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Thomas G. Burns, a member of PIRINC's newly created Board of Visitors, prepared the enclosed report, *California's Electricity Woes — and the Potential Impact on the Refining Industry*. The Board of Visitors allows PIRINC to draw on leading energy experts to help assess research priorities and, on occasion, to contribute their own analyses of key energy issues.

As is well known, California is experiencing electric power shortages that are attributable to a confluence of forces that have been building over an extended period. The attached paper does not seek to delve into the underlying causes and possible outcomes of the fundamental situation, but rather tries to assess the potential problems and opportunities for the refining industry in California. Each industry grouping will experience its own unique set of challenges, depending upon its historical power needs and supplier relationships, and upon its ability to adapt rapidly to changing circumstances. This limited survey of the California situation should be of help to the refining industry, but perhaps also to other major co-generators and consumers of natural gas, both within the state and elsewhere.

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California's Electricity Woes
And The Potential Impact On The Refining Industry

Executive Summary

California's electric power problems have been the subject of intensive national news coverage over the past several months. A series of rolling blackouts in January followed by a second set in March portends ill for the coming summer when seasonal demand reaches its annual peak.

The crisis began with shortages of incremental power during winter peak periods and rapidly escalated to a financial crisis for the state's major utilities, which were unable to pass on higher unregulated wholesale prices in the regulated rates they could charge their end-user customers. Wholesalers that were not being paid for electricity already delivered also saw their financial security threatened, and, in some cases have stopped supplying California utilities with electric power. The crisis has now grown to the point where it is impacting the state's credit rating. As the expected higher electricity prices begin to ripple through the economy, businesses will have to curtail operations, leading to a slowing economy and rising unemployment.

An increasingly tenuous natural gas supply/demand balance further complicates the electric power situation since gas accounts for a dominant share of fossil fuel power generation in the state. Although higher gas prices were passed through to end-users, the system remains under severe strain. Gas inventories have been extremely low since last summer, when replenishment was deferred due to high demand. Hydroelectric power supplies are also threatened next summer as a result of below normal snowpack in the Sierra Nevada and continued dry weather in the Pacific Northwest.

Refineries in California are both producers and consumers of electricity, in some cases with interruptible supply contracts. Much of the cogeneration capacity installed in refineries burns natural gas as the preferred fuel. Although refineries have worked hard and made major investments over the past several decades to improve their energy efficiency, they still remain significant consumers of electric power.

The refining industry is participating in the attempts to resolve the electricity crisis successfully by continuing to conserve during peak demand periods, by optimizing cogenerated electricity output, and by searching for alternative fuel sources to keep their facilities operating. Gas has been the favored fuel over the past decade, both due to its attractive price and to its relatively low air emissions. As the price of gas rises relative to other fuels, this equation is changing. In times of crisis, California may have to consider temporary relaxation of some of its air emissions standards in order to keep the lights on.

Background

It is important to recognize that California imports almost 20% of its electricity and about 80% of its natural gas, making it dependent on out of state suppliers to meet local demand. This

means that critical components of California's energy supply system are beyond the control of the State Public Utilities Commission.

California's electric power problems began last summer when growing demand started to strain the state's supply capabilities. High demand for power generated from natural gas, which represents the incremental fuel in California's electricity supply mix, made it impossible to replenish the gas storage volumes that are normally held in reserve to meet peak winter heating demand.

The utilities began to buy power at increasingly high spot prices but were unable to pass the higher costs on to their retail and industrial customers due to continuing rate regulations. An abnormal seasonal demand/supply imbalance in December and January, due in large part to unanticipated plant outages, coupled with cash flow problems experienced by wholesale suppliers due to slow payment by the utilities, led to reserve shortages, and in January, to the first rolling blackouts.

What began as a power supply problem rapidly escalated to a financial crisis for the utilities and their power suppliers, located both in California and out of state. Neither utilities nor power generators (who were not being paid by the utilities) were able to continue to finance the rapidly escalating cost of power for California. In March, additional rolling blackouts were made necessary by the lack of available power to maintain system integrity, and the crisis again moved to a new level, this time threatening the fiscal integrity of the state itself. In response, the California Public Utilities Commission approved a significant rate increase at the end of March to try to bring additional funds into the system. The state also is negotiating to purchase the transmission facilities of the major utilities, intending to receive tangible assets in return for providing an injection of cash needed to maintain the financial stability of the utilities.

In early April, additional relief was offered in the Governor's proposal for a structured rate increase for the utilities. However, believing that policy conditions and regulatory commitments in support of the combination of rate increases and asset purchases was insufficient, Pacific Gas and Electric subsequently declared Chapter 11 bankruptcy in order to gain time to reorganize their finances under the supervision of the court.

In addition to the impact on California's utilities and power suppliers, the situation is now starting to affect other business segments as well. So far industrial and commercial customers have only occasionally been subjected to short power outages during the "rolling blackouts" imposed when power reserves fell below safe limits. But they have already seen the impact of the much higher prices for natural gas and can now expect to see higher electricity bills in the near future. Small businesses including cafes, restaurants, dry cleaners, and grocery stores are already feeling the pinch of higher energy prices. If they are unable to pass these costs on to their customers, they may have to consider shortening business hours or eliminating some energy intensive product lines, which could easily result in near term increases in unemployment.

Much has been written about how California got into its present predicament. There is still an ongoing dispute as to whether or not California really deregulated its electricity industry. The outcome of this dispute will have serious implications for the future of electricity deregulation (and regulation) both in California and in many other states as well.

The essence of the situation is that, at best, California only partially deregulated its electricity industry, and then only at the wholesale level. Furthermore, in a well intentioned, but ultimately counter-productive move, California required its main electric utilities to sell off 50% of their natural gas and oil fired generation facilities and to refrain from making long-term power purchase contracts. In the end, the utilities elected to sell all of these facilities to third party suppliers of electricity.

After the utilities missed the opportunity to make long-term supply purchase contracts when prices were low, the state is now attempting to negotiate long-term contracts under much less favorable market conditions.

The deregulation process also failed to grasp the importance of the load-leveling and dispatch functions performed by the utilities. There was a failure to ensure a smooth transfer of these and other functions to the Independent System Operator which was set up to handle these activities after deregulation . The whole notion of a systems engineering approach to dealing with these issues has collapsed, and new rules and responsibilities have had to be worked out in real time under crisis conditions.

The purpose here is not to add to the extensive debate on the merits of electricity deregulation, but rather to try to ascertain the potential impacts on the refining industry and to draw some conclusions about possible future scenarios over the next year.

Problems

1) <u>The situation is likely to get worse before it gets better</u>

California's electricity balance in the coming months will remain precarious. Population continues to grow and housing starts have been strong. Summer months generally experience periods of peak electricity demand, due both to air-conditioning requirements and to increased water pumping. If anything, the surprise so far has been that problems first surfaced in the winter months, an ominous sign for the future.

Summer peak day demand generally runs about 30 to 35% higher than the winter peak, which is experienced in early December, and 50% higher than the demand levels that have led to rolling blackouts in recent months. Hourly peak requirements are an even bigger problem. Late summer afternoons represent the period of absolute maximum demand, when industrial, commercial, and residential loads overlap. It was peak hour demand, and not peak day demand, that led to the rolling blackouts that were imposed in January and March 2001.

2) <u>Supplies will continue to be tight at least through the summer</u>

Low volumes of stored water in the Pacific Northwest will continue to restrict the hydroelectric power available for export to California. A below average current snowpack in California also seems likely to limit in-state hydroelectric generation during the coming summer.

Gas inventories that were low going into the winter have been further depleted, again reducing next summer's incremental electricity supply from gas-fired generation. Gas supplies, while

easing, still remain tight and pipeline capacity is insufficient to meet both current demand and the need to replenish inventories.

3) Demand management won't be much help in the short term

As described below, voluntary reduction and conservation efforts could help during the coming summer, but they require changes in behavior and comfort levels. Without investments, which take time, such behavior changes generally don't have a lasting impact. The proposed price increases for all classes of customers will help reinforce consumer behavior, but, since they are not now expected to come into play until June, they, too, may have a modest impact in the coming summer months.

Nascent energy conservation programs requiring investment probably will not be able to contribute much in the way of permanent reductions in electricity demand in the next few months. There is also some indication that past conservation and efficiency investments have already reduced the opportunities for rapid gains in the near future. Furthermore, a slowing national economy (even including parts of Silicon Valley) will not have much impact on electricity demand since California's industry is not particularly energy intensive, at least as compared with other large states.

California ranks 47th in the nation with respect to per capita use of electricity. Its generally favorable climate and the absence of energy intensive industries allows its residents to consume only about 60% of the electricity consumed by the average US resident.

4) The role of interruptible customers is critical

There is another problem that so far at least has not received much attention in the public discussion of the issue—the role of interruptible electricity customers. In the previously regulated environment, large industrial customers were granted lower rates in return for their willingness to accept occasional interruptions in their power supply. In fact, because such interruptions rarely occurred in the past, the regulators were, in effect, merely recognizing the need to grant large customers a type of volume discount. It turns out that some customers that really needed a firm power supply banked on the historical absence of interruptions in their decision to obtain the lower rates for interruptible supplies. These include both industrial customers and service businesses for whom power interruptions are extremely costly.

Interruptible electricity supply contracts generally provide that a customer can have its power interrupted only a certain number of times or for a certain number of hours in a specified period. Interrupting power supply to these customers has been one way that the utilities have been able to manage their way through many of the recent periods of insufficient power reserves, limiting the need to go to the measure of last resort—rolling blackouts for all customers.

Many of these contractual limits on permitted interruptions have now been reached and the contracts cancelled, with an attendant loss of future flexibility for the utilities going into the peak summer demand season. The effect of this history is that, in the future, virtually all customers will be entitled to so-called "non-interruptible" supply. This will make it just that much more difficult for the utilities to maintain continuous electricity supply to their residential and commercial customers, exacerbating their political and public relations problems.

How Will The California Consumer React?

In general, demand side adjustments take time to have a significant impact. Consumer habits are difficult to change in the short term, especially in the absence of clear price signals. After all, electricity consuming equipment and appliances are already in place and meeting consumer needs, either for comfort and convenience or to produce and market goods and services. Replacement of existing energy consuming equipment one-by-one through purchases of new, more energy efficient appliances and machinery takes place slowly.

Furthermore, like many other regions, California has long had conservation policies in place that encourage the purchase of more energy efficient appliances, air conditioners, and insulation. This has resulted in an extended period during which electricity consumption growth lagged both economic growth and population growth. For example, statewide electricity demand has risen at an average rate of only about 1% per year since 1990.1 During the same period, California's population grew by 4.1 million people, or about 1.3% per year, and its economy grew even faster. Although there are still many cost-effective conservation options available, most of them will require time and investment to realize.

Large industrial customers, including refineries, are already being approached with requests to curtail peak power demand at critical points during the day. However, it does not now seem as if these voluntary efforts will be sufficient to carry the system through the peak demand periods of the summer months.

In recent weeks, California consumers have been inundated with advertising intended to raise general awareness of the pending situation and exhorting them to conserve electricity. Most citizens seem largely indifferent to the situation, at least until rolling blackouts occur and get their attention. So far, these have been sporadic and limited in scope, with a similarly limited impact on consumer attitudes.

The so-called "Power Police" have had only a modest impact, although some targeted businesses like automobile dealerships have started to include a statement in their radio ads to the effect that they are reducing their night time lighting by as much as 50%. Gestures like this represent important, non-price signals to the general public about the seriousness of the situation even though they don't directly address the issue of peak power loads.

In this regard, however, it may be appropriate to draw an analogy with the drought years of the late 1980s and early 1990s. At that time, water consumption was largely unaffected by early calls to conserve—at least until pictures began appearing in the newspapers of empty reservoirs. Then consumers finally began to respond, even in areas without water meters. In other words, if consumers become convinced 1) that there is a real problem and 2) that their personal actions can have a meaningful impact; they will respond. These "voluntary" actions of consumers to reduce waste were also reinforced in some areas that do have water meters by pricing systems that charged much higher rates for water consumption above a fixed base level.

[1] However, the 1% average is composed of zero growth between 1990 and 1995 and about 2% annual growth between 1995 and 1999.

Short-term measures to reduce electricity demand that are readily available to residential and commercial consumers include higher indoor temperatures (72° or higher rather than 68° F) in the summer; elimination of second (usually older, less efficient) refrigerators for cold drink storage; reduction of non-essential lighting; reduction of water consumption (most California water is pumped with electric pumps at some point); doing laundry and dishes outside of peak electricity consumption hours; etc. These types of behavioral changes can be made if consumers believe that they can actually have an impact and when they see their neighbors reacting as well. During the drought years, peer pressure was an important influence, and brown lawns became a status symbol in some particularly impacted areas.

In contrast to the water situation where much of the state's water consumption is paid for in a fixed annual or monthly payment, everyone in California has an electric meter. This does offer feedback to the consumer on current and past consumption levels as well as an opportunity to show real cost savings associated with reduced power consumption. If the rate structure provides for much higher prices for consumption over some baseline amount, price could, for the first time,(particularly if price changes were skewed towards time of day or peak use) begin to have a real effect on electricity demand.

At the end of March, the regulators moved to allow a meaningful price signal to help reinforce consumer behavior, but that is now not scheduled to take place until June at the earliest. Unfortunately, consumers will probably see this primarily as a penalty for a flawed deregulation process rather than as a necessary piece of information that will help them make better energy consumption decisions.

How Will Future Price Increases Affect Refiners?

Although the exact rate structure is not yet final, California industry is today facing price increases of 30 to 45% as a result of recent decisions by the State Public Utilities Commission. There is a wide range of industrial customers, and there will undoubtedly be a heated discussion about exactly which ones will receive which rate levels. Over time, these higher prices will certainly reinforce existing conservation programs at refineries and probably induce additional investments in cogeneration facilities.

In the short term, however, they will have to be absorbed in petroleum product costs, and, if oil market conditions do not permit this, may even result in reduced output of California refiners. Refiners may, for example, elect to reduce the amount they pay for incremental electricity supplies by trimming output to match their own electricity production from cogeneration.

There are basically four reasons why a refinery (or any industrial company) makes conservation and cogeneration investments. The first is system reliability. Having control over operating inputs like electric power makes control of overall operations more effective. Many industrial operations require power supplies to be consistent and of consistently high quality. This is particularly prevalent in businesses that rely on process integrity to assure product quality. In California, for example, manufacturers of electronic equipment like computer chips generally require power of higher quality with fewer voltage fluctuations than do traditional industries that have gotten used to dealing with small variations in voltage. But the need for reliable power

supply is not limited to "new economy" companies. Brewers, for example, have already had to destroy large batches of semi-finished products as a result of power supply failures.

The second reason is economics. Whenever a "make or buy" analysis shows strong reasons to shift sources of supply, new investments are made. The intense pressure on petroleum industry cost structures in the past decade has intensified review of past decisions made under different economic conditions. Pricing of purchased supplies is obviously one of the critical inputs in the "make or buy" decision. In the case of electricity, cogeneration economics will be enhanced by rising costs of purchased electricity. The wild card in this equation is the future cost of purchased natural gas, since refiners probably will be unable or unwilling to burn liquid fuels in normal operations.

The choice of fuel is often related to the third reason—the environment—which businesses consider when they decide to make investments in conservation or cogeneration. Environmental permit restrictions may limit the operating flexibility of a refinery, leading to the decision to make such investments.

The final factor that leads to investments of this type is the desire to enter into a new line of business that is expected to provide profitable growth for the company. Some petroleum companies have sought opportunities in power production, either as the result of new technologies or because of the availability of economic supplies from cogeneration or the availability of a unique fuel. This could be refinery gas, wellhead casing gas, an otherwise unsalable refinery by-product stream, or even coke. Some companies have strategically sought out opportunities to build stand-alone electric generation facilities in order to gain entry to the electricity business, which has been growing faster than the market for conventional petroleum products.

Conservation Programs Of California Refiners

Because of supply logistics, California has always had relatively high energy costs. Therefore, conservation has long been a staple of the refinery's bag of tricks used to cut operating costs. Just as California's consumers use energy more sparingly than people do in other parts of the country, California's refineries have also devoted a considerable amount of attention to energy efficiency programs. These efforts have resulted in energy efficiency improvements for a similar output mix of 10% to 20% since the recovery from the oil price collapse in the late 1980s and as much as 30% to 40% in the almost 30 years since the first oil price shocks. Even so, petroleum refining remains a very energy intensive business.

Counteracting these efforts to improve overall refinery energy efficiency, however, has been the trend to ever-higher standards of petroleum product quality required to meet tightening air emissions standards. As is well known, more intensively refined products require more energy in the refining processes. The smaller average size of California's refineries also hurts overall energy efficiency per barrel of throughput, at least when compared with the larger US Gulf Coast refineries.

California refineries have employed programs similar to those used throughout the refining industry to cut costs by conserving energy. These programs have included replacement of major

energy consuming facilities (like crude units, for example) with more modern and efficient units. Refinery steam and electrical systems have also undergone a thorough modernization over the past decade. One refinery in California has been able to save over three-quarters of a million dollars per year solely as a result of electrical system upgrades.

One of the key changes in refinery design comes from integrating energy efficiency into the standard design parameters. During the design phase, both for new and replacement equipment, energy efficiency is now one of the prime considerations. Normal maintenance shutdowns are also regularly used to improve efficiency of existing units, by electrical system upgrades or addition of insulation, for example.

Because refineries consume large amounts of heat for process units, they represent prime candidates for cogeneration. Many refineries have begun (in some cases completed) the switch away from boilers used to make process steam in favor of installation of combined cycle electric generators that provide both heat and power. This switch raises the overall efficiency of the refinery energy balance considerably.

Oil companies have also been in the forefront of improving efficiency throughout their operations, including, for example, in their office buildings. Although the absolute amount of energy savings is much smaller than in a refinery, it is nonetheless meaningful. Energy efficient lighting, more balanced indoor air management systems, and more efficient electric and electronic equipment are among the approaches used to reduce building energy consumption by more than 50% in some cases.

Energy awareness among employees at work also carries over to their homes. Many companies have provided employees with information that they can use to improve energy efficiency at home and, thus, reduce their electricity needs. Some companies have also developed businesses that engineer and install cogeneration facilities or provide energy audit services designed to help their customers use energy more efficiently.

Energy efficiency programs are generally based on an approach that starts with measurement and then seeks ways to reduce consumption. In the days of historically cheap energy, designs were often based on operability, initial cost, and longevity rather than energy efficiency. Now, energy efficiency is one of the critical parameters evaluated in any design study. Once processes or units that consume large amounts of energy are identified, engineers and operators can go to work finding ways to improve their efficiency.

Power From And For The Refining Industry

The California electric power supply mix has changed considerably during the past decade. Non-utility generation has risen from 20% of total generation to 35% of total supply over the past decade. Although California as a whole generates about 30% of its total power from natural gas, over 70% of the power generated by non-utilities is based on natural gas.

As both large power users and large steam and process heat consumers, the refining industry has long been an important place to locate gas-fired cogeneration plants. Over the past several decades, California's refineries have become one of the more important sources of non-utility

power. Many refineries generate part or all of their internal requirements and, at times, are able to sell surplus power to the grid. This not only reduces the demand on the utility systems, but it also provides the utility with some generation flexibility under certain circumstances.

In fact, in the past, the utilities often considered cogeneration opportunities in preparing their overall electricity generating plant siting and capacity addition programs. By coordinating plans for major power plant expansions with smaller cogeneration additions, for example, they were able to keep their capacity additions growing in line with expected demand. At times when new incremental electricity supply capacity was not yet needed, they would grant a large, potential cogenerator like a refinery, a preferential rate for power. Later, when the utility's need for new capacity increased, they would raise this rate in order to encourage construction of cogeneration facilities.

In normal operations today, almost all of California's refineries are generators of electricity and many of them have the ability to sell any excess power they may occasionally produce (during process unit shutdowns, for example) to the grid. As a general rule, however, they want to run their facilities to optimize output of petroleum products and not primarily to generate electricity. Many refiners have been cooperating with the utilities during recent periods of insufficient electricity reserve capacity by trimming their peak period purchases and even supplying incremental power to the grid.

Cogeneration In The San Joaquin Valley Oil Fields

Although not strictly part of the refining sector, the vast steam injection projects to enhance recovery of heavy oil in the San Joaquin Valley represent another major source of electric power from cogeneration. In normal operations these projects are net generators of electricity for sale because their steam requirements are much larger than their internal need for electric power.

Originally, these projects burned produced heavy crude in boilers to provide the steam needed to enhance oil recovery. Injecting heat in the form of steam into the reservoirs reduces the viscosity of the oil, allowing it to flow toward the boreholes where it can be pumped to the surface. In the past decade, as natural gas pipeline supply capacity increased and natural gas prices fell relative to crude oil, it became economically attractive to burn gas instead of oil.

New gas combustion facilities were almost always built as combined cycle gas turbines, which generate both steam and electricity. The construction of these facilities also served to reduce emissions from the plants and improve San Joaquin Valley air quality.

At times in recent months, however, the price of natural gas has risen above the energy equivalent value of heavy crude oil. As a result, some producers have cut back on steam floods in order to be able to divert the natural gas ordinarily consumed to higher valued uses.

The Oil Industry's Dependence On Natural Gas

In order to meet California's emissions standards and to keep costs down, the oil industry has tended to use natural gas to the extent possible to meet its own energy needs. Natural gas has historically been priced at 80-90% of the equivalent refinery fuel derived from crude oil.[2]

When natural gas was cheap and readily available, this was clearly an advantageous strategy. Refineries prioritized their energy sources as follows: first refinery gas, then purchased natural gas, and finally liquid fuels. This strategy not only reduced costs, but also permitted maximum output of marketable petroleum products.

As natural gas becomes not only more costly, but also relatively less available, this approach may have to be re-evaluated. The interplay of natural gas supply, demand, and price suggests that a new era may be dawning for the gas industry.

The remedy for this impending change depends upon major investment projects, including gas exploration, development, and pipelines, that have a much longer time horizon than the mere construction of power plants. Compared to such gas development projects, power plants of the kind being proposed for California today can be completed (once sites and permits are approved) relatively quickly.

The current natural gas situation going into the summer of 2001 is not favorable. Increased demand in the summer of 2000 made it impossible to replenish inventories. High demand this past winter has continued to deplete remaining reserves. As demand for gas has grown, pipeline capacity has not kept pace, making it logistically difficult to bring additional supplies into the state.

Interrelationships With Other Industries

Refining is also closely interconnected with other parts of the California industrial infrastructure. Pipelines are a critical part of the distribution network for crude oil products. Most of the product pipelines are energized by electricity. These lines not only distribute products to terminals nearer to the point of consumption, thus reducing road tanker traffic, but they also bring products directly to major consumers, including industrial customers, power plants, and airports. In some cases, these supplies are buffered by storage facilities, but inventories are generally kept to a minimum in order to reduce costs.

One "near miss" already occurred during the year-end holiday season at the San Francisco Airport. When the pipeline to the airport was threatened with a power interruption, the airport came within a day or two of having to shut down for lack of jet fuel. Only intervention at the highest government levels averted this potential disaster.

If California refineries are called upon to curtail either natural gas or electricity consumption in the summer, the impacts on other sectors of the economy could be significant. Peak summer electricity demand periods coincide with the peak driving season. As has been amply shown in

[2] PADD V refiners accounted for about 5% of total gas consumed in PADD 5 (California, Washington, and Oregon) in 1999.

the past, California gasoline standards (CARB gasoline) make it difficult to obtain incremental supplies of California specification gasoline from out-of-state sources. Although this situation has eased somewhat in the past year, it remains an obvious concern for California refiners and policymakers.

A critical part of the California economy is its highway and rail transportation system. Trucks and trains that burn diesel fuel move most goods, both inside California and across state borders. Curtailments of refinery operations in the summer months could jeopardize critical supplies of diesel fuel. Similarly, supplies of jet fuel for air cargo and travel could be impacted, with severe national and international economic consequences.

Another potential demand for distillate products may come from hundreds of new package diesel generators being installed across the state to help individual industrial, commercial, and service business customers to bridge across the expected rolling blackouts. Although these facilities may not actually operate for very many hours during the year, each one does require some diesel inventory, which will represent a drain on the supply of distillate fuels in the coming months.

Prognosis

Challenges for California refineries will come both on the energy supply side (electricity and natural gas availability and cost) and on the operational side (balancing output of refined products with requests to reduce electric consumption and to supply cogenerated electricity to the grid). Energy conservation programs will continue to have a high priority, but operational considerations, including the optimization of the mix of fuels consumed, will probably dominate the activities of refinery planners in the coming summer months.

Shortages of electricity supply to refineries could occur in any of several ways. Refineries that still rely on the grid for incremental supplies of electricity could find themselves curtailed, especially if they have contracted for interruptible power.

Lack of natural gas deliverability could lead to less cogeneration, which, in the absence of electrical system reserves and air quality limitations on the firing of liquid fuels, might result in partial or even complete plant shutdowns. Firing of liquid fuels could also lead to increased NOX emissions, perhaps in excess of permit allowables, which could also require refineries to curtail operations and reduce petroleum product output.

Shifting to liquid fuels may be virtually impossible in most refinery and oilfield cogeneration facilities without some investment and substantial government regulatory relief as it runs counter to California's current emissions requirements. Just as the State Government is now considering expedited permit approvals for power plants, a review of emissions policies related to electric generation may also be in order.

If California heavy oil producers are unable to acquire sufficient quantities of natural gas at economically attractive prices, they may be forced to curtail operations, leading to lower total crude oil production. Refineries that depend on the supply of California crude may be forced to reduce, or at least rearrange, their crude slates.

As in the refineries, facilities limitations or emissions permits may, in some cases, preclude San Joaquin Valley producers from switching back to crude burning. One option being considered is the burning of light gasoline components (like pentanes, for example) that may have to be removed from the gasoline stream to meet changing product quality requirements. Some facilities (at the very least, tanks and other handling equipment) would be required in order to make a switch to a new fuel.

In the event of a declared electricity supply "emergency," it is conceivable although not likely that cogenerators could be ordered to produce and feed maximum amounts of electricity to the grid, even to the extent of reducing internal consumption. Normally, supplies to the grid are made only after meeting internal needs. A government edict that turned cogeneration plants into power plants would be an extreme, but not impossible measure. If this were to happen, however, there would be immediate impacts on the availability of liquid fuels throughout the entire West Coast market.

Supply and logistics departments will have to keep close tabs on refinery energy supply and related output to ensure that alternative supplies of gasoline and diesel are available in the event that refinery operations within the state have to be curtailed for lack of electricity supply.