed for the 400,000 square foot office building described above is 1 MW (or 1,000 kw). A fuel cell CHP for this building would cost \$4.1 million while a combustion engine CHP would cost \$900,000.

The generating capacities of office CHPs fall within the range of 0 to 4.9 megawatts. There are 781 existing commercial and institutional CHP systems that fall within this capacity range (Table 6). Eighty-seven percent of these CHPs are driven by reciprocating engines. Reciprocating engines are easy to start-up. Their emissions have been reduced significantly with exhaust catalysts and improved combustion controls.

Table 6 Primary Driver for Small-Scale CHPs

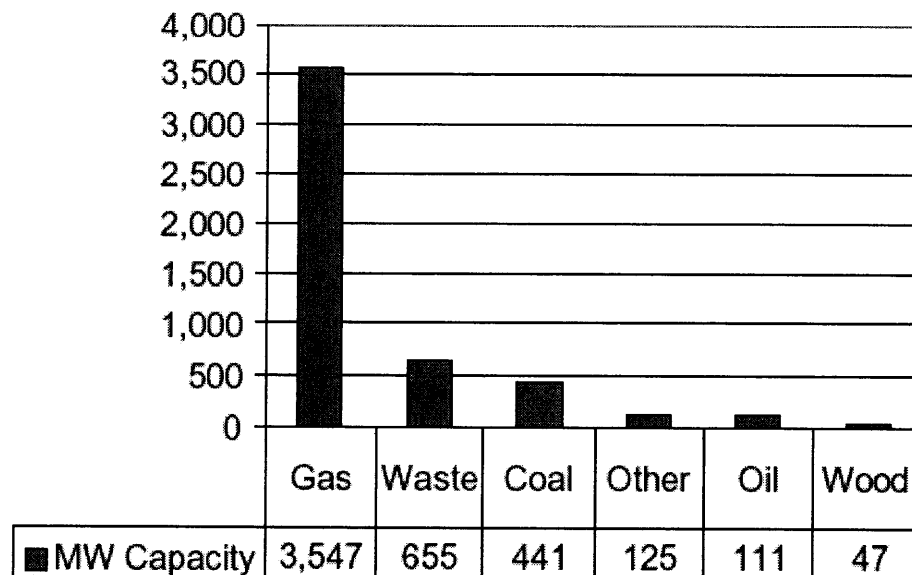
Capacity	Reciprocating Engine	Boiler / Steam	Combustion Turbine	Other	Total
0 to .999 MW	663	7	20	16	706
1.0 to 4.9 MW	18	15	42	0	75
Total	681	22	62	16	781
% of Total	87%	3%	8%	2%	100%

Source: "The Market and Technical Potential for Combined Heat and Power in the Commercial / Institutional Sector". Energy Information Administration, U.S. Department of Energy Report. January, 2000.

The fuel that is used most often to drive CHPs is natural gas. 72% of all the CHP capacity in the U.S. relies on natural gas for its fuel source (Exhibit 19). Virtually all of the office CHPs being installed will be fueled with natural gas as are 90% of the new centralized power plants being sited across the U.S.⁵⁹. Natural gas is relatively simple to deliver to remote sites via existing natural gas pipelines. Natural gas burns cleanly such that the cost of emission controls on small-scale CHPs is manageable.

Exhibit 19

Primary Fuel Sources for CHPs



Source: "The Market and Technical Potential for Combined Heat and Power in the Commercial / Institutional Sector". Energy Information Administration, U.S. Department of Energy Report. January, 2000.

OWNING & OPERATING VS. OUTSOURCING THE CHP FUNCTIONS

The magnitude and timing of the CHP's economic benefits to the landlord is dictated by whether the landlord chooses to outsource the ownership and operation of the CHP to a 3rd-party, or keep these functions in-house.

3rd-party CHP Developer. The arrangement which 3rd-party CHP developers are proposing to landlords is very similar to that which has been offered by telecommunications entrepreneurs wanting the exclusive right to provide internet access to an office landlord's tenants. Under this arrangement the CHP developer pays the landlord a monthly fee for the exclusive right to provide the landlord's tenants with reliable CHP-generated electricity at a cost that is less than or equal to the cost of IOU-provided electricity. The CHP developer is also responsible for (a) obtaining all the necessary CHP permits; (b) purchasing, installing and operating the CHP at its sole cost; and (c) negotiating and purchasing natural gas contracts at its sole expense.

The monthly fee paid to the landlord can be fixed or variable. Often it is set at a percentage of the CHP's gross electricity sales or at some percentage of the building's total electricity savings. The landlord may elect to share a portion of this fee with its tenants to reduce their electrical costs. The power entrepreneurs have determined that the price differential illustrated in Exhibit 18 is great enough to pay the landlord this monthly fee and make an acceptable return on their investment. CHPs are used most during peak hours when the cost of IOU-provided electricity is the highest and the resultant price differential is the greatest. During non-peak hours (e.g., evenings and the weekends), the spread is typically not great enough to justify the operation of the CHP. This is one of the reasons why most office CHPs will remain connected to the grid. Another reason is that the grid provides a back-up system should the CHP system fail or is down for scheduled maintenance. Also, excess power created by the CHP could be sold back to the IOUs, creating another revenue center. The term of the agreement varies, but typically is 15 years in length. This roughly coincides with the useful life of the CHP system. At the end of the 15-year term, the landlord can either renew its contract or not. If it doesn't, the 3rd-party CHP developer still owns the equipment which it must then remove from the building. The expected payback period for the 3rd-party developer is about 4 to 5 years.

Landlord Owns and Operates CHP. When a landlord opts to own and operate its CHP system, there is a tradeoff. By eliminating the 3rd-party developer, there is more profit for the landlord. However, the increase to the landlord's net operating income (NOI) will not occur as rapidly and the landlord will not have the use of this extra money as quickly. How rapidly the landlord's NOI will increase is largely dictated by the type of leases which it has with its office tenants. There are three basic types of office leases.

Gross Lease. In a gross lease, the tenant pays a predetermined rental rate, e.g. \$40 per square foot. The landlord is responsible for paying all of the operating expenses and taxes of the building, e.g. \$10 per square foot, out of the gross rent which it receives. If the CHP reduces the building's electrical expense by e.g. \$1 per square foot, the tenant's \$40 psf rental payment does not change and the landlord will keep all of the \$1 psf savings, increasing its NOI accordingly.

Triple-Net Lease. In a triple-net lease, the tenant pays the landlord a base rental rate, e.g. \$30 per square foot and is responsible for paying all of the operating expenses and taxes associated with the space it leases, e.g. \$10 per square foot (psf). If the CHP reduces electricity costs by \$1 psf, then the tenant pays only \$9 psf in operating expenses and taxes while continuing to pay the landlord the same \$30 psf in base rent. The tenant is the sole beneficiary of the CHP savings. The only time that the landlord can benefit under a triple-net lease is when the tenant's lease is up for renewal and the landlord can increase the rent for the existing (or new) tenant to reflect the energy savings. Office leases typically have terms of 3, 5 and 10 years. Typically, it takes seven years for all of a building's leases to come up for renewal⁶⁰. Waiting this long to realize the full benefit of the CHP savings may be a disincentive for some landlords to own and operate their own CHPs.

Fully Serviced Lease. A fully serviced lease, is a hybrid of the gross and triple net lease. The payment that the tenant makes is comprised of a rent component (e.g., \$30 psf), an operating expense component (e.g., \$9 psf) and a property tax component (e.g., \$1 psf). The tenant is responsible for any increases in operating expenses and taxes over the term of the lease beyond the respective \$9 psf and \$1 psf "base rates". It is possible for both the tenant and the landlord to benefit from the electricity cost savings created by a CHP system. To illustrate, refer to the five-year lease shown below (Table 7). Operating expenses and taxes often track inflation. If inflation increases by 2% then the Year 1 operating expense and tax rate of \$10 psf (combined below for simplicity) will increase to \$10.82 by Year 5. The tenant's pass-through expenses equal the difference between the total operating expenses and taxes for each year

and its \$10 combined base rate. In Year 3, pass-through expenses are $\$.40 = \$10.40 - \$10.00$. If a CHP is sited in this office building in Year 3 which reduces electricity costs by $\$.50$, then the total operating expense and taxes in this year will drop from $\$10.40$ to $\$9.90$. Since this total rate is below the tenant's combined $\$10.00$ base rate, its pass through expenses have been reduced by $\$.40$ to zero. Because most fully serviced leases do not rebate the tenant when operating expenses and taxes fall below the base rates, the remaining $\$.10$ goes to the landlord in Year 3. However, in Years 4 and 5 when operating expenses and taxes increase to $\$10.61$ and $\$10.82$, and the tenant's pass-through expenses increase to $\$.61$ and $\$.82$, all of the $\$.50$ electricity savings will go to the tenant. In Year 6, the landlord can renew the tenant's lease or lease the space to another tenant. In either case, the base rate which the tenant will be responsible for will be adjusted to $\$10.54$ ($\$11.04 - \$.50$). If market rents in Year 6 are still at $\$40$, then the landlord's net rental rate will be $\$29.46$ ($\$40 - \10.54) which is $\$.50$ greater than it would have been had electricity costs not been reduced with the CHP system. This demonstrates how the landlord becomes the sole beneficiary of the energy cost savings as leases rollover. Most office buildings utilize fully serviced leases. Given that the intermittent benefits to the landlord, much of which occurs upon lease renewal, short-term holders of real estate may prefer to outsource the CHP functions.

Table 7 Allocation of Electricity Cost Savings Under a Fully Serviced Office Lease

Year	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>
Operating Expenses + Taxes	10.00	10.20	10.40	10.61	10.82	11.04
Tenant's Pass-Thru Expenses	0.00	0.20	0.40	0.61	0.82	0.00
CHP Electricity Cost Reduction psf	-	-	0.50	0.50	0.50	0.50
Tenant Electricity Cost Savings psf	0.00	0.00	0.40	0.50	0.50	0.00
Landlord Electricity Cost Savings psf	-	-	0.10	-	-	0.50

BENEFITS TO OFFICE TENANTS

Lower Electricity Costs. If the landlord outsources the CHP functions to a 3rd-party, the CHP developer has an incentive to charge approximately the same price for electricity as the IOU does, given that this will maximize the developer's price-spread and revenues. Unless the landlord elects to share a portion of its monthly fee with its tenants, it's not likely that the tenants will see their electricity costs drop significantly. If the landlord owns and operates its CHP, then the tenants will realize all or part of the energy cost savings depending upon whether they are on a triple-net or fully serviced lease. Gross leases that were common 30 years ago are seldom used today for office buildings.

Improved Power Reliability. In the vernacular of the power industry, electricity provided over the grid offers “two 9s” of reliability, meaning that end-users can rely on power being provided 99% of the time. In telecom-hotels, the end-users require six 9s of reliability. The redundancy of an office CHP increases the reliability of power beyond the two 9s of the grid. For some tenants such as stock brokerages, bond traders and data-base management companies, this level of reliability may be critical. For this protection, these tenants will pay a premium in the form of additional rent or a separate charge.

Circumvention of Loss-Related Surcharges. California office tenants currently can realize a significant cost savings in being able to avoid the prospective surcharges associated with the billions of dollars of (a) losses incurred by the IOUs and the state, (b) stranded investments, and (c) grid-upgrades. These costs are not yet recoverable from electricity that is generated by CHPs.

BENEFITS TO LANDLORD

Capturing the Price Differential between CHP- and IOU-provided Electricity. By nearly all accounts, this is the driving force behind investing in office CHPs. The only question is whether the landlord will choose to outsource the CHP function or keep it in-house. Landlords that prefer to outsource this function may include the following:

- Landlords with smaller portfolios, as it may not be practical to spread the cost of in-house CHP expertise over a limited number of properties.
- Traders (short-term holders) which want to increase the property’s NOI and value as quickly as possible.
- Institutions and pension funds that prefer to shift the responsibility of the CHP function to a third party for fiduciary or liability purposes.
- REITs which want to increase funds from operation and franchise value as quickly as possible.
- Landlords concerned with the extent of operating risks.

Landlords that prefer to keep the CHP function in-house may include:

- Landlords with large portfolios that can spread the cost of in-house CHP expertise over many properties.
- Long-term holders of real estate.
- REITs which want to increase franchise value over the long-term.

Of the 52 office buildings that had CHPs as of 1999, 28 of these systems (or 56%) were owned and operated by 3rd-parties, while 24 of them (or 44%) were owned and operated by the landlord⁶¹.

Reliable Power Rent Premium. There is a high level of expectation that a premium can be charged to those tenants which are particularly sensitive to power outages. This is tantamount to paying an insurance premium as a risk hedge. Recall that office CHPs are designed to handle up to 50% of the peak load demand. If there is a power outage on the grid, the CHP will only be able to provide peak load supply to 50% of the building. Therefore, some tenants will be without power. Those tenants for which this is not an option will pay a rent premium to ensure that they are part of the 50% that continues to be provided with electricity.

Tenant Retention and Attraction. The tenant improvement costs, brokerage commissions and lost rental income associated with having to lease a vacant office space are considerable. Keeping these costs to a minimum by retaining existing tenants and quickly attracting new ones is a top priority for office owners. Landlords with CHP systems in place intend to achieve this objective by promoting the reliability and lower cost of electricity in their building via their marketing / leasing materials, constant communications with leasing agents, tenant newsletters and tenant surveys. It is with this knowledge that tenants can clearly evaluate the advantages of being in a building that has lower-cost and reliable power.

Selling Excess Power Back to the Grid. This source of income is one that would be welcomed if it arises, but is not being banked upon by any of the interviewees.

Lower Greenhouse Gas Emissions. Because CHPs are more efficient and burn less fossil fuel per kilowatt than large, centralized generators, CHPs reduce the amount of carbon dioxide being released into the atmosphere by electricity generators. Carbon dioxide is the greenhouse gas that contributes most to global warming. While landlords and CHP developers consider this environmental benefit a good business practice, none anticipate that it will have any direct economic benefit to them in the short- or mid-term, nor would any of them invest in CHPs on this basis alone.

BUSINESS RISKS AND MITIGATION STRATEGIES

The business risks which the owner / operator of the CHP system is exposed to and the mitigation measures it consequently takes are presented below. The owner / operator can be either the landlord or the 3rd-party developer.

Natural Gas Price Volatility. Office CHPs are driven by combustion engines, which are fueled by natural gas. The price volatility of natural gas is one of the greatest concerns of the owner / operator. To mitigate this risk, it is absolutely critical that mid- and long-term natural gas procurement contracts are obtained. Without these contracts, there is no CHP investment. Recall that skyrocketing natural gas prices are what initially set the California energy crisis in motion (Exhibit 5).

Natural Gas Infrastructure. Over 90% of the new large-scale, centralized power plants being built in the U.S. will be fueled by natural gas. Virtually all, new CHPs will be fueled by natural gas. As the deployment of CHPs becomes widespread, increasing the capacity of natural gas transmission and distribution lines will be critical. Recall that transmission constraints in California resulted in wholesale natural gas prices increasing six-fold while prices across the rest of the country increased only two-fold. Currently, this is not considered a major risk. Most new office CHPs will go into existing buildings that already have gas connections that supply fuel to the boilers. The mid- and long-term electricity contracts which California and large energy companies have signed should induce gas distributors to build the needed infrastructure. Expectations are that two major pipelines will soon be built that will bring more natural gas into California from the Southwest and Midwest.

Re-Regulation. Some interviewees expressed considerable concern that California will overreact to the economic fallout that has occurred by returning to a rate-regulated electricity market. If CHPs are sited and rates are subsequently established by the CPUC that are less than those needed for the CHP investment to be viable, significant losses will result. Leasing the CHP system instead of owning it is one way to partially mitigate this loss. The only way to completely avoid this risk is to stay out of the California market.

Decline of Retail Electricity Prices. When the price of power from the grid declines, so does the price spread between CHP- and IOU-provided electricity. A precipitous and rapid decline in retail prices could render a CHP system non-competitive. It is important that factors affecting retail prices such as supply & demand and prevailing surcharges be carefully monitored. In places like California, a sudden drop in retail prices is considered a possibility, but not a probability given the issues discussed in Chapter 2.

Financing Costs. Currently, both debt and equity are relatively inexpensive. It is possible that these could change. But the expectation is that rates will not change significantly over the four- to five-year payback period anticipated for most CHP systems. Each of the companies interviewed have hedging instruments at their disposal, if this expectation changes.

Technological Obsolescence. While specific CHP technology could become obsolete, new technology takes a while to get deployed. Considering the expected short payback period, none of the parties expressed great concern over this risk. If they become concerned later, they each have the option to lease the CHP equipment rather than purchasing it.

Local Emissions. Per kilowatt generated, office CHPs produce 50% fewer emissions than centralized power plants. However, because these reduced emissions may occur closer to the end-user, local air-quality districts may impose tighter emission controls on CHPs. Though such controls could be quite expensive, most of the office CHPs being deployed will have emission controls that equal or exceed the best available technology⁶².

System Reliability. A concern that landlords have in providing exclusive on-site generation rights to any 3rd-party is that the system will fail and tenants will be without power for days at a time. This will lead to lawsuits and tenant exodus, reducing the property's net operating income and value. This very rational concern can be addressed in three ways. First, CHP systems are connected to the grid that serves as a back-up source of power until the CHP is brought back into service. Second, the exceptional reliability of reciprocating engines used to drive the generator is well documented and time-tested. North America alone produces 35 million reciprocating engines each year for autos, trucks and many other products. Third, warranties are obtained from the vendors of the CHP's component parts (e.g., combustion engine and generator) and from the contractors that assemble and install the CHP systems.

Financial Strength of 3rd-Party Developer. When a landlord outsources the CHP function, the capitalization, experience and long-term viability of developer can be a concern. Some landlords will prefer to work with a large "energy partner" with deep pockets or the ability to obtain sufficient liability insurance to protect against financial insolvency. Others landlords are comfortable with smaller CHP companies, particularly when the key executives are industry savvy and their investors are well known and highly sophisticated. Should the developer go bankrupt, the landlord typically has an option or first

right of refusal on the CHP equipment. But even without the CHP equipment, the landlord's worst case scenario is that it will go back to buying all of its electricity from the grid. When financial insolvency is not an issue, the choice between big or small is often based on whether the landlord wants a customized set of services or a large array of bundled services.

TARGETING MARKETS FOR CHP APPLICATIONS

Landlord. While the economic benefits of CHPs to the landlord are worth pursuing, they alone will not drive any landlord's decision to purchase a given office building. Considerations such as purchase price, rent upside, and leasing risk will compel this decision, not whether the building is located in a state that is deregulated and has high retail electricity prices. The decision to install an office CHP begins with ascertaining which of their existing properties can capitalize on the fuel and transmission savings afforded by the CHP's heat-activated cooling system. Heating, ventilation and air-conditioning accounts for 35% to 45% of an office building's annual electricity consumption⁶³. Air-conditioning (AC) systems in office buildings are very expensive and have a useful life of 25 to 35 years⁶⁴. If a landlord has a building with a 10-year old air-conditioning system, then the upside resulting from installing a new CHP system may not be sufficient to justify, e.g., paying-off the remaining 25 years of financing costs on the original AC system. The most likely candidates for CHPs are brand-new buildings or buildings with relatively old and inefficient AC systems. If a given AC system should be replaced (or if a new system is needed for a ground-up development), then factors such as retail electricity prices and deregulation will become critical in deciding to install a CHP system or not. Landlords will also focus on those buildings in which tenants need highly reliable power, such as trading floors, airline reservations companies, and HMO data base companies.

3rd-Party CHP Developer. The CHP developer is primarily concerned with the price spread between CHP- and IOU-provided electricity. Consequently, they concentrate on regions with high retail electricity prices and low tariffs. Typically, tariffs are taxes or surcharges that are added onto the ratepayers bill. Examples include competition transition fees, stand-by fees and exit fees.

Stand-By Fees and Back-Up Power. IOUs have argued that they have to build excess capacity in order to provide back-up power should a CHP or other cogenerator fail during a period of peak demand. These IOUs have persuaded many regulators that their stand-by fees should reflect the very high marginal cost of building additional generating capacity for this sole purpose. This is not a valid

argument in states with reserve margins in excess of 15% to 20%, as there already are suitable levels of back-up capacity. Nor is it applicable if a CHP system is being installed into an existing building. The amount of back-up power that the CHP requires is no more than the demand that it originally removed from the grid. The resultant excess capacity to the grid should, in turn, be available for back-up power. If a CHP is being installed into a new building, then new back-up capacity is warranted. Under any of these scenarios, IOUs can effectively use stand-by fees to discourage competition. While in certain instances back-up power is appropriate, some industry insiders contend that it's not needed to the extent and cost which the IOUs have claimed.

In places like in California where the reserve margin has dipped so low as to result in blackouts, the benefit of bringing new CHPs on-line greatly out-weighs any risk of all of them failing during a peak demand period. This is why the State of California has mandated that stand-by fees are to be waived through 2010 for CHPs that are brought on-line over the next 2 years. IOUs set stand-by fees as high as the regulators will allow, attempting to eliminate the price spread between CHP- and IOU-provided power, in order to thwart competitive generation. Consequently, this 10-year waiver of stand-by fees presents a tremendous inducement to site CHPs in California.

Exit Fees. Exit fees are directly related to competitive transition fees. As discussed in Chapter 1, the latter effectively results in a surcharge which is added to the ratepayers electricity bill to help pay-down the IOU's stranded investments. Consider a hypothetical IOU that has \$1 billion in stranded investments. To pay-down these investments, the IOU issues a revenue bond with an interest rate of 6% and a term of 5 years. If this IOU has 1 million customers, then each would pay a pro-rata monthly surcharge of roughly \$24 over the next 5 years. What would happen if half of these customers installed CHP systems and purchased the balance of their electrical needs from a wholesaler like Enron? Would the IOU be forced to double the surcharge it assesses its remaining customers or extend the term of the surcharge by another 5 years? Such moves would result in more customer defection, exacerbating an already bad situation. The solution which the IOUs have successfully presented to many regulators is an exit fee in which the departing customer continues to pay all or part of the competitive transition charge which it had been assessed. MIT is a case in point. In 1995, MIT put a 22-megawatt cogeneration facility into service. It was expected to meet 95% of the heat, cooling and power needs of the campus, to cut energy bills by 40%, and to reduce annual pollutant emissions by 45%⁶⁵. This installation occurred during the time that Massachusetts was in the process of deregulating its electricity markets. The Massachusetts Department of Utilities approved the local IOU's request to impose an exit fee on MIT of \$1.3 million per year even though MIT was already paying \$1 million per year in stand-

by fees for back-up power⁶⁶. MIT took its case ultimately to the state's Supreme Court that determined that no ratepayer which opts for self-generation should have to pay an exit fee. When the dust had settled on Massachusetts deregulation laws in late 1997, CHP systems with over 50% efficiency were exempted from such exit fees. California is currently considering the imposition of an exit fee given its concern that many IOU customers will switch to other energy sources and providers. However, the exit fee may cover more than just stranded investments. It may also apply to the losses of the IOUs and the state that have not been recovered. If this exit fee is imposed, then the additional price differential described in Exhibit 18 would be eliminated. Whether an exemption for CHPs will be provided, as in Massachusetts, has yet to be determined.

Interconnectors. For office buildings to continue to receive electrical service from the IOUs when the CHPs are not being operated (e.g., during non-peak hours or maintenance periods) there must be a physical interconnection between the grid and the CHP system. Since the IOUs own the transmission and distribution lines, they could refuse to provide these interconnections were they not required to by law. PURPA, the applicable law, mandates such interconnections for CHPs and other cogenerators that are 50% more efficient than the national average for IOUs. PURPA, however, still allows the IOUs to determine what constitutes a safe and proper interconnection⁶⁷. Such latitude has enabled the IOUs to discourage CHP development by driving the design and cost of the interconnection as high as possible⁶⁸. This is a major concern of the interviewees.

IOUs have argued that such elaborate designs and costs are necessary given that improperly connecting the grid to a CHP that is out-of-phase with the grid can cause explosions and extensive damage. Though some industry insiders assert that the costs of the IOU-imposed interconnections can cost three to four times as much as are necessary to provide a safe interconnection⁶⁹, many regulators are reluctant to oppose these practices and assume responsibility (and liability) for such safety issues. However, in California government officials and regulators have been successful in pressuring the IOUs to provide interconnections at a reasonable cost and within a reasonable period of time. In other states where the power infrastructure falters, pressure from business, industry and the electorate should compel comparable responses and actions taken.

A more preemptive strategy, however, is to establish state- or nation-wide interconnection standards that would facilitate and expedite the siting of CHPs. This is precisely what Senate Bill 933 is trying to accomplish. This bill was submitted by Senator Jeffords et al. to Congress on May 22, 2001. Its title is the, “Combined Heat and Power Advancement Act of 2001”. Its purpose is to “encourage energy productivity and efficiency increases by removing barriers to the development and deployment of combined heat and power technologies and systems”. It proposes to “establish reasonable and appropriate technical standards for the interconnection of a generating facility (e.g., CHP) with the distribution facilities of the local distribution utility (e.g., IOU)”. S-933 also requires IOUs to provide back-up power to CHPs at rates that are “just and reasonable and not unduly discriminatory or preferential, taking into account the actual incremental cost, wherever incurred by the local distribution utility, to supply such back-up power service during the period in which the back-up power service is provided, as determined by the appropriate regulatory authority”. S-933 is part of the Comprehensive Energy Bill which will continue to be negotiated through the fall. Whether S-933 remains part of the Comprehensive Energy Bill won’t be determined until next year when the CEB should be enacted.

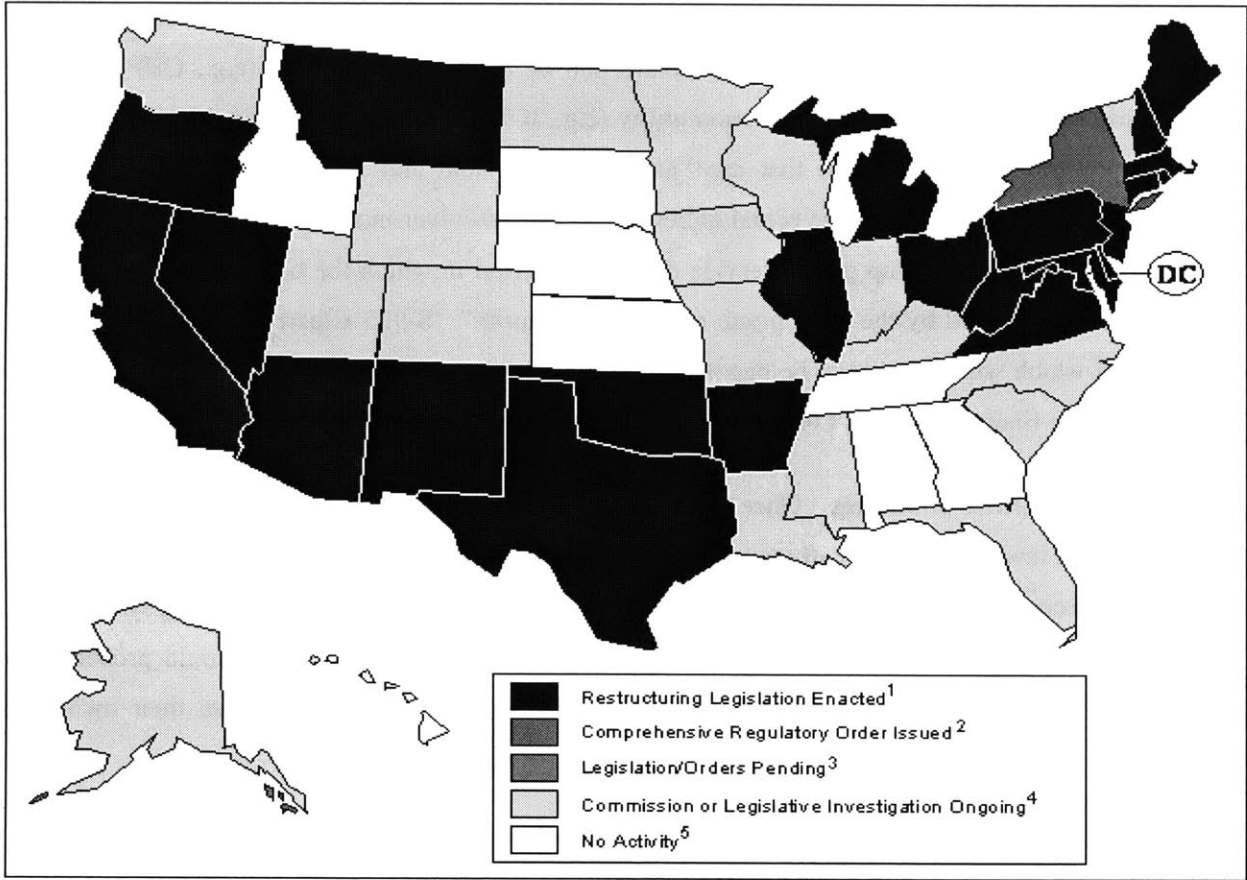
Landlords and Older Buildings. Once the 3rd-party developers have identified the states with high retail rates and low tariffs, they will naturally focus on (a) landlords with large holdings in these areas and (b) urban cores where there are large concentrations of buildings with air-conditioning systems that are 25 or more years old. Data on the age of the AC system in each building could probably be obtained from air-conditioning distributors that track this data in order to facilitate their own sale efforts.

CHP MARKETS IN THE SHORT- AND MID-TERM

California is the immediate target for most 3rd-party developers and landlords with office buildings that have been identified as good CHP prospects. Other markets which may develop over the short- and mid-term will be those in which conditions exist that are similar to those in California, namely: (1) a deregulated electricity market; (2) high retail electricity prices; and (3) constrained supply relative to demand. The states which share all of these conditions in common with California and have the largest technical potential for office CHPs (as described in the DOE’ report on CHPs) should also be primary targets.

Deregulation. Twenty-three states and the District of Columbia have already enacted legislation to deregulate their electricity markets (Exhibit 20). While New York state is not officially deregulated, the comprehensive regulatory order that has been issued instead has opened the wholesale and retail electric markets to full competition in six IOU service territories, including the territory in which New York City is located.

Exhibit 20 Deregulated States

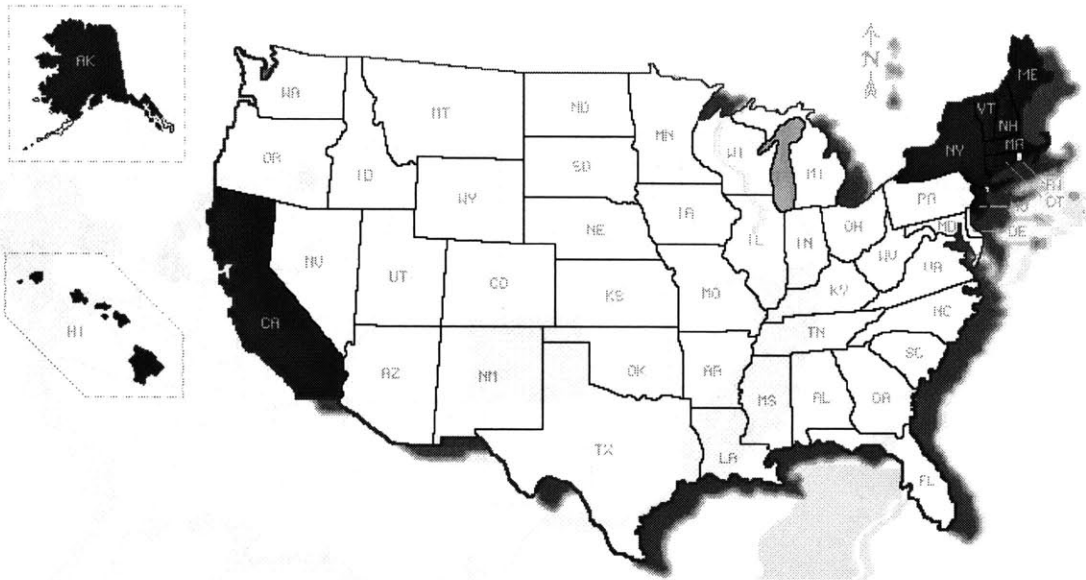


Source: Energy Information Administration

- (1) Arizona, Arkansas, California, Connecticut, Delaware, District of Columbia, Illinois, Maine, Maryland, Massachusetts, Michigan, Montana, Nevada, New Hampshire, New Jersey, New Mexico, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, Texas, Virginia, and West Virginia.
- (2) New York
- (3) None
- (4) Alaska, Colorado, Florida, Indiana, Iowa, Kentucky, Louisiana, Minnesota, Mississippi, Missouri, North Carolina, North Dakota, South Carolina, Utah, Vermont, Washington, Wisconsin, and Wyoming.
- (5) Alabama, Georgia, Hawaii, Idaho, Kansas, Nebraska, South Dakota, and Tennessee

High Retail Electricity Prices. The higher retail electricity prices are, the greater the price spread between CHP- and IOU-provided electricity. The states with the ten highest average retail rates for commercial users are shown below (Exhibit 21). They are California, Hawaii, New Hampshire, New York, Vermont, Maine, New Jersey, Connecticut, and Massachusetts.

Exhibit 21 States with Ten Highest Retail Electricity Rates



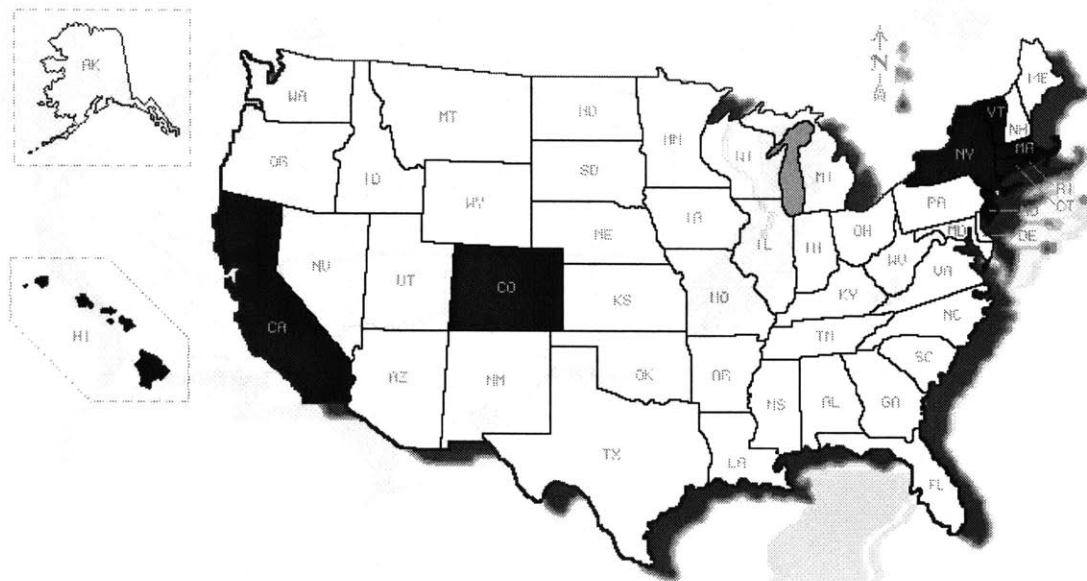
7-29-01

State	CA	HI	NH	NY	VT	ME	NJ	CT	AK	MA	US Avg.
Commrc'l Rate (cents)	15.5	12.7	11.4	11.2	10.7	10.5	9.7	9.7	9.2	8.9	7.3

Source: Energy Information Administration, US Department of Energy

Constrained Supply Relative to Demand. The more generation and transmission are constrained, the longer rates will remain elevated, as evidenced in California. A simple metric for assessing how constrained supply is relative to demand is to compare how much generating capacity there is in each state per resident. The lower this per capita ratio, the more likely supply is constrained. The states with the ten lowest per capita generating capacities are shown below (Exhibit 22). They are Rhode Island, the District of Columbia, California, Vermont, New York, Colorado, Hawaii, New Jersey, and Connecticut. Note the correlation between Exhibits 21 and 22.

Exhibit 22 States with Ten Lowest per Capita Generating Capacities



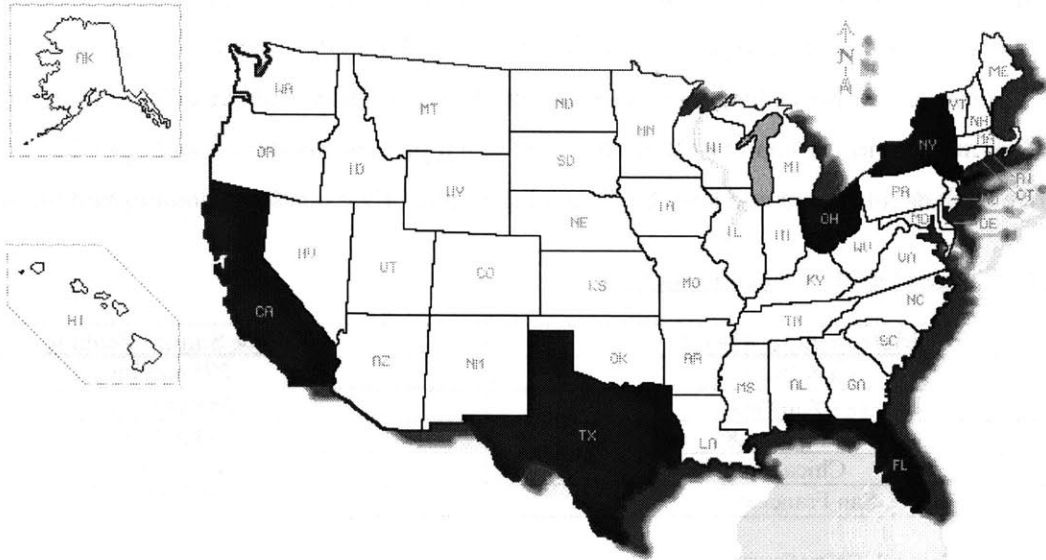
7-29-81

State	RI	DC	CA	VT	NY	MA	CO	HI	NJ	CT	U.S. Avg.
kW per Person	.94	1.4	1.6	1.6	1.8	1.9	1.9	1.9	2.0	2.1	2.8

Source: Energy Information Administration, US Department of Energy

Technical Potential for Office CHPs. In addition to the above market conditions, owner/operators will also want to be in states where the technical potential for CHP applications (as identified by the DOE report) is the greatest. As shown below, the five states with the greatest technical potential for office CHPs are California, New York, Texas, Florida and Ohio (Exhibit 23). Note the correlation between Exhibits 21, 22 and 23.

Exhibit 23 States with Highest Technical Potential for Office CHPs



7-29-01

State	California	New York	Texas	Florida	Ohio
Office (MW)	3,933	2,902	2,450	1,920	1,370

Source: "The Market and Technical Potential for Combined Heat and Power in the Commercial / Institutional Sector". Energy Information Administration, U.S. Department of Energy Report. January, 2000.

Summary. The clear pattern highlighted by the preceding four maps is that only California and New York are consistently among the subset of states that are deregulated, have the highest electricity rates, are supply constrained, and have the highest technical potential for office CHPs. It is simple to conclude from this data that California has the greatest potential for office CHP development followed by New York state. This is the same conclusion reached by most of the interviewees. Most are focussing on California, New York City and Chicago. While Illinois has relatively low commercial electricity rates (\$.074 per kilowatt-hour), those in Chicago are relatively high. The recurrent blackouts that Chicago experienced over the past few years is symptomatic of power infrastructure in which demand is outstripping deliverable supply. These considerations along with the commercial and industrial electricity sectors being opened up to competition by Illinois' deregulation have made Chicago an attractive target. The office markets in New York, Los Angeles, San Francisco Bay Area and Chicago are among the top five office markets in the country (Table 8). The depth of these markets should provide fertile grounds for office CHP development and keep CHP developers and office landlords preoccupied for several years.

Table 8 Largest Office Markets in the U.S.

Metropolitan Area *	Office Square Footage
New York	709 million
Los Angeles	353 million
Washington DC	333 million
Chicago	304 million
San Francisco	279 million

Source: "Market Trends". CoStar Group, Inc

* Includes the central business district and suburbs.

CHP MARKETS IN THE LONG-TERM

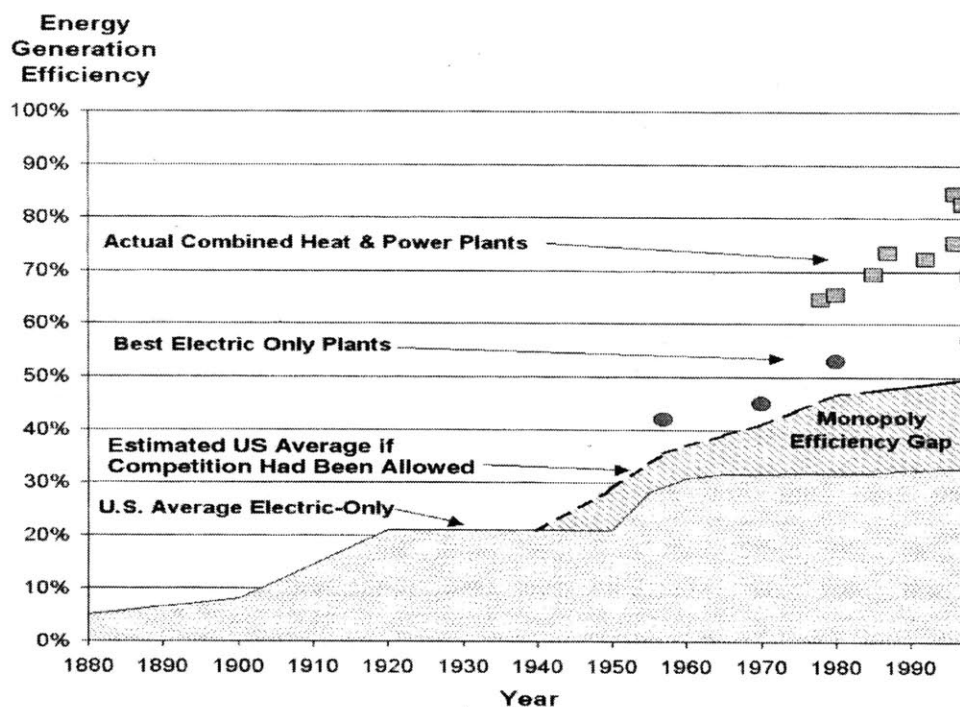
Electricity as a fraction of total energy use in the U.S. has grown from 25% in 1970 to 40% today⁷⁰. If it continues to grow by approximately two percent per year, 150GW of new capacity will be needed over this decade⁷¹. As in California, CHPs can play a significant role in helping the nation meet its growing energy demands. With widespread application, they can reduce the demands on central generation. Office CHPs can also remove a significant amount of the congestion on the nation's transmission and distribution lines, allowing more centralized generation to reach the end-users.

The latter is particularly critical given the long lead times and great expense of grid upgrades. There are three macro-forces that are likely to encourage the widespread deployment of CHPs over the long-term: the deregulation of electricity markets throughout the U.S., the National Energy Policy, and the Kyoto Protocol to reduce worldwide greenhouse gas emissions.

Deregulation. Deregulation is by far the most important and dynamic force for long-term changes in the power industry. Without deregulation, competition in both the wholesale and retail electricity markets would not exist. Nor would there be investment opportunities in office CHPs. As previously mentioned, twenty-three states and the District of Columbia have already enacted legislation to deregulate their electricity markets; the State of New York is effectively deregulated; and eighteen more states are actively investigating deregulation as an alternative to their existing regulated electric monopolies (Exhibit 20). State leaders have recognized that a regulated, monopolistic system no longer works. The blackouts in California, Chicago, Wisconsin and New York are not unrelated and purely coincidental⁷². They are symptomatic of power infrastructures across the U.S. that are aging, overburdened and in need of renewal.

That regulated monopolies did not prevent power infrastructures across the nation from deteriorating to this point should not come as a total surprise. IOUs are not compensated in a manner that provides incentives to invest in energy-efficiency or renewal. The rates that IOUs can charge are based upon their costs and a fair return on invested capital, not on cost savings. Regulators in nearly all the states require that any cost savings resulting from efficiency upgrades be passed along to the consumer⁷³. Because fuel costs can be passed through to the rate-payers, the IOUs have little incentive to pursue energy-efficiency upgrades⁷⁴.

To illustrate, the 33% delivered efficiency of thermally based power plants was achieved over 40 years ago (Exhibit 24). Though much more efficient generating technologies were available during this period, the IOUs did not pursue them. The circles on Exhibit 24 show the efficiency of the best electric only plants that have been put into operation over the same 40-year period. The squares show that CHP plants commissioned during this time were by far the most energy-efficient.



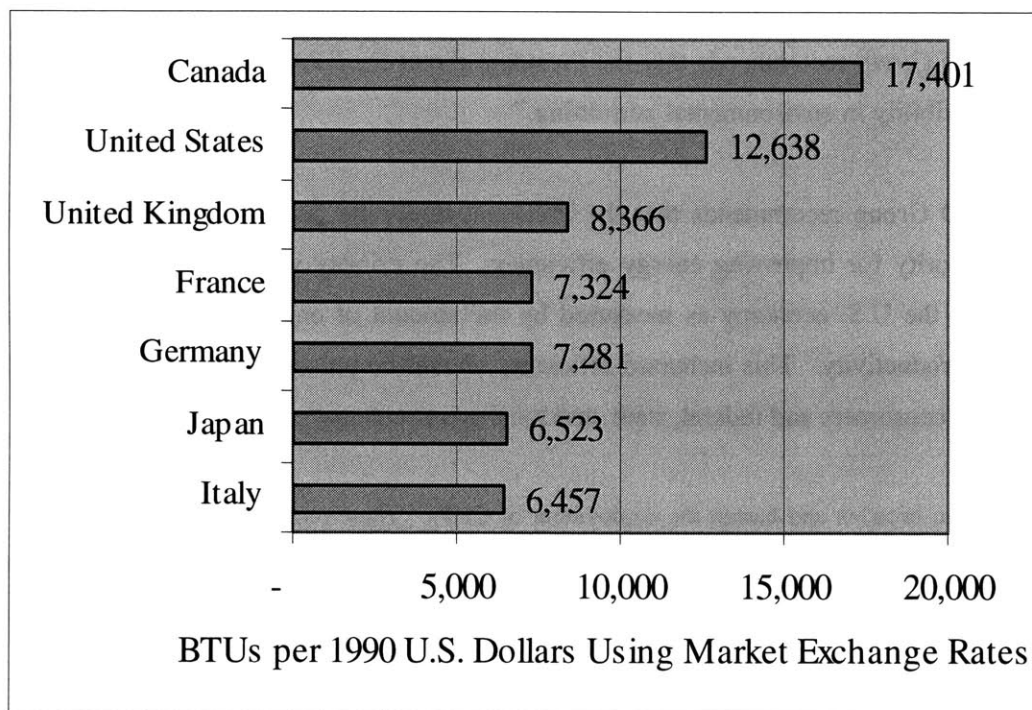
Source: Casten, Thomas. **Turning Off the Heat**. New York: Prometheus Books, 1998

In a deregulated and competitive electric market, efficiency and renewal are rewarded. Each power generator is trying to grab a larger share of the market. To do so, large- and small-scale generators alike must find ways to produce and deliver electricity to their customers at prices that are lower than their competitors'. For example, CHPs convert seventy-five percent of the energy released by thermal generation into usable energy. This results in half the fuel consumption and fuel costs of IOU power plants. Lower costs means lower rates to consumers.

If CHPs and other types of energy-efficient generators are deployed on a large-scale basis, the U.S. economy could become more energy-efficient. A metric for gauging a country's energy-efficiency is the ratio of primary energy consumption per dollar of gross domestic product. Primary energy consumption is the value of energy (measured in British thermal units) at the point it enters the home, building or establishment; plus losses that occur in the generation, transmission and distribution of energy. The lower this ratio is, the more energy efficient the country is. Exhibit 25 shows the energy-intensity for each of the G7 countries. They are the world's major industrial democracies. The U.K., which deregulated its electricity markets twelve years ago, is among the most energy-efficient economies, while the U.S. is among the least efficient with an energy-intensity that is 51% greater than that of the U.K.

It is evident that the G7 countries which have smaller land masses are significantly more energy-efficient than the larger countries: Canada and the U.S. One explanation that may partly account for this disparity is that the farther that electricity must travel from centralized power plants to reach the end-users, the more of it gets lost in the transmission. To make-up for this deficit, more power generation is required, increasing the country's energy-intensity. If this explanation is valid, then it presents another compelling argument for decentralized generation such as CHPs. If the U.S. lowers its energy intensity via the widespread deployment of office CHPs and other energy-efficient generators, then it will be able to produce comparable levels of GDP while lowering fuel and transmission costs. This will translate to greater profits, national and personal wealth. Since deregulation promotes energy-efficient generation, which in turn will increase personal wealth and the living standards of the electorate, legislators have a strong motivation to push for genuine deregulation. Improving the energy-intensity of the U.S. is a major priority of the National Energy Policy. These forces bode well for CHPs in office buildings.

Exhibit 25 **Energy Intensity: Primary Energy Consumption per Dollar of GDP**



Source: Energy Information Administration, U.S. Department of Energy

National Energy Policy. The National Energy Policy ties our energy use in with our national security and the need to reduce (if not curtail) our dependence on foreign oil. Along with expanding our domestic energy supplies, energy efficiency is a prominently featured strategy for reaching this objective. Heat and power production consumes two-thirds of all the fuel burned in the U.S. Transportation consumes the other third. Given how efficient CHPs are and how quickly they can be deployed, it is no coincidence that three of the primary recommendations of the National Energy Policy Development (NEPD) Group are as follows:

- “The NEPD Group recommends the President direct the Secretary of the Treasury to work with Congress to encourage increased efficiency through combined heat and power (CHP) projects by shortening the depreciation life for CHP projects or providing an investment tax credit.” (Under the current tax code, a combustion engine that is used in a truck, bus or plane can be depreciated over five to seven years. If the same engine is used to power a generator, then the depreciation period increases to fifteen years. If an office landlord or 3rd-party developer uses this combustion engine as part of its CHP system, the depreciation period is twenty years⁷⁵.)
- “The NEPD Group recommends that the President direct the EPA Administrator to promote CHP through flexibility in environmental permitting.”
- “The NEPD Group recommends that the President direct the Secretary of Energy to establish a national priority for improving energy efficiency. The priority would be to improve the energy intensity of the U.S. economy as measured by the amount of energy required for each dollar of economic productivity. This increased efficiency should be pursued through the combined efforts of industry, consumers and federal, state, and local governments.”

The clear intent is to broaden and hasten the deployment of CHPs. These recommendations should provide non-partisan support for S.933 the “Combined Heat and Power Advancement Act of 2001”. No recommendation was made in the NEP to provide any direct financial subsidy to any other form of electric generation.

Kyoto Protocol. In December 1997, most of the world’s industrialized nations met in Kyoto, Japan with the objective of ratifying a treaty that would commit each nation to reducing its greenhouse emissions, particularly carbon dioxides and nitrous oxides. The U.S. is being asked to reduce its carbon emissions by 7% below 1990 levels⁷⁶. To date, the U.S. has not become a signatory. In part, our resistance is due to

the lack of specifics that would detail how other countries would also cooperate and reduce their own greenhouse emissions. Our reticence is also founded in the positive relationship between energy consumption and gross product (Exhibit 12). For some, conservation is an anathema, resulting in reduced gross domestic product, personal wealth and quality of life. Given that CHP has twice the conversion efficiency of large-scale power plants, the same amount of power can be produced with half the fuel. Since fuel costs are reduced 50% while output remains the same, more wealth is actually created under this energy conservation scenario.

Two-thirds of America's electric generation capacity comes from plants built over 25 years ago before the Clean Air Act was enacted⁷⁷. They are twenty times more polluting than the newest power plants. For example, current technology exists which enables large, gas turbine generators to produce only 2 to 5 parts per million of nitrous oxides⁷⁸. This is a 99% decrease relative to the 200 parts per million of nitrous oxides emitted by power plants built before 1975⁷⁹. Unfortunately, the same strides have not been made to reduce carbon dioxide emissions. There is no technology today that can remove carbon dioxide emissions without itself consuming so much energy that more carbon dioxide is created than removed⁸⁰. The only way to emit less carbon dioxide is to burn less fossil fuel. This calls for more efficient generators like CHPs.

Six years after the United Kingdom deregulated its electric market, carbon dioxide and nitrous oxide emissions per kilowatt-hour of electricity dropped respectively by 39% and 51% due to the use of more energy-efficient centralized and distributed generation⁸¹. If CHPs and other energy-efficient generating systems grab a significant share of the U.S. generation market, then greenhouse emissions may no longer be a thorny environmental or diplomatic issue for the U.S. (This presents another strong argument for deregulation.) If not, then the frequency and magnitude of natural calamities linked to global warming such as hurricanes, rising ocean levels and droughts may continue to climb. So will mega-insurance claims and payouts. In the book, *Financing Change*, Frank Nutter, president of the Reinsurance Association of America states, "The insurance industry is first in line to be affected by climate change...it could bankrupt the industry." Large, powerful insurance companies will either force legislation that puts a large price tag on greenhouse emissions or they will simply stop insuring against the related risks. If the latter occurs, outcries from the electorates of the affected states may be great enough to compel state or federal legislators to enact more stringent energy-efficiency laws. Alternatively, the states and ultimately the federal government will have to shoulder the entire cost of massive property and casualty losses. If these costs reach an unacceptable level, the needed energy-efficiency laws may follow. If they

do, such laws will cull out inefficient power plants in favor of CHPs and other energy-efficient generators.

What's Old Is New. In 1881, Thomas Edison built the first commercial power plant in the world. Located near Wall Street in New York City, Edison recovered the steam created by this plant, piped and sold it to nearby buildings where the steam was used for space heating in the winter. The revenue that he received from the sale of his steam lowered his net cost of making electricity and the price he could charge his customers. In turn, the lower retail rates expedited the deployment of electricity in New York City. This type of CHP system was utilized in most major U.S. cities, leading to the development of district steam systems in each. In the early 1900s over 25% of the nation's electricity was produced by cogeneration⁸². By the 1970s, that percentage had dropped to 4%.

CONCLUSION

Deregulation is opening the floodgates of competition into the U.S. electric market. Competition favors the efficient. Currently, there is no power generation system that is more efficient and cost-effective than CHPs. The National Energy Policy has made the development and deployment of CHPs a top priority, recommending a shortened depreciation period or tax credit to accelerate both. CHPs located on-site reduce the amount of power needed from centralized plants and reduces congestion on overburdened transmission lines. With operating efficiencies twice that of the average thermal power plant, CHPs can produce the same level of power with half the fuel, cutting fuel costs and greenhouse emissions in-half. Being located on-site, there are no transmission costs. Maintaining productivity while reducing fuel expenses and eliminating transmission costs results in increased profits and personal wealth. These outcomes are compelling to the electorate and legislators alike. The recommendations of the National Energy Policy suggest a vision of a future power infrastructure that is balanced, diverse and in which CHPs will have an integral role.

The growth potential for office CHP development is significant. However, it is predicated upon how many states fully embrace deregulation. Many states are taking a wait-and-see approach to deregulation, observing and learning from California's experience. As they watch, office CHPs that are installed in California and New York will demonstrate whether or not office CHPs are viable energy options and desirable investment opportunities. If they do prove themselves, the time it takes to do so could dovetail with the receptivity of many other states to finally depart from the status quo.

GLOSSARY

APPENDIX 1

Air Quality Management Districts (AQMDs): A local agency charged with controlling air pollution and attaining air quality standards.

Bay Area Economic Forum: A public private partnership that is involved in many regional efforts throughout the Bay Area. It's primary objective is to help sustain the region's record of economic success and enhance its overall quality of life.

British Thermal Units (Btu): The standard measure of heat energy. It takes one Btu to raise the temperature of one pound of water by one degree Fahrenheit at sea level.

California Energy Commission: The entity which reviews and approves permit applications for the construction, operation and eventual closure of large, thermal power plants with generating capacities of 50 megawatts or greater.

California Gross State Product (GSP): The output of all goods and services produced by the State of California. GSP provides the broadest measure of an economy and is often used to measure growth and make comparisons.

California Independent Systems Operator (CAISO): The CAISO is responsible providing non-discriminatory access to the California power grid, managing congestion, maintaining the reliability and security of the grid, and providing billing and settlement services. CAISO has no affiliation with any market participant. It is regulated by the Federal Energy Regulatory Commission (FERC).

California Public Utilities Commission: The public service commission that regulates the investor-owned utilities in California.

Central(ized) Generation Plants (CGPs): Large-scale power plants which produce up to 2,000 megawatts of electricity which then gets distributed over long distances to end-users via a system of transmission and distribution lines. Prior to deregulation, most CGPs were owned and operated by investor-owned- and municipal-utilities.

Central(ized) Power Plants (CGPs). Large-scale power plants which produce up to 2,000 megawatts of electricity which then gets distributed over long distances to end-users via a system of transmission and distribution lines. Prior to deregulation, most CGPs were owned and operated by investor-owned- and municipal-utilities.

Cogeneration: An on-site, generation facility in which two forms of usable energy (esp. heat and electricity) are produced from a single fuel source.

Combined Heat and Power (CHP): An on-site generation facility in which two forms of usable energy (i.e., heat and electricity) are produced from the combustion of one fuel source.

Competition Transition Charge (CTC): A charge authorized by the California Public Utilities Commission which the investor-owned utilities could impose on their ratepayers to pay-down the IOUs' stranded costs over the 4-year transition period prescribed by California's deregulation. The CPUC provided for the CTC by freezing retail rates at their relatively high 1996 levels, so that the IOUs could capture the spread between these high rates and the then prevailing low wholesale electricity rates.

Congestion: A condition that occurs when insufficient electric transfer capacity is available to simultaneously implement all scheduled loads.

CPUC: See California Public Utilities Commission.

Day-Ahead Market: The forward market for the supply of electrical power at least 24 hours before delivery to buyers and end-users.

Demand: The rate expressed in kilowatts, or megawatts, at which electric energy is delivered to or by a system, or part of a system at a given instant or averaged over an designated interval of time.

Department of Water Resources: The State of California's Department of Water which was authorized by emergency legislation to purchase electricity from power generators and wholesales on behalf of the beleaguered investor-owned utilities.

Distribution: The delivery of electricity to the retail customer's home or business through low voltage distribution lines.

Electric Energy: The generation or use of electric power by a device over a period of time, expressed in kilowatt-hours (kWh), megawatt-hours (MWh), or gigawatt-hours (GWh).

End-User: A residential, commercial, agricultural, or industrial customer in the electric industry who buys electric power to be consumed as a final product (not for resale).

Exit Fees: The recurrent fees which investor-owned utilities charge customers when they leave the grid in order to recover the customer's share of stranded- and other costs which were incurred during the time that the IOU was providing electricity to the customer.

FERC: The Federal Energy Regulatory Commission, an independent regulatory agency within the Department of Energy that regulates the transmission, sale and other key issues in interstate commercial energy markets.

Forced Outage: Generators taken out of service due to breakdowns, storms or other unplanned occurrences.

Generator: An entity capable of producing electrical energy.

Gigawatt (GW): One billion (10^9) watts. This is enough power needed to supply approximately one million homes.

Grid: The 12,500 miles of transmission lines in California that are owned by the three largest IOUs, but which are managed by the California Independent System Operator (CAISO).

Hour-Ahead Market: the electric power futures market that is established 1-hour before delivery to End-Use Customers

Independent System Operator (ISO): The ISO is the entity which is responsible providing non-discriminatory access to the grid, managing congestion, maintaining the reliability and security of the grid, and providing billing and settlement services. The ISO has no affiliation with any market participant. It is regulated by the Federal Energy Regulatory Commission (FERC).

Investor Owner Utility (IOU): A utility entity whose assets are owned by investors. Cities which wanted the development of electric generation and distribution to be accomplished with private money provided power entrepreneurs with exclusive territories that would enable them to raise debt and equity financing more readily. In turn, this would expedite the deployment of electricity to the cities' residents and businesses.

IOU: See investor-owned utility.

Kilowatt (kW): One thousand (10^3) watts. This is enough power needed to supply approximately one home.

Kilowatt Hour (kWh): One kilowatt of electricity supplied for one hour.

Load: The amount of energy being delivered to any point, or points, in the system at a given time

Losses: Electric energy losses in the electric system which occur principally as energy transformation from kilowatt-hours (kWh) to waste heat in electrical conductors and apparatus.

Market Based Pricing: System in which retail charges for generation reflect actual average wholesale generating costs incurred by the relevant procurement authority to purchase power for a group of consumers over a given period. In this case, residential rates may go up and down depending upon wholesale prices. This is similar to what existed briefly in San Diego in the summer of 1999.

Market Forces: Competition for sales, new alliances, innovative pricing structures, customer demand, choice, and various kinds of services

Megawatt (MW): One million (10^6) watts. This is enough power needed to supply approximately one thousand homes.

Megawatt Hour: One megawatt of electricity supplied for one hour.

Municipal Utility: A local Publicly Owned Electric Utility that owns or operates electric facilities subject to the jurisdiction of a municipality, as opposed to being subject to FERC or CPUC jurisdiction.

NERC: North American Electric Reliability Council.

Non-Utility Owners (NUOs): Power plant owners that are typically publicly traded corporations, but which are not investor-owned or municipal utilities.

Output: The value-added of the products and services produced, or the sum of wages and salaries and pre-tax profits accruing to an industry.

Pacific Gas & Electric Company (PGE): One of California's three largest investor-owned utilities, suffering huge losses from under-collections.

Path: A line or group of lines in which WSCC assigned as paths with numbers to differentiate them.

Planned Outage: Generating units not in operation due to planned maintenance, scheduled closures, refueling, or other planned occurrences.

Power Grid: The 12,500 miles of transmission lines in California that are owned by the three largest IOUs, but which are managed by the California Independent System Operator (CAISO).

Public Agencies: A municipal corporation, a municipal utility district, an irrigation district, or a joint power authority (which can include one or more of the agencies mention above) furnishing electric services over its own transmission facilities, or furnishing electric service over its own or its members' distribution system.

Publicly-Owned Electric Utilities: See Public Agencies.

Qualified Facilities (QFs): An entity that owns and/or operates a generation facility, but is not primarily engaged in the generation or sale of electric power. QFs are either renewable power production or cogeneration facilities that qualify under Section 201 of PURPA.

Real-Time Market: The competitive generation market controlled and coordinated by the ISO for arranging real-time imbalance power.

Real-Time Pricing: The ability to charge different prices for electricity, based on the time the electricity was consumed. With real-time pricing, utilities could charge more for one kilowatt hour in the middle of a summer day, for instance, than for one kilowatt hour consumed in the middle of the night. Furthermore, the price may change from day-to-day as wholesale prices fluctuate. Currently, most residential consumers are billed at the same rate for each kilowatt-hour consumed, regardless of when it was consumed.

Reliability: The ability of the electric system to deliver energy in the amount demanded by the customer.

Retail Sales: The electric energy sales made by a retailer to end-use customers.

Reserve Margin: The reserve margin is the amount by which available supply must exceed peak demand. As in many states, peak demand in California occurs during summer afternoons when air-conditioners are used the most. The 15% to 20% reserve margin provides a cushion against unpredictable changes in supply and demand. Unexpected changes in supply result from e.g., power plants going off-line due to equipment failure and lower than normal amounts of power being imported into California from nearby states. Unexpected changes in demand are primarily weather.

San Diego Gas & Electric (SDGE): One of California's three largest investor-owned utilities, suffering losses from under-collections but not to the same degree as the other two IOUs.

Silicon Valley Manufacturing Group: An industry association of 195 high-tech luminaries such as Intel and Adobe Systems.

Southern California Edison (SCE): One of California's three largest investor-owned utilities, suffering huge losses from under-collections.

Spot Market: Refer to Real-Time Market.

Stage 1 Emergency When the reserve margin falls below 7%, all electricity consumers are asked to voluntarily reduce their power consumption as much as possible by e.g., turning-off lights, appliances and office machinery.

Stage 2 Emergency: When the reserve margin falls below 5%, power may be interrupted to some heavy commercial and industrial users such as oil refineries. These interruptible customers have special contracts with power providers which gives them discounted rates in exchange for agreeing to curtail their power during Stage 2 emergencies.

Stage 3 Emergency: When the reserve margin falls is expected to fall below 1.5% within a 2-hour period, coordinated blackouts may be implemented. To avert blackouts, the ISO feverishly attempts to locate last-minute sources of imported power. In some instances the ISO will halt the huge state-owned pumps which push water down the California Aqueduct from Northern to Southern California, reducing demand by 300 MW

Stand-By Fees: The recurrent fees which investor-owned utilities charge on-site generators to provide back-up power to them should the on-site generation system fail, particularly during peak demand periods.

Stranded Investments (Costs): These were unprofitable investments primarily made into nuclear and renewable energy power plants which the IOUs may not have made had the CPUC not legally required them to do so. These investments were originally financed by the IOUs based upon assurances from the CPUC that repayment of the debt could be made through future electricity sales. Because these power plants could not provide electricity at competitive rates in a deregulated environment, they would ultimately be stranded

System Reliability: Refer to Reliability.

Tariff: Typically, tariffs are taxes or surcharges that are added onto the ratepayer's bill. Examples include competition transition fees, stand-by fees and exit fees.

Thermal Plants. Power plants which combust fossil fuel to generate electricity. Often thermal plants are used to refer to central power plants.

Transmission: Transporting bulk power over long distance lines at very high voltages.

Under-collections: The losses incurred by the investor-owned utilities in having to pay more for wholesale electricity than they could collect from their retail customers given the retail rate freeze.

Unplanned Outages: outages of generation, transmission, or distribution facilities not noticed in advance to the ISO.

WSCC: The Western Systems Coordinating Council which provides the coordination that is essential in operating and planning a reliable and adequate electric power system for the western part of the continental U.S., Mexico and Canada.

Sources: California ISO, McKinsey & Company, Thomas R. Casten, and Thesis Author

CHRONOLOGY OF CALIFORNIA ENERGY CRISIS

APPENDIX 2

Sep 96 California Governor Pete Wilson signs deregulation legislation (Assembly Bill 1890). Expectations are that by 2003 residential rates will drop 20% and all customers will be able to buy their electricity from any energy service provider they choose.

Jan 98 Deregulation law goes into effect.

Nov 98 PGE sells over \$1 billion in power plants, including all fossil-fueled plants though deregulation required that it sell just 50% of them. PGE also keeps 2,200 MW Diablo Canyon nuclear plant.

Jul 99 San Diego Gas & Electric pays-off its stranded costs, allowing it to lift the retail rate price cap imposed by deregulation. Within one year, customer bills triple as SDGE passes on wholesale power costs.

May 00 First Stage II emergency in 2000 declared by ISO. Oil refineries and other heavy industrial customers reduce their electricity consumption.

Jun 00 California imposes price cap of \$750 per MW on wholesale electricity costs.

Jul 00 Wholesale electricity rates have increased 270% over last year. Residential electric rate for San Diego Gas & Electric customers increases 5 cents from 11 cents to 16 cents per kWh.

California reduces price cap from \$750 to \$500 per MW on wholesale electricity costs.

Aug 00 Public protests in San Diego spread as power bills have doubled in past three months.

California reduces price cap from \$500 to \$250 per MW on wholesale electricity costs. Unintended consequence: imports from other states decrease due to higher wholesale prices outside of CA.

Sep 00 PUC places a 6.5 cent cap on electric rate increase for residences and small business in the San Diego Gas & Electric service territory.

PGE reports that it has lost \$2 billion due to the rate freeze and that amount is rising about \$700 million per month.

Dec 00 Electricity reserves dip below 3% for the first time ever.

Wholesale prices in CA reach cap of \$250 per megawatt-hour (8 times the level of one year ago), while wholesale prices in Pacific Northwest were as high as \$1,200. Less electricity being imported out of the Northwest, while power exported out of CA into the Northwest.

Natural gas prices triple over past year due to increased demand from natural-gas-fired electric plants, and due to increasing congestion on gas transmission pipelines.

U.S. Energy Secretary, Bill Richardson, orders twelve power generators and wholesalers to sell electricity to CA IOUs despite their concerns over non-payment.

Electricity imports from northwestern states drop virtually to zero due to severe cold-front.

Peak-demand, wholesale electric prices have risen from \$30 per megawatt (Jul 99) to more than \$1,400 per MW.

Eight largest power providers to CA estimated to have made \$10 billion in profits in the last 6 months.

Jan 01 PUC approves an average rate increase of 10%. PGE and SCE have incurred \$11 billion in debt over the past 6 months. PGE and SCE corporate bonds lowered to junk status for the first time ever.

SCE cannot pay \$596 million in outstanding bills as it has run out of cash. PGE has \$583 million power bill due Feb. 1, but has only \$500 million in available cash; Another \$431 million is due on Feb 15th, followed by a \$1.2 billion on March 2. SCE close to filing bankruptcy.

State officials order widespread rolling blackouts for the first time, affecting hundreds of thousands of N. Californians.

Governor Davis signs emergency legislation authorizing the state's Department of Water Resources (DWR) to buy \$400 million of wholesale electricity and then resell it to IOUs.

Standard & Poor's warns California that its credit rating could be downgraded if it enters into contracts to buy electricity directly from generators and wholesalers.

New administration Energy Secretary Spencer Abraham extended two federal emergency orders forcing suppliers to continue selling electricity and natural gas to CA for an additional 2 weeks.

Oregon and Washington officials complain that emergency orders forcing generators to supply power to energy to CA are draining scarce power from the Northwest, sharply raising their own electricity rates.

Feb 00 Emergency legislation (AB1X) provides \$10 billion in funds for DWR to immediately begin purchasing power from generators and wholesalers via mid- to long-term contracts to secure prices well below those on the spot market on which California has been spending \$45 million each day. Money will be raised by issuing revenue bonds over the next two years.

IOUs now saddled with \$13 billion in debt.

Governor Davis negotiating with IOUs to buy 12,000 miles of transmission lines for as much as \$6 billion. SCE agrees to sell its part of the grid for \$2.76 billion. Deal subject to comparable deal with PGE. Proceeds to be used by IOUs to pay-down their debt and improve their credit standing. If entire grid is purchased, California will need to sink at least \$1 billion on grid upgrades. State and PGE are still far apart on terms.

Mar 01 Federal Energy Regulatory Commission (FERC) says that generators may have overcharged Californians \$55 million in February, demanding that they justify any prices over the \$150 "soft cap" that were charged during Stage 3 alerts. Companies included Dynegy, Williams Energy, Duke Energy, Reliant, Mirant and Portland General Electric Company.

Rolling blackouts were imposed for the first time ever over the entire state of CA. Inadequate supply caused by 12,000 MW of capacity being down for routine repairs, a fire in a S. Cal electric plant, and smaller generators shutting down due to non-payment by the IOUs.

565,000 Californians went without power for 90 minutes yesterday. 440,000 hit in the PGE territory. 50,000 hit in the SCE territory. 75,000 in the SDG&E territory.

President Bush vows not to support wholesale electricity price controls in California, stating, "The tests for any energy policy are simple. Does it increase supply and do its incentives encourage conservation? A policy that fails to meet these tests is bad public policy. And that is why this administration does not and will not support energy price controls."

The California ISO reports that wholesalers overcharged state IOUs by \$5.5 billion over the past 10 months.

Apr 01 PGE, unable to payoff \$9 billion in debt files for bankruptcy on April 6, 2001

State Assembly approved 67-to-4 a bill to accelerate the approval process for power plant development by shortening the public review process and allowing new power plant owners to pay mitigation fees for pollution when pollution credits are not available.

May 01 Bay Area Economic Forum predicts blackouts could cost CA's GDP as much as \$16 billion this summer. From January to the present (May 8) CA has purchased over \$5.5 billion of electricity on behalf of IOUs. Blackout impacted 225,000 customers for about 1 hour.

300,000 homes and businesses were subject to rolling power outage today, beginning at 3:10 pm and ending around 5:15pm. The Southwest baked with triple-digit temperatures. Resultant high electricity usage in Nevada and AZ meant less power exported to California.

PGE and SCE have lost nearly \$14 billion since June, 2000.

Governor Gray Davis signs emergency legislation SB6X which creates the California Consumer Power & Conservation Financing Authority to construct, own, operate power plants which would compete with other power generators.

Jun 01 Largest electricity rate increase in California history goes into effect. Average increase is 3 cents per kilowatt-hour. Since certain groups are shielded from increase e.g., low income residents, other customers will pay substantially more than the average increase.

Mirant Corp. receives permit to expand capacity of Bay Area power plant by 530 MW that could have on-line by June 03. However, may delay \$250 million construction project given uncertainty created by California's push for federal price controls, windfall profit tax and possible seizures of power plants.

Duke Energy admits that charged \$3,880 per mWh for 5,500 MW sold from San Diego plant, resulting in \$19 million in receivables.

Source: San Francisco Chronicle Articles

ASSUMPTIONS FOR SUMMER (2001-4) RESERVE MARGIN CALCULATIONS

APPENDIX 3

DEMAND

Given the slowdown in the economy and in the expected rate of business and resident migration into California, we will assume that demand will drop from 4% in 2000 to 3% in 2001. Thereafter, it will revert to its historical 2% growth rate. In 2000, peak demand was 52.7 gigawatts. Increasing this amount by 3% gives us a peak demand estimate for the summer of 2001 of 54.3 gigawatts.

As previously mentioned, peak demand has already dropped 10% (factoring out the annual demand growth discussed above). This is the same outcome which our elasticity of demand of .25 predicted would result from the 40% rate increase in June. During the summer months, hot temperatures and the desire to remain comfortable will reduce the demand elasticity such that peak demand will be down 5% instead of 10%. We will assume that demand will not drop any further due to rate increases given that new in-state supply that should come on-line from 2001 through 2004 will offset any prospective rate increases when the retail rate freeze is lifted on March 31, 2002.

Period	June 2001	July 2001	August 2001	Summer 2002	Summer 2003	Summer 2004
Annual Demand Growth	3%	3%	3%	2%	2%	2%
Peak Summer Demand (MW)	54.3	51.6	51.6	52.6	53.7	54.7
Demand Reduction	5%	0%	0%	0%	0%	0%
Resultant Demand (MW)	51.6	55.1	54.5	60.1	66.0	67.1

SUPPLY

New In-State Generating Capacity. The table below shows the planned capacity additions for in-state power plants which have received their permits and are currently on-line or under construction. It typically takes two years to bring a power plant on-line once construction has started. The table below shows that the Governor's goal of bringing 10,400 MW of new in-state capacity by the summer of 2003 is on schedule.

Year	2001	2002	2003	2004	Total
Added Capacity (MW)	3,800	1,900	4,600	1,000	11,300

Source: California Energy Commission

This relatively high level of activity can be attributed to many of the steps taken by California's leadership to stimulate new generator development. For example, the permit process has been overhauled to whittle-down the time frame from the official 12 months to 6. The state has entered into numerous, medium- and long-term contracts with power generators, creating forward markets and the needed incentives to stimulate new power plant development.

Imports / New Out-of-State Generating Capacity. Electricity is imported and exported to and from several western states, parts of Canada, and parts of Mexico. Included are Arizona, California, Colorado, Montana, Nevada, Oregon, Utah, Washington, Wyoming, Alberta-Canada, British Columbia-Canada, and Baja-Mexico. Collectively, they form the Western Systems Coordinating Council region. The table below shows the number and generating capacity of WSCC power plants (excluding CA) that have already been permitted and are currently on-line or under construction.

Year	2001	2002	2003	2004	Total
# of New Power Plants	48	15	6	0	69
Added Capacity (MW)	6,388	4,593	3,290	0	14,271

Source: California Energy Commission

Prior to the energy crisis, California imported 10,000 megawatts (or roughly 18% of its entire supply) from neighboring states. During the crisis, imports dropped to as low as 1,200 megawatts with a median of approximately 2,900 megawatts (Exhibit 12). Considering the population increases of many of the WSCC states, we might expect that these states to take a “wait-and-see” position in 2001, providing no more than they did during the summer months of 2000. Thereafter, we will assume that these states will part with a base of 2,900 megawatts and up to 10% of their new capacity for each of the following years. The table below shows what total import levels would be under these assumptions.

Year	Jun-01	Jul-01	Aug-01	2002	2003	2004
Summer 2001 Imports	3,200	2,800	1,200	.---	.---	.---
Base Import	.---	.---	.---	2,900	.---	.---
10% Added Imports (MW)	.---	.---	.---	459	329	76
Total Imports	3,200	2,800	1,200	3,359	3,688	3,764

Source: California Energy Commission

Planned and Unplanned Outages. Given that the summertime is the time of year when demand is the greatest, we need to anticipate planned and unplanned outages for this period. Prior to the energy crisis, planned outages during the summer peak, typically were 1,000 MW, while unplanned outages resulting from equipment failure or dearth of emission credits added up to another 1,000 MW. During the summer of 2000, planned outages remained at roughly 1,000 MW while unplanned outages reached 3,000 MW. As more supply comes on line, the less existing power plants will have to run continuously without routine maintenance. This will result in fewer unplanned outages. Consequently, we will assume that for the summer, planned and unplanned outages during the summer peak demand will be as follows:

Outages	2001	2002	2003	2004
Planned (MW)	1,000	1,000	1,000	1,000
Unplanned (MW)	3,000	2,000	2,000	1,000

BIBLIOGRAPHY

- Associated Press.** *California Regulator Calls for 40% Rate Increase.* Web Posting. March 26, 2001.
- Associated Press.** *Developments in California's Energy Crisis.* SFGate. May 31, 2001.
- Associated Press.** *California Signs Energy Contracts.* New York Times. June 14, 2001.
- Associated Press.** *Chronology of California's Power Crisis.* SFGate.Com. April 6, 2001.
- AUS Consultants.** *Impact of a Continuing Electricity Crisis on the California Economy.* AUS Consultants. May 3, 2001.
- Berthelsen, Christian and Gledhill, Linda.** Chronicle Staff Writers. *U.S. Energy Chief Steps In – Keeps Lights On in California.* San Francisco Chronicle. December 14, 2000.
- Berthelsen, Christian.** Chronicle Staff Writer. *Duke Admits Overcharging Utilities \$3,880 Bill per Megawatt Hour.* SF Chronicle. June 2, 2001.
- California Energy Commission.** *4-Month & Emergency Peaker Projects Status.* Web Page: www.energy.ca.gov/sitingcases/peakers/peaker_status. June 19, 2001.
- California Energy Commission.** *California Emergency Siting Peaker Power Plant Permitting.* Web Page: www.energy.ca.gov/sitingcases/peakers/index. June 20, 2001.
- California Energy Commission.** *California Energy Maps.* Web Page: www.energy.ca.gov/sitingcases/peakers/peaker_status. April 12, 2001.
- California Energy Commission.** *Comparison of Energy Commission Siting Processes Under Current Executive Orders.* Web Page: www.energy.ca.gov/sitingcases/siting_process_comparison. February 16, 2001.
- California Energy Commission.** *Congested Paths Within California EHV Transmission System.* Map. February, 2001.
- California Energy Commission.** *Database of Proposed Generation within the Western Systems Coordinating Council.* Web Page: www.energy.ca.gov/electricity/wsc Proposed_generation. June 19, 2001.
- California Energy Commission.** *Energy Facility Licensing Process, Developers Guide of Practices and Procedures.* California Energy Commission. November 2000.
- California Energy Commission.** *Power Facility Licensing Cases Currently Before the Commission.* Web Page: www.energy.ca.gov/sitingcases/current. June 22, 2001.
- California Energy Commission.** *Power Facility Licensing Cases Recently Approved by the Energy Commission.* Web Page: www.energy.ca.gov/sitingcases/approved. June 6, 2001.

California Energy Commission. *SB1345 Proceeding: Solar Energy and Distributed Generation Grants Program.* California Energy Commission. Web Page: www.energy.ca.gov/renewables/sb1345. March 20, 2001.

California Energy Commission. *Update on Energy Commission's Review of California Power Projects.* Web Page: www.energy.ca.gov/sitingcases/backgrounder. June 13, 2001.

California Energy Commission. *Western Natural Gas Pipelines.* Map. May, 2001.

California Independent System Operator. *CA ISO How It Works....* Report. February, 20, 2001.

California Independent System Operator. *CA ISO Power Central.* Web Page: www.caiso.com/aboutus/brochure/

California Independent System Operator. *CA ISO Summary / Brochure.* Web Page: www.caiso.com/aboutus/brochure/

California Independent System Operator. *California ISO Declared Emergencies for 2000.* Report. January 13, 2001.

California Independent System Operator. *California ISO Load Shedding Detail.* Report. January 17, 2001.

California Independent System Operator. *California ISO Load Shedding Detail.* Report. January 18, 2001.

California Independent System Operator. *California ISO Load Shedding Detail.* Report. January 21, 2001.

California Independent System Operator. *California ISO Load Shedding Detail.* Report. March 19, 2001.

California Independent System Operator. *California ISO Load Shedding Detail.* Report. March 20, 2001.

California Independent System Operator. *California ISO Load Shedding Detail.* Report. May 7, 2001.

California Independent System Operator. *Electrical Emergency Escalates to Stage Three, Rotating Outages Underway.* News Release. March 19, 2001.

California Independent System Operator. *Northern California Blackouts Ordered.* News Release. January 18, 2001.

California Independent System Operator. *Northern California Impacted by Brief Power Outage.* News Release. January 21, 2001.

California Independent System Operator. *Rotating Customer Outages Ordered Statewide at 9:20 a.m.* News Release. March 20, 2001.

California Independent System Operator. *Rotating Power Outages Ordered in Northern California.* News Release. January 17, 2001 .

California Independent System Operator. *Rotating Power Outages Ordered Statewide.* News Release. May 7, 2001.

California Independent System Operator. *Rotating Power Outages Ordered Statewide.* News Release. May 8, 2001.

California Independent System Operator. *Total Number of No Touch, Alert, Warning, Emergency and Power Watch for 1998 - 2001.* Report. June 30, 2001.

California Independent System Operator. *Trip Through Electricity Restructuring.* Web Page: www.caiso.com/aboutus/restructure.

California Public Utilities Commission. *Interim Opinion Regarding Rate Design.* California Public Utilities Commission. May 15, 2001.

Casten, Thomas R. *Turning Off the Heat.* New York: Prometheus Books, 1998.

Cave, Damien. *Power and the People.* CBS.MarketWatch.com. January 30, 2001.

Clement, Douglas. *Power Struggle.* FedGazette. Federal Reserve Bank of Minneapolis. <http://minneapolisfed.org/pubs/fedgaz/01-01/cover.html>. January 2001

CNN. *California Electric Rate Hike Leaves Loophole for Conservers.* Web Posting. March 27, 2001 at 8:45 p.m.

Curtis, Charles. *Distributed Energy: Towards a 21st Century Infrastructure.* The Consumer Energy Council of America Distributed Energy Domestic Policy Forum. July 2001.

Doggett, Tom. *Senator: U.S. Taxpayers May Be Liable for California's Debts.* Reuters. January 31, 2001.

Egelko, Bob. Chronicle Sacramento Bureau. *Judge Denies PG&E Bid to End Rate Freeze – Firm's Bankruptcy Filing Doesn't Limit PUC's Authority.* SF Chronicle. June 2, 2001.

Emshwiller, John R. Wall Street Journal Staff Reporter. *The Big Power Crunch.* The Wall Street Journal. May 9, 2001.

Energy Information Administration. *1995 Commercial Buildings Energy Consumption Survey.* Office of Energy Markets and End Use, Energy Information Administration, U.S. Department of Energy. December 22, 2000.

Energy Information Administration. *Annual Electric Generator Report – Utility.* Energy Information Administration, U.S. Department of Energy. August, 2000.

Energy Information Administration. *Annual Electric Generator Report – Nonutility.* Energy Information Administration, U.S. Department of Energy. August, 2000.

Energy Information Administration. *Annual Energy Outlook.* Energy Information Administration, U.S. Department of Energy. December 22, 2000.

Energy Information Administration. *California Electric Energy Crisis – Background.* Web Page: www.eia.doe.gov/cneaf/electricity/california/background. Energy Information Administration, U.S. Department of Energy.

Energy Information Administration. *California Electric Energy Crisis – Provisions of AB1890.* Web Page: www.eia.doe.gov/cneaf/electricity/california/assemblybill. Energy Information Administration, U.S. Department of Energy.

Energy Information Administration. *California’s Electricity Situation, Briefing for the Staff of the U.S. House of Representatives,* February 9, 2001. Web page: http://www.eia.doe.gov/cneaf/electricity/california/hrbrief5_9_2001.ppt. Energy Information Administration, U.S. Department of Energy.

Energy Information Administration. *Electric Power Annual.* Energy Information Administration, U.S. Department of Energy. August, 2000.

Energy Information Administration. *Selected California Electric Energy Statistics for 1999.* Web Page: www.eia.doe.gov/cneaf/electricity/california/statistics. June 19, 2001.

Energy Information Administration. *State Electricity Profiles.* U.S. Department of Energy. Web Page: www.eia.doe.gov/cneaf/electricity/st_profiles. June 4, 2001.

Energy Information Administration. *Subsequent Events – California’s Energy Crisis.* Web Page: www.eia.doe.gov/cneaf/electricity/california/subsequentevents. Energy Information Administration, U.S. Department of Energy.

Energy Information Administration. *Trends in California’s Electricity Retail Prices Fact Sheet.* Web Page: www.eia.doe.gov/cneaf/electricity/page/fact_sheets/facts. Energy Information Administration, U.S. Department of Energy.

Feiler, Thomas. *California’s Electricity Supply.* RMI Solutions. Volume XVI#2 / Fall / Winter 2000.

Freedman, Matthew. *Cooking the Books: How PG&E and SCE hide assets, artificially inflate their power purchase costs, and want consumers to pay for it.* The Utility Reform Network. October 18, 2000 (rev).

Gas Research Institute. *Power Generation Markets.*
www.gri.org/pub/aboutgri/businessunits/distrib__enduse/power.html

Gledhill, Linda and Lucas, Greg, Chronicle Sacramento Bureau. *Davis Proposes Tiered Plan to Boost Rates – Governor Wants Slightly Lower Increases Than PUC Adopted.* San Francisco Chronicle. April 6, 2001.

Gledhill, Lynda, Chronicle Sacramento Bureau. *State Meets Price-Cap Deadline; but Argues ISO Rejects Plans of Federal Regulators.* SF Chronicle. June 2, 2001

Gledhill, Lynda. Chronicle Sacramento Bureau Chief. *Power Lines Deal – Davis, Edison Come to Terms but PG&E Remains a Balky Holdout.* San Francisco Chronicle. February 24, 2001.

Golden, Mark. *Hay-wired California Power Market Seen Clearly at Night.* Dow Jones Newswires. May 30, 2001.

Griscom, Amanda. *Power Struggle.* www.NewYorkMag.com. June 18, 2001.

Harris, Scott. *New Power Generation.* The Industry Standard. September 18, 2000.

Harris, Scott. *Power Play.* The Industry Standard. June 18, 2001.

Harvard Electricity Policy Group. *Reshaping the Electricity Industry, A Public Policy Debate.* Harvard University. May 2000.

Hedman, Bruce A. *The Market and Technical Potential for Combined Heat and Power in the Commercial / Institutional Sector.* Energy Information Administration, U.S. Department of Energy. January 2000.

Hines. *Hines Wins National EPA Award for Energy Conservation.* Press Release. Hines. March 20, 2001.

Hirsch, Jerry. Times Staff Writer. *Declaring Energy Independence.* LaTimes.com. February 10, 2001.

Holding, Reynolds, Chronicle Staff Writer. *PG&E Files for Bankruptcy – The Battle Ahead: Utility’s Fate in Judge’s Hands – Bankruptcy Court Could Over-Rule PUC, Establish Electric Rates Itself.* San Francisco Chronicle. April 7, 2001.

Holson, Laura M. *Official Questions the Math Behind California’s Energy Bond Issue.* New York Times. June 30, 2001.

Hunt, Nigel. *Rolling Blackouts Hit California Again.* Reuters. May 8, 2001.

Interview. A. Denny Ellerman. Executive Director, MIT Center for Energy and Environmental Policy Research. Cambridge, MA. June 15, 2001; July 16, 2001.

Interview. Andrew Kitchens. Senior Manager of Engineering Services, Hines. Houston, TX. July 13, 2001; July 30, 2001.

Interview. Bob Accomando. Vice President of Operations, Arden Realty. Los Angeles, CA. April 13, 2001; June 14, 2001; July 19, 2001; July 23, 2001; August 2, 2001.

Interview. Dan McFadden. Professor of Economics and Nobel Laureate, UC. Berkeley. Berkeley, CA. July 16, 2001.

Interview. Erin Boedicker. Operation Research Analyst, Commercial Energy Demand Analysis and Forecasting, Integrated Analysis and Forecasting Division, Energy Information Administration, U.S. Department of Energy. Washington, D.C. June 14, 2001

Interview. Ernest Moniz. Former U.S. Undersecretary of Energy; Professor of Physics, MIT. Cambridge, MA. July 17, 2001.

Interview. *Frank Frankini*. Senior Vice President of Design and Construction, Equity Office Properties. Chicago, IL. July 16, 2001; July 30, 2001; August 2, 2001.

Interview. *Franklin W. Nutter*. President, Reinsurance Association of America. Washington DC. July 25, 2001.

Interview. *G. Mitchell Wilk*. Past President & Commissioner of the California Public Utilities Commission (1986 – 1991); Managing Director, Law and Economics Group. San Francisco, CA. July 2, 2001.

Interview. *Greg Huseby*. Vice President of Engineering, Arden Realty. Los Angeles, CA. June 12, 2001; June 20, 2001.

Interview. *J. Alan Beamon*. Economist, Electricity Generation and Cost Forecasting, Integrated Analysis and Forecasting Division, Energy Information Administration, U.S. Department of Energy. Washington, D.C. April 20, 2001.

Interview. *James Sweeney*. Senior Fellow, Stanford Institute for Economic Policy Research, Stanford University, Palo Alto, CA. July 12, 2001.

Interview. *Kenneth Breeden*, President, Commercial & Industrial Division, TXU Energy Services, Dallas, TX. July 21, 2001.

Interview. *Kevork Derderian*. Former CEO, Continental Development, Chicago, IL. July 17, 2001; July 23, 2001; August 1, 2001.

Interview. *Leslie MacDonald*. Senior Rates Analyst. Pacific Gas and Electric Company. San Francisco, CA. June 1, 2001; July 2, 2001.

Interview. *Mari Capestany*. Manager of New Business Ventures. Enron. Houston, TX. July 30, 2001.

Interview. *Matthew Freedman*. Staff Attorney. The Utility Reform Network. Interview. July 23, 2001.

Interview. *Michael Croft*. President and CEO, Commonwealth Partners (An Investment Fund Manager for CalPERS). Los Angeles, CA. July 20, 2001; July 30, 2001.

Interview. *Paul Joskow*. Director, MIT Center for Energy and Environmental Policy Research. Cambridge, MA. July 12, 2001.

Interview. *Paul Slye*. President, RealEnergy. Los Angeles, CA. April 19, 2001; June 12, 2001; June 21, 2001; July 15, 2001; July 30, 2001; August 2, 2001.

Interview. *Steve Greenberg*. Senior Energy Officer, RealEnergy. Los Angeles, CA. August 3, 2001.

Interview. *Suzanne Watson*. Senior Policy Analyst, Northeast Midwest Institute, Washington, D.C. July 30, 2001.

Interview. *Warren Otto*, Vice President of Portfolio Management, RREEF, San Francisco, CA. April 16, 2001.

Jeffords, James. *Combined Heat and Power Advancement Act of 2001 (S.933)*. U.S. Senate, Washington, D.C. May 22, 2001.

Joskow, Paul et al. *Manifesto on the California Energy Crisis*. Haas School of Business, University of California at Berkeley. January 26, 2001.

Kahn, Joseph. *California and Energy Providers in Talks Over Electric Fees*. New York Times. June 26, 2001.

Lazarus, David and Gledhill, Lynda, Chronicle Staff Writers. *Feds Hint at Power Bill Refunds – Firms Ordered to Justify High Rates*. San Francisco Chronicle. March 10, 2001.

Lazarus, David, Chronicle Staff Writer. *Blackouts Across California After PGE Can't Pay Bills – Out of the Blue: 1 Million Lose Power as Many Generators Sit Idle*. San Francisco Chronicle. March 20, 2001.

Lazarus, David, Chronicle Staff Writer. *PUC Votes to Jack-Up Rates – Tiered Increases Approved As Protests Disrupt Meeting*. San Francisco Chronicle. March 28, 2001.

Lazarus, David, Chronicle Staff Writer. *Utilities' Demand Blocks Bailout – Blackouts Roll On: Weather, Increased Consumption Blamed*. San Francisco Chronicle. March 21, 2001.

Lazarus, David. Chronicle Staff Writer. *Davis Discloses Plan to Purchase Power Lines from Utilities -- Analysis: In the Long Run, Utilities Likely to Benefit At Expense of Ratepayers*. San Francisco Chronicle. February 17, 2001.

Lazarus, David. Chronicle Staff Writer. *Highest Energy Alert – Stage 3 Emergency – Rolling Blackouts Narrowly Averted by Shutting Down Huge Pumps – Crunch Likely to Worsen*. San Francisco Chronicle. December 8, 2000.

Lazarus, David. Chronicle Staff Writer. *PUC Calls for Probe of Deregulation—State Power Market System “Not Working” Report Says*. San Francisco Chronicle. August 2, 2000.

Lazarus, David. Chronicle Staff Writer. *PUC Sidesteps On Who Pays Utilities' Costs. Meanwhile, Commission OK's rate cap for San Diego*. San Francisco Chronicle. September 8, 2000.

Lazarus, David. Chronicle Staff Writer. *PUC Tags Consumers With Huge Rate Boost – Electricity Bills: Burden Shifts from Business to Heavy Residential Users*. San Francisco Chronicle. May 16, 2001.

Lazarus, David. Chronicle Staff Writer. *Why the State Can't Keep Up with the Demand for Energy – Even in December*. San Francisco Chronicle. December 7, 2000.

Lazarus, David. Chronicle Staff Writers. *Davis Puts State In Power Business – Governor Signs \$400 Million Bill to Buy Electricity and Re-Sell it to Utilities*. San Francisco Chronicle. January 20, 2001.

Lazarus, David. Chronicle Staff Writers. *Energy Earnings Skyrocketed – Power Suppliers Casing In On Soaring Prices*. San Francisco Chronicle. December 15, 2000.

Lazarus, David. Chronicle Staff Writers. *Lights Out: Juice Cut Again – SF Sues Power Firms.* San Francisco Chronicle. January 18, 2001.

Lazarus, David. Chronicle Staff Writers. *PG&E May Default In a Matter of Days – Southern Cal Edison Says It Can't Pay Bills.* San Francisco Chronicle. January 17, 2001.

Lazarus, David. Chronicle Staff Writers. *Power Rate Boost OKd—Wall Street Scorns PUC Approval of Modest 10% Increase.* San Francisco Chronicle. January 5, 2001.

Lazarus, David. Chronicle Staff Writers. *Rolling Blackouts Hit – Power Cut to Parts of Bay Area at Mid-day – PGE Defaults on Debt – Energy: Officials Say Power Loss Could Continue Around California Today.* San Francisco Chronicle. January 18, 2001.

Lazarus, David. Chronicle Staff Writers. *U.S Entry into State Power Crisis Off to Rough Start—Governor and Consumers Sought More Decisive Action from Commission.* San Francisco Chronicle. December 16, 2000.

Little, Arthur D. *Making Distributed Generation Pay, The Opportunities and Challenges of Disruptive Technologies.* Memorandum. Arthur D. Little. Cambridge, MA. 1999.

Lochhead, Carolyn. Chronicle Washington Bureau. *Energy Department Gives State A Reprieve – Order To Suppliers: They Must Sell Electricity & Gas 2 More Weeks.* San Francisco Chronicle. January 24, 2001.

Lucas, Greg and Salladay, Robert, Chronicle Sacramento Bureau. *Regulators Find More Possibilities of Gouging.* San Francisco Chronicle. March 17, 2001.

Lucas, Greg. Chronicle Sacramento Bureau. *Page One (Sacramento)—State Electricity Rates to Drop 20% by 2003, Wilson Signs Bill That Ends Utilities' Monopoly.* San Francisco Chronicle. September 24, 1996.

Lucas, Greg. Chronicle Sacramento Bureau Chief. *State Oks \$10 Billion for Power—First Step: A Bid to Avert Blackouts and Bankruptcy.* San Francisco Chronicle. February 2, 2001.

Makovich, Lawrence J. *Hot Times Ahead for California and West as Shortage Intensifies.* Cambridge Energy Research Associates. CERAWEEK. February 12, 2001.

Melley, Brian. *California Adopts \$10 Billion Power Plan, Aims to Keep Lights On While Lawmakers Try to Fix Crisis.* Associated Press. February 1, 2001.

Miller, Brian K. *State Quickens Power Plant Approval Process.* GlobeSt.com. April 24, 2001.

Muto, Shiela. *California Real Estate Finds Strength in Power Woes.* Wall Street Journal. May 9, 2001.

National Energy Policy Development Group. *National Energy Policy.* U.S. Government. May 16, 2001.

Norr, Henry. Chronicle Staff Writer. *Searing Heat Tests PG&E Limits -- Thousands of Bay Area Customers Lose Power During Rolling Cutoffs.* San Francisco Chronicle. May 23, 2000.

North American Electricity Reliability Council. *Net Internal Demand Summer.* North American Electricity Reliability Council. 2000.

North American Electricity Reliability Council. *Net Internal Demand Winter.* North American Electricity Reliability Council. 2000.

North American Electricity Reliability Council. *Planned Capacity Resources Summer.* North American Electricity Reliability Council. 2000.

North American Electricity Reliability Council. *Planned Capacity Resources Winter.* North American Electricity Reliability Council. 2000.

Office of the Governor. California Energy Efficiency and Demand Reduction Program. State of California. Web Page: www.flexyourpower.ca.gov/rebates/ab29x-sb5x_program_summary. April 16, 2001.

Office of the Governor. *Governor Davis Announces 11 Percent in Overall Electricity Use for May.* Press Release, Office of the Governor, State of California. June 4, 2001.

Office of the Governor. *Governor Davis Announces List of Energy Conservation Resources for Businesses.* Press Release, Office of the Governor, State of California. April 24, 2001.

Office of the Governor. *Governor Davis Announces Recovery Web Site That Makes Finding Energy Rebates Easy.* Press Release, Office of the Governor, State of California. May 7, 2001.

Office of the Governor. *Governor Davis Announces State Agreements to Spur Energy Efficient Buildings.* Press Release, Office of the Governor, State of California. March 20, 2001.

Office of the Governor. *Governor Davis Orders Financial Incentives for Businesses Who Cut Energy Use.* Press Release, Office of the Governor, State of California. June 10, 2001.

Office of the Governor. *Governor Davis Signs Measure Authorizing Energy Bond Sale.* Press Release, Office of the Governor, State of California. May 10, 2001.

Office of the Governor. *Governor Davis Unveils 20/20 Energy Rebate Program for Summer 2001.* Press Release, Office of the Governor, State of California. March 13, 2001.

Office of the Governor. *Governor New Electricity Metering Program to Cut Peak Energy Use.* Press Release, Office of the Governor, State of California. June 7, 2001.

Office of the Governor. *Governor Signs Landmark Energy Conservation Package.* Press Release, Office of the Governor, State of California. April 11, 2001.

Pacific Gas and Electric Company. *Air Conditioning / Agriculture / Gas Rebates.* Web Page: www.pge.com/003_save_energy/003b_bus/003b1a11_gasreb_small. Pacific Gas & Electric Company. May 31, 2001.

Pacific Gas and Electric Company. *Understanding Baseline Quantities.* Web Page: www.pge.com/001_res_svc/baseline. Pacific Gas & Electric Company. May 31, 2001.

Pacific Gas and Electric Company. *Rule 21—Generating Facility Interconnections.* Pacific Gas and Electric Company. January 5, 2001.

Peabody, Zanto. Times Staff Writer. *Gambles Pay Off as Public Universities Avoid Spiraling Costs.* Latimes.com. February 10, 2001.

Peltz, James F. *Energy Concerns Dim Mid-Size Firms' Optimism.* Latimes.com. February 2, 2001.

Pena, Michael and Gledhill, Lynda. Chronicle Staff Writers. *Company Hesitant to Build Power Plant; Worry Over State's Energy Policies.* SF Chronicle. June 2, 2001.

Pressman, Aaron. *Gridlock: California Could be Just the Beginning.* The Industry Standard. June 25, 2001.

Real Estate Roundtable. *Real Estate Roundtable Members Receive Government's First Energy Star Building Award.* Press Release. The Real Estate Roundtable. March 28, 2001.

Reuters. *Energy Chief Sees Potential California Blackouts.* Web Posting. March 25, 2001.

Robb, Jim, et al. *The Bay Area – A Knowledge Economy Needs Power.* McKinsey & Company on behalf of the Bay Area Economic Forum. April 2001.

Saefong, Myra P. *Consultant: California Gets Its Just Deserts.* CBS.MarketWatch.com. January 24, 2001.

San Jose Chamber of Commerce. *Energy for Everyone, A Public Policy Position of the San Jose Chamber of Commerce.* Web Page. May 31, 2001.

Saunders, Chris. *Electric Deregulation Flops in California, Helps Elsewhere.* Reuters. January 30, 2001.

SFGate. *Energy Crisis Overview: The Impact.* San Francisco Chronicle. May 8, 2001.

SFGate. *California Power Shuffle.* San Francisco Chronicle. www.sfgate.com/cgi-bin/sfgate/object.cgi?object=/chronicle/pictures/2000/12/15.

Shogren, Eliabeth. *Other States Put Brakes on Deregulation.* Latimes.com. February 8, 2001.

Smith, Rebecca. Chronicle Staff Writer. *PG&E to Sell Power Plants For \$1Billion – They Sold for Nearly Double Their Book Value.* San Francisco Chronicle. November 25, 1998.

Stahlkopf, Karl. *About Distributed Resources.* Electric Power Research Institute. www.epri.com

Stahlkopf, Karl. *California's Electricity Crisis – Causes and Solutions.* Electric Power Research Institute. www.epri.com

State of California. *Permit Assistance Centers.* California Environmental Protection Agency. Web Page: www.calgold.ca.gov/pac.asp.

Tarsala, Mike. *Governors to Meet on Power Crisis.* CBS.MarketWatch.com. February 1, 2001.

U.S. Bureau of the Census. *Census 2000.* U.S. Government. April 2, 2001.

U.S. Department of Commerce, Bureau of Economic Analysis. *California Gross State Product 1963 to 1999.* U.S. Government. June 6, 2001.

York, Anthony. *The Deregulation Debacle.* CBS.MarketWatch.com. January 30, 2001.

Zoeliner, Tom. Chronicle Staff Writer. *Power Companies in the Hot Seat—Unreasonable Weather Strains System..* San Francisco Chronicle. May 23, 2000.

FOOTNOTES

- ¹ Thomas R. Casten, *Turning Off the Heat* (New York: Prometheus Books, 1998), p. 38.
- ² *Ibid.*, p. 32.
- ³ Energy Information Administration, *California Electric Energy Crisis – Background*, www.eia.doe.gov/cneaf/electricity/california/background, p. 1.
- ⁴ California Independent Service Operator, *Power Central*, www.caiso.com/powercentral, p. 2.
- ⁵ Energy Information Administration, *Provisions of AB1890*, www.eia.doe.gov/cneaf/electricity/california/assemblybill, p. 2.
- ⁶ Jim Robb, *The Bay Area - A Knowledge Economy Needs Power*, (San Francisco: Report prepared by McKinsey & Company for the Bay Area Economic Forum, April 2001), p.3.
- ⁷ Matthew Freedman, Staff Attorney, The Utility Reform Network, Interview, July 23, 2001; Various San Francisco Chronicle Articles 2001 cited herein.
- ⁸ Greg Lucas, Page One (Sacramento)—State Electricity Rates to Drop 20% by 2003, Wilson Signs Bill That Ends Utilities’ Monopoly, San Francisco Chronicle. September 24, 1996.
- ⁹ Thomas R. Casten, *Turning Off the Heat* (New York: Prometheus Books, 1998), p. 196.
- ¹⁰ *Ibid.*, p. 11.
- ¹¹ Jim Robb, *The Bay Area - A Knowledge Economy Needs Power*, (San Francisco: Report prepared by McKinsey & Company for the Bay Area Economic Forum, April 2001), ps 42 and 43.
- ¹² North American Electricity Reliability Council. *Planned Capacity Resources Summer; and Planned Capacity Resources Winter*. (Princeton: North American Electricity Reliability Council. 2000).
- ¹³ Jim Robb, *The Bay Area - A Knowledge Economy Needs Power*, (San Francisco: Report prepared by McKinsey & Company for the Bay Area Economic Forum, April 2001), ps 42 and 43.
- ¹⁴ *Ibid.*, p. 14
- ¹⁵ Lawrence J. Makovich, *Hot Times Ahead for California and West as Shortage Intensifies*, CERAWEEK, Cambridge Energy Research Associates, February 12, 2001.
- ¹⁶ Jim Robb, *The Bay Area - A Knowledge Economy Needs Power*, (San Francisco: Report prepared by McKinsey & Company for the Bay Area Economic Forum, April 2001), p. 4.
- ¹⁷ *Ibid.*, p. 5.
- ¹⁸ *Ibid.*, p. 4
- ¹⁹ *Ibid.*, p. 4
- ²⁰ *Ibid.*, p. 9
- ²¹ *Ibid.*, ps. 4 and 5.
- ²² Energy Information Administration U.S. Department of Energy. *Subsequent Events – California’s Energy Crisis*. Web Page: www.eia.doe.gov/cneaf/electricity/california/subsequentevents, p. 3.
- ²³ Jim Robb, *The Bay Area - A Knowledge Economy Needs Power*, (San Francisco: Report prepared by McKinsey & Company for the Bay Area Economic Forum, April 2001), p. 16.
- ²⁴ *Ibid.*, ps. 53 and 54..
- ²⁵ Energy Information Administration, U.S. Department of Energy. *California’s Electricity Situation, Briefing for the Staff of the U.S. House of Representatives*, February 9, 2001. Web page: http://www.eia.doe.gov/cneaf/electricity/california/hrbrief5_9_2001.ppt.
- ²⁶ Jim Robb, *The Bay Area - A Knowledge Economy Needs Power*, (San Francisco: Report prepared by McKinsey & Company for the Bay Area Economic Forum, April 2001), ps. 8 and 13.
- ²⁷ *Ibid.*, p. 9
- ²⁸ U.S. Bureau of the Census, Census 2000.
- ²⁹ Jim Robb, *The Bay Area - A Knowledge Economy Needs Power*, (San Francisco: Report prepared by McKinsey & Company for the Bay Area Economic Forum, April 2001), ps. 8 and 10.
- ³⁰ *Ibid.*, ps. 8 and 12.
- ³¹ *Ibid.*, ps. 8 and 10.
- ³² *Ibid.*, ps. 8 and 18.

33 Matthew Freedman, Staff Attorney, The Utility Reform Network, Interview, July 23, 2001; Various San Francisco Chronicle Articles 2001 cited herein.

34 California ISO, *California ISO Declared Emergencies for 2001*, (Sacramento: California Independent System Operator, June 30, 2001), p. 3.; SFGate, *California Power Shuffle*, www.sfgate.com/cgi-bin/sfgate/object.cgi?object=/chronicle/pictures/2000/12/15.

35 David Lazarus, *Rolling Blackouts Hit – Power Cut to Parts of Bay Area at Mid-day – PGE Defaults on Debt – Energy: Officials Say Power Loss Could Continue Around California Today*, San Francisco Chronicle. January 18, 2001

36 Jim Robb, *The Bay Area - A Knowledge Economy Needs Power*, (San Francisco: Report prepared by McKinsey & Company for the Bay Area Economic Forum, April 2001), p. 37.

37 Ibid., p. 34.

38 Lawrence J. Makovich, *Hot Times Ahead for California and West as Shortage Intensifies*, CERAWEEK, Cambridge Energy Research Associates, February 12, 2001.

39 U.S. Department of Commerce, Bureau of Economic Analysis. *California Gross State Product 1963 to 1999*. Washington, D.C.: U.S. Government. June 6, 2001).

40 Jim Robb, *The Bay Area - A Knowledge Economy Needs Power*, (San Francisco: Report prepared by McKinsey & Company for the Bay Area Economic Forum, April 2001), p. 36.

41 California Energy Commission, *Database of Proposed Generation Within the Western Systems Coordinating Council*, (Sacramento: California Energy Commission), www.energy.ca.gov/electricity/wsc_database_status, ps. 1-9.

42 David Lazarus, *Davis Discloses Plan to Purchase Power Lines from Utilities -- Analysis: In the Long Run, Utilities Likely to Benefit At Expense of Ratepayer*, San Francisco Chronicle, February 17, 2001

43 Jim Robb, *The Bay Area - A Knowledge Economy Needs Power*, (San Francisco: Report prepared by McKinsey & Company for the Bay Area Economic Forum, April 2001), ps. 11 and 18.

44 Jim Robb, *The Bay Area - A Knowledge Economy Needs Power*, (San Francisco: Report prepared by McKinsey & Company for the Bay Area Economic Forum, April 2001), ps. 28 and 30.

45 State of California, *Governor Davis Announces 11 Percent Reduction in Overall Electricity Use for May*, Issues (Press Release from Governor of California), June 6, 2001.

46 Laura M. Holson, *Official Questions the Math Behind California's Energy Bond Issue*, New York Times, June 30, 2001.

47 Associated Press, *California Signs Energy Contracts*, The New York Times, June 14, 2001.

48 Ibid.

49 Laura M. Holson, *Official Questions the Math Behind California's Energy Bond Issue*, New York Times, June 30, 2001

50 Bruce A. Hedman, *The Market and Technical Potential for Combined Heat and Power in the Commercial / Institutional Sector*. Report by On-Site Sycom Energy Corporation for Energy Information Administration, U.S. Department of Energy, January 2000, p. 60.

51 Ibid., p. 15.

52 Energy Information Administration, U.S. Department of Energy, *Commercial Building Energy Consumption Survey 1995, Table 13: Electricity Consumption and Conditional Energy Intensity by Building Type*, www.eia.doe.gov/emeu/cbecs.

53 Paul Slye, President, RealEnergy, Interview; Luke Stowe, California Environmental Protection Agency, E-Mail Response, June 26, 2001.

54 California Energy Commission, *Comparison of Energy Commission Siting Processes Under Current Executive Orders*, www.energy.ca.gov/siting_cases/siting_process_comparison, February 16, 2001.

55 Paul Slye, President, Real Energy, Interview.

56 The process for identifying 3rd-party developers included the following: (1) Contacting each of the forty active members of the California Alliance for Distributed Energy Resources (CADER) to see if they (or any company they were familiar with) provided these 3rd-party services. (2) Scouring related

-
- journals and newspaper articles. (3) Obtaining the names of those energy service companies that had approached the above-mentioned landlords offering to provide related services.
- 57 Paul Slye, RealEnergy Marketing Brochure
- 58 Bruce A. Hedman, *The Market and Technical Potential for Combined Heat and Power in the Commercial / Institutional Sector*. Report by On-Site Sycom Energy Corporation for Energy Information Administration, U.S. Department of Energy, January 2000, p. 19.
- 59 National Energy Policy Development Group. *National Energy Policy*. U.S. Government. May 16, 2001, Overview p. xiii.
- 60 Kevork Derderian, Interview.
- 61 Bruce A. Hedman, *The Market and Technical Potential for Combined Heat and Power in the Commercial / Institutional Sector*. Report by On-Site Sycom Energy Corporation for Energy Information Administration, U.S. Department of Energy, January 2000, p. 46.
- 62 Paul Slye, President, Real Energy, Interview.
- 63 Andrew Kitchen, Manager of Engineering Services, Interview.
- 64 Andrew Kitchen, Manager of Engineering Services, Interview; Kevork Derderian, Interview.
- 65 Thomas R. Casten, *Turning Off the Heat* (New York: Prometheus Books, 1998), p. 192.
- 66 Ibid., p. 192
- 67 Ibid., p. 167
- 68 Ibid., p. 168
- 69 Ibid., p. 168
- 70 Charles Curtis et al, *Distributed Energy: Towards a 21st Century Infrastructure*, The Consumer Energy Council of America Distributed Energy Domestic Policy Forum, July 2001, p. 2.
- 71 Ibid., p. 2.
- 72 Douglas Clement, *Power Struggle*, FedGazette, Federal Reserve Bank of Minneapolis, <http://minneapolisfed.org/pubs/fedgaz/01-01/cover.html>, January 2001
- 73 Thomas R. Casten, *Turning Off the Heat* (New York: Prometheus Books, 1998), p. 159.
- 74 Ibid., p. 159.
- 75 Ibid., p. 187.
- 76 Ibid., p. 124.
- 77 Ibid., p. 4.
- 78 Ibid., p. 3.
- 79 Ibid., p. 3.
- 80 Ibid., p. 3.
- 81 Ibid., p. 11.
- 82 Ibid., p. 157.