

Market Power

Public Service Commission of Utah

Report to the

Electrical Deregulation and Customer Choice Task Force

September 8, 1998

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Executive Summary

The 1997 Legislature asked the Commission for a written report on three market power issues: "(i) what constitutes the relevant market or markets for analyzing market power issues; (ii) whether any electric service provider could exercise market power in a manner that would unduly restrict competitive choice for consumers of electricity in Utah; and (iii) if an electric service provider could exercise undue market power, what legislative actions could be taken to mitigate the market power."

Our investigative staff in the Division of Public Utilities analyzed these issues. It contracted with LCG Consulting for a simulation analysis of the geographic extent of the market relevant to Utah. This, plus standard techniques of economic or structural analysis, is the basis upon which we assess the potential for market power. The Division's draft report was submitted to us on July 30, and, after consideration here, to interested parties for comment on August 14, 1998. Comments of seven parties were received on or soon after August 26, 1998.

After editing the Division's report and incorporating where possible the comments of parties, we adopt the Division's study and issue our Report. The complete comments of the parties are appended for members of the Legislative Task Force.

We conclude that market power in a deregulated retail electricity market will be a serious problem. It must be addressed or effective competition will not arise. The principal firm in the market relevant to Utah will be, as it is today, PacifiCorp. This market will vary in geographic size during hours of the day and months of the year. Its size can

be expected to vary from most of the western U.S. at times to little more than the state of Utah some of the time. In accordance with differing size, we conclude that the structure of this market will vary from loose oligopoly, through tight oligopoly, to, at the extreme, dominant firm. These market structure terms are defined in the report but mean that in all cases PacifiCorp will be able to exercise market power, even that of loose oligopoly, when effective competition is, in theory, possible. The result is that the competitive choice of customers will be restricted. These conclusions, for reasons the comments of the parties help to make clear, are preliminary: market structure analysis is complex, and in this case, dealing as it does with a hypothetical market, conjectural. It follows that a cooperative effort by all parties, including most particularly PacifiCorp, since it possesses both expertise and much required information, would be the best way to complete the necessary work.

PacifiCorp, though it did contribute some information, now states that the conclusions reached by LCG Consulting are "suspect." PacifiCorp criticizes the LCG model, and the data and assumptions it employs. PacifiCorp believes that our market power conclusions will not withstand the further analysis it recommends. But in supporting our conclusion about market power, the Committee of Consumer Services suggests that the very economic foundations of the electric business will not allow effective competition, and that antitrust measures -- a point with which we agree -- will not stem the exercise of entrenched market power. As to this, our principal recommendation is that restructuring should not proceed until the legislature takes the actions necessary to ensure effective competition from the beginning. Merely opening the market to retail competition will not do it.

Utah Associated Municipal Power systems (UAMPS) and Utah Municipal Power Agency (UMPA) assert, contrary to PacifiCorp, that we have actually underestimated the potential for market power. Each offers generally similar suggestions to refine our discussion of the role PacifiCorp does now and will in the future play, and to correct certain assumptions underlying our analysis of the regional transmission system which bear on our conclusions about the scope for market power abuse.

Two parties, Utah Industrial Energy Consumers (UIEC) and Utah Electric Deregulation Group (UEDC), both representing customers who are large consumers of electricity, assert that our conclusions about market power are not strong enough. They not only contend that market power will be an issue in a deregulated retail electricity market, but admonish us to address market power as an issue today. PacifiCorp, they suggest, through strategic pricing behavior in the regulated retail and the unregulated wholesale markets, may already exercise it. The Utah Office of Energy and Resource Planning (OERP) commends our report and urges careful consideration of institutional arrangements to promote ease of entry into the market by new firms and to ensure effective competition. OERP concludes, as we do, that further research is required to deal adequately with market power and to ensure customers "equitable access" to electricity. OERP states that "new institutions" will be needed so that the exercise of market power does not prevent effective competition.

How to mitigate market power is a subject that must be studied further. Public policy options include: requirements for an independent system operator (ISO), measures such as better metering and time-of-day pricing to help consumers respond to market conditions, phasing regulatory changes with the actual appearance of effective competition, requiring investment in transmission, and forcing divestiture of an incumbent utility's generation plant. Though we have reached conclusions about the size of the relevant market and the potential exercise of market power, we have not yet fully assessed these and other public policy measures to mitigate market power. We therefore make no policy recommendations in answer to the legislature's third question at this time, but strongly support serious study of mitigation measures if the legislature desires to proceed with electric utility restructuring.

Introduction

With the possible exception of stranded costs, market power is the most important issue in the restructuring debate. It is also the least understood. Our analysis reveals a clear potential for market power abuse in a restructured Utah electricity market. Through concentrated ownership of generation and bottlenecked facilities, and the strategic advantages it enjoys as a dominant incumbent supplier, PacifiCorp could cause Utah prices to be higher during a 12-year study period than they would be absent market power. We therefore recommend serious study of market power mitigation measures if policymakers decide to permit retail competition in the market for electricity. It is our judgment that Utah should not permit the release of public utility assets to competition until steps are taken that make a

competitive market more likely.

These and other conclusions about market power are in part based on analysis of a study commissioned by the Division of Public Utilities and conducted by LCG Consulting. Simulation techniques are used to analyze a hypothetical, competitive retail market for electricity in the western United States. The standard techniques of economic or structural analysis are also employed.

We discuss the indicators of market power and the difficulty of detecting market power abuse. We begin with the current regulated monopoly market structure for electricity in Utah and consider the effect that introducing competition would have on it. The computer simulation study of a competitive electricity market in the West is used to identify both the geographic scope of the electricity market which includes Utah and the potential for market power abuse. Factors which might thwart competition are discussed, such as barriers that prevent the entry of new firms into this market. The clear need for strategies to mitigate or avert market power abuse reveals areas for further study and analysis.

Comments of interested parties are considered. We summarize them here. All parties, except PacifiCorp, agree with our conclusion that the potential exists for PacifiCorp to exercise market power in a restructured deregulated environment and that this must be addressed. This Company disagrees that market power would be derived from "the concentrated ownership of generation and bottleneck (transmission) facilities and strategic advantages of a dominant incumbent supplier." PacifiCorp urges the legislature to place little credence in our Report, which it criticizes on two different levels. First, the Company believes we have misapplied market power theory and misunderstood the nature of competition in Utah: we confuse the operation of a competitive market with market power. A tight oligopoly market structure, PacifiCorp asserts, is unlikely so our concern about the potential for collusive behavior is misplaced. The empirical evidence we cite in showing that the market share of a dominant firm erodes slowly is disputed. Slow erosion may apply to normal industries but not regulated industries undergoing restructuring, PacifiCorp states.

Second, Pacificorp criticizes our reliance on the LCG study, asserting that it fails to use appropriate data (standard WSCC data) to model the transmission system and relies on a number of faulty assumptions. For example, the study fails to adequately consider the use of phase shifters. PacifiCorp, on the basis of its preliminary review, believes the LCG study is flawed and its results unreliable. Our interpretation of the LCG study results also cannot be relied on. In particular, our use of the Justice Department's five percent price differential as a rule of thumb to discern separate markets is too restrictive and leads to faulty conclusions.

Utah Associated Municipal Power Systems (UAMPS) and Utah Municipal Power Agency (UMPA), organizations that represent municipal utilities, concur with our analysis and most of our findings. They contend that because PacifiCorp has been granted near monopoly ownership of generation and transmission within the state, its significant market power must be mitigated before restructuring in Utah occurs. On the basis of daily dealings with PacifiCorp in the competitive wholesale arena, they observe that PacifiCorp, through the configuration of its generation and transmission facilities and its strategic actions, exerts much more market power than our Report indicates.

UAMPS and UMPA identify the Report's assumptions that result in underestimation of market power. Some contractual relationships and transmission system operating procedures are not accurately modeled, they say. For instance, the contractual relationship between Deseret Generation and Transmission and PacifiCorp diminishes the potential for Deseret to act as a vigorous competitor to PacifiCorp. The Intermountain Power Project's (IPP) potential to import power is overstated because contractual commitments to California and the physical capabilities of the direct-current line are not adequately recognized. These parties point out that Utah generation is required for reliable operation in Utah, giving strategic advantages to existing Utah generators. They question the ability of the Federal Energy Regulatory Commission (FERC) to effectively open the transmission system to competitors, citing their current complaint on this subject at FERC.

Two groups, Utah Industrial Energy Consumers (UIEC) and the Utah Electric Deregulation Group (UEDG), representing customers who are large consumers of electricity, are concerned about both potential and current market power abuse. UIEC recognizes a clear potential for market power abuse in a restructured electric market but emphasizes a fundamental conclusion it has reached -- regardless of the geographic scope of the market, Utah's electricity market will never be fully competitive because of PacifiCorp's significant market share. It concludes that Utah consumers may be harmed by uncontrolled deregulation at the same time that PacifiCorp is able to increase profits. Current market structure, with regulated retail and unregulated wholesale transactions, may be ripe for market

power abuse. "The bottom line is that when both regulated and unregulated markets exist, both the Commission and the Legislature must be concerned about protecting the customers." UEDG agrees that our effort identifies structural problems that may lead to the strategic employment of market power and urges us to expand the scope of our inquiry to address potential market power abuses that exist today.

Two state agencies, the Committee of Consumer Services (Committee) and the Office of Energy and Resource Planning (OERP), submit comments. OERP suggests that further analysis of the institutional arrangements that foster competitive entry should be pursued. It recommends the formation of an independent system operator (ISO) and implementation of efficient transmission pricing. OERP believes divestiture of generation plant is a viable option for mitigating market power, but recognizes possible efficiency losses and related problems if it is required. OERP recommends examination of foreign markets, especially the United Kingdom, to identify market conditions that lead to gaming the system. Market power mitigation strategies, it concludes, will either require increased oversight by existing regulatory bodies or the establishment of new institutions.

The Committee's extensive comments question the wisdom of restructuring for low-cost states such as Utah, warning that market power will transfer restructuring benefits from Utah customers to utility shareholders. Unless fail-proof mitigation methods are in place at the outset, policymakers must not restructure. The Committee notes that PacifiCorp can be considered a dominant firm, second only to an unregulated monopoly in its ability to manipulate price.

The Committee questions whether competition can benefit Utah customers even in the absence of market power. It counters the economist's argument that competition will result in marginal cost pricing, noting that such a pricing strategy is only stable in a perfectly competitive market. This market structure will not occur in the electric utility industry for reasons such as the unique demand and supply conditions of the electricity market. The Committee concludes that "absent regulation, public ownership or repeal of the anti-trust laws to legalize cooperation, economic efficiency cannot occur in the electric power industry, regardless of measures to curb market power."

The Committee notes that market power can be curbed by consumers if they are able to respond to price increases with drastic reductions in the amount they consume. This ability to respond holds true only for a small number of large industrial customers who can effectively find substitutes for electricity. Ninety-eight percent of the customers cannot respond adequately to price increases because good substitutes for electricity do not exist. Thus, the electric industry is susceptible to price discrimination. The Committee assesses public policy options to mitigate market power, and concludes that all options will prove ineffective. In the final analysis, it concludes that regulated monopoly best serves consumers in Utah.

Measurement of Market Power

The premise that competition will benefit consumers assumes that an effectively competitive market for generation will actually emerge from electric restructuring efforts. For this reason, policy makers and regulators must remedy conditions that might favor anti-competitive behavior. Otherwise, it may be decades before effective competition develops. ⁽¹⁾

The exercise of market power by a firm thwarts competition. Market power enables a firm or a group of firms to raise the market price of electricity above competitive levels. Market power means that a plant owner can offer prices higher than costs, or withhold capacity and profitably raise market price, and competitors will not be able to bring market price closer to the competitive level. As shown in Appendix A, owners of plants that operate "on the margin" (the last plants needed to serve consumers), can manipulate price even with relatively small market share. Market power can be measured as the relative markup of the market clearing price above the marginal cost of production; the greater the markup, the greater the firm's market power. ⁽²⁾ Market power is "horizontal" if high market share in a local geographic market allows the dominant supplier or suppliers of a product to manipulate price to its advantage. It is "vertical" if a firm can use that power in one segment of the business to favor its position in another portion of the business.

A supplier of electricity may be able to exercise market power even in a seemingly competitive market. As illustrated in Appendix A, the particular characteristics of the electric industry explain why. This complicates the analysis of market power and means that not only must the structural characteristics of the market be understood but economic modeling of profit-maximizing behavior may be required to reveal the potential for market power abuse. Our study employs structural analysis plus a computer stimulation of a perfectly competitive market.

Market Power Assessment Methods

In what is termed a structural analysis, such characteristics of market structure as the number and size of competitive sellers, the ease of entry and exit, the degree of information flow, and the conditions of supply and demand, are examined. Empirical research shows that the greater a firm's size (its market share) and the fewer the number of leading firms, the more concentrated the market and the greater the expected profitability of the leading firms. Concentrated markets exhibit more market power than less concentrated markets do.

Concentration depends on the geographic size of the market. As a rule, the smaller the market the more likely that fewer firms will dominate; in other words, the more concentrated it will be. But the geographic size of the electricity market can change hourly, as supply availability, demand levels and transmission capability vary. This makes structural analysis of the electric market difficult. Computer simulation is one way to estimate the geographic scope of the market. Simulation of the relevant market allows concentration analysis to be performed. Recent research indicates that standard concentration measures may understate the potential for market power abuse in electricity markets. "Firms with moderate . . . levels of concentration in generation markets . . . may have the ability to increase generation prices above truly competitive levels."⁽³⁾ Simulation of unilateral pricing and output decisions by generation plant owners can provide useful information about the potential for market power abuse in restructured electricity markets. The outcomes of strategic pricing and operation behavior of firms can be analyzed using various economic models. The Cournot model is an example of this approach. It may better indicate the potential for market power in the electric power industry than reliance on market shares because an "oligopoly" market structure (see footnote 28) is likely to emerge.

With enough time, all these techniques to examine market power could be employed. Our report uses market simulation to identify the geographic scope of a restructured Utah electricity market. We analyze barriers that can be expected to deter the entry of new firms ("entry barriers"), and we simulate the effects of unilateral pricing by PacifiCorp.

The geographic size of the Utah market for electricity is affected by cost and availability of supply, demand levels, transmission congestion, and distance. For example, the lower the transmission congestion, the greater the geographic size of the market. Our analysis shows that as demand and supply conditions change, transmission congestion occurs in the western interconnected system. This means that the size of the market relevant to Utah changes with time because supply and demand conditions vary hourly and seasonally. Our report distinguishes seasonal variations as low-demand and high-demand months. Daily variations in supply and demand conditions make weekends and late night - early morning hours off-peak, while weekday daytime hours are on-peak. Analysis of the LCG study indicates that the geographic size of the market varies from the entire Western Systems Coordinating Council (WSCC) area to approximately Utah's state boundaries.

Given these market size characteristics, our report relies on a previous analysis⁽⁴⁾ and an evaluation of market entry barriers to draw general conclusions about the potential for market power abuse. As discussed more fully below, we conclude that in a deregulated market, PacifiCorp will continue to hold a prominent position and, to the detriment of the Utah consumer, will be able to exercise market power.

Market Power Problems Unique to the Electricity Industry

In the face of entrenched market power, antitrust law may be ineffective because it attempts to *prevent* monopolization. Monopolies, of course, already exist under regulation. Moreover, it will be difficult to discern whether high prices are the result of market power or simply a volatile market. These are reasons why we recommend institutional arrangements to achieve effective competition before restructuring is permitted to go forward.

Antitrust Law

There are three opportunities for antitrust intervention. First, a proposed merger or acquisition which significantly increases horizontal concentration (and reduces competition) is subject to challenge under state or federal antitrust laws.⁽⁵⁾ Second, collusive agreements or combinations among competitors (e.g., price fixing) are illegal under antitrust law.⁽⁶⁾ Third, exclusionary conduct by a monopolist is an offense, though such cases are often lengthy, cumbersome and difficult to prove.⁽⁷⁾ Market power, short of monopoly, which is entrenched in the structure of an industry and exercised unilaterally may be beyond the reach of antitrust. In view of these limitations, we conclude that Utah must ensure that newly opened electricity markets are competitively structured from the beginning. Otherwise, antitrust enforcers will have limited options and consumers may pay more for electricity than they should.⁽⁸⁾

Distinguishing Market Price Volatility from Market Power Abuse

Recent experience shows that competitive electricity markets produce the greatest price volatility of any product in the world. This important fact owes to certain unique characteristics of electricity -- limited storage, difficulty in transporting it over long distances, and the simultaneity of supply and demand which causes an inability to predict the cost of supply and level of demand in a given hour. In such a market, either the exercise of market power or simple price volatility can quickly shift a significant amount of wealth from consumers to producers.

Two recent events illustrate the problem. In late June, 1998, violent weather led to plant and line outages in the Midwestern U.S. A power marketer began renegeing on service obligations. In turn, spot prices climbed, 80 interruptible agreements were deployed and blackouts hit some 24,000 customers. Spot prices paid spiked to a high of \$7,500 per megawatt hour from a normal level of \$35 to \$55. In response, parties asked FERC to impose a price cap; others have demanded a federal investigation of the events and spot pricing behavior. Yet these problems were not completely unexpected. A National Energy Reliability Council Report in May warned that the transmission system might be forced to operate under "unprecedented" conditions.⁽⁹⁾ The chief executive officer of a Midwestern utility stated that the uncertainties of deregulation had limited investment in generation and transmission facilities, and had "tighten[ed] supply and demand."⁽¹⁰⁾ It is not yet known whether these extraordinarily high prices were the result of market rationing based on value or the exercise of market power in a thin spot market. Whatever the case, price spikes of this magnitude may demonstrate the need for price caps for emergency power.⁽¹¹⁾

Another recent example occurred in the market for replacement reserves in California. Several plant owners in California have been granted permission to offer market-based prices for ancillary services. On July 9, 1998, bids spiked for a five-hour period, rising to as much as \$5,000 per megawatt-hour for three hours. The result was a total cost of \$9.125 million for replacement reserves usually costing much less -- for example, during the same time period on June 25, the total was just \$3,300. On July 13, the price of replacement reserves again spiked, this time to \$9,999 per megawatt-hour, the highest bid permitted by the California Independent System Operator (ISO). The accepted bid resulted in total charges of nearly \$6 million. In FERC filing EL98-62, Southern California Edison asserts that these high prices were a result of market power caused by "thinness in the ancillary services and replacement reserves market."

The problem goes 'undetected in a traditional market dominance analysis,' SoCal Ed said. For example, if a market has 10 suppliers, each of which has a 100-MW supply, the market would appear competitive because no seller controls more than 10% of the market. 'But if the total inelastic demand in the market is more than 900 MW, and the market price is set equal to the highest winning bid, *then every seller has market power*,' it reasoned. Since the market cannot clear without supply from every seller, 'each seller can bid as high as it likes with the assurance that it will be selected at no less than its bid price.' That is the situation in California today, the utility continued. 'Moreover, this problem is not limited to the market for replacement reserves. On the contrary, the potential for such market-power abuse is even *greater* in the markets for regulation service, spinning reserves and nonspinning reserves, where the supply is even more limited and the ISO [independent system operator] has less discretion as to the amount it must purchase.'⁽¹²⁾

On July 13, SoCal Ed filed an emergency request at FERC to suspend market-based pricing authority for ancillary services and replacement reserves. On the same day, the California ISO implemented a \$500/MW cap and asked FERC to stay three recent orders approving market-based rates for ancillary services. That prompted Dynegy Marketing and Trade, which has market-based rate authority to sell ancillary services, to threaten to seek damages. A June 30, 1998 FERC order (ER98-2843, *et al*) concluded that replacement reserves are not an ancillary service under order 888 -- despite being defined as such in the ISO's tariff, "and therefore do not require a specific showing of a lack of market power in order to sell at market-based rates."

The California story illustrates the importance of identifying and mitigating market power at the outset. In this case, \$15 million shifted from buyers to sellers in just six hours.

Detecting market power in electricity markets will require intimate acquaintance with detailed cost, bid, and transmission data. Because excess capacity exists much of the year, cost recovery for highest cost (peaking) units may only occur through bids seeking to recover total costs during a few hours of the year. To distinguish limit pricing (pricing just below that which might provoke the entry of new firms) made possible by market power from the behavior of prices under competitive pressure will require knowledge of transmission congestion.

Market price is a critical signal calling forth new investment. Since much of the benefit of competition comes from more efficient investment decisions, the importance of correct price signals should not be underestimated. Market power pricing will distort efficient investment decisions. Prices may be volatile, but market design must prevent abuse of market power.

Current Market Structure

Before discussing the assumptions and results of the dynamic market simulation study, it is instructive to identify current market structure and to evaluate entry barriers to a competitive Utah retail market.

The current market structure in Utah is regulated monopoly. Retail power sales in Utah are concentrated and marked by the high market share of one firm. That firm, PacifiCorp, sells 81 percent of the kilowatt hours consumed in Utah. The remaining 19 percent of retail sales are provided by municipal and cooperative utilities, and the Western Area Power Administration, a federal power marketing agency. If this were an unregulated market, economists would refer to it as a *dominant firm* market structure, one that exists when a single firm has at least a 60 percent share of the market. It would rival a monopoly market structure and would be characterized by less economic efficiency, price above competitive levels, output below competitive levels, a greater potential for price leadership and tacit collusion, and earnings above competitive levels. Research indicates that the dominant firm's market share erodes slowly, declining about one percentage point per year.⁽¹³⁾

PacifiCorp owns 85 percent of the generation plant that can serve Utah without encountering a transmission constraint (we will refer to this as "unconstrained generation"). This indicates a potential for horizontal market power. Though seven firms own the transmission lines leading to

Utah's population centers, PacifiCorp alone owns 60 percent of it. This again is a dominant position.⁽¹⁴⁾ Absent adequate separation between transmission activities and generation activities, PacifiCorp could use its dominant position in transmission to deter others from accessing transmission into Utah, thus favoring sales from its own generation facilities (vertical market power). (See section on transmission access for discussion of FERC Orders 888 and 889.)

Effect of Competition on Current Market Structure

Some argue that if the future Utah retail power market is open to alternative providers, the mere threat of entry by other firms would discipline the pricing strategy of the incumbent monopoly, thereby preventing the abuse of market power associated with high market share. This idea is termed "contestability" in the economics literature. If correct, the threat of entry would cap the price the incumbent provider could charge at a price that would provoke entry. In this view, factors that could cap prices might include the cost of power imported into the area, demand-side bids, entry of onsite generators, and new merchant plants like single or combined cycle combustion gas turbines. Many, however, criticize contestability as an academic theory having little practical consequence. For example, London Economics, Inc.,⁽¹⁵⁾ states that an incumbent's prices might be constrained by *potential* entry only if a number of stringent conditions are satisfied.⁽¹⁶⁾ These conditions, which we find do not characterize electricity markets, include a complete lack of sunk costs, so that an entrant can employ a "hit and run" strategy designed to take advantage of high prices as they occur. An entrant must be able to take the incumbent's market faster than the incumbent could reduce price. The potential entrant must have the same cost of production as the incumbent. In reality, there are potential sunk costs in generation, large fixed costs, differences in the cost structures, and many barriers to entry -- not least the incumbent's ownership of essential facilities. The mere threat of entry would not discipline the pricing behavior of an unregulated PacifiCorp. We mention contestability here because it is sometimes found in discussions of deregulation.

Actual entry, on the other hand, could discipline prices. But actual entry depends upon manageable or nonexistent barriers to the entry of new firms in the Utah electricity market. We therefore briefly examine entry barriers.

Market Entry Barriers

Barriers to entry prevent effective competition by making it too difficult or costly for new firms to enter the market. The huge costs of constructing plant typical of the electric industry is a barrier to entry, as are the economies of scale and scope the incumbent firm realizes because it owns a number of plants of various kinds and is vertically integrated. With preferential access to resources, skills and information, the incumbent manages risk more effectively than can a new entrant. The unregulated incumbent, as a dominant firm, will behave strategically, pricing anticompetitively and discriminatorily, building on its strength as first-in-the-market. It will exploit an existing relationship with customers, particularly the large ones which it retains with favorable, usually proprietary, long-term service contracts, locking out competitors for years. All are entry barriers. If they are high and pervasive, the market power of incumbent firms will be entrenched and unassailable. In such a case, merely opening the market by removing legal barriers to entry will not overcome market power. The question is whether this general description of entry barriers applies here. We look more closely at potential barriers.

1. Transmission Capacity.

Because of PacifiCorp's dominance in unconstrained Utah generation, effective competition in the Utah market will depend upon the ability to import electricity. The combined capability of unconstrained generation⁽¹⁷⁾ and import paths is about 8,000 megawatts: generation, 2,900 megawatts; transmission, 5,100 megawatts. Imports are necessary to meet 1996 peak Utah State demand (3,600 MW) but local unconstrained generation is adequate to meet 1996 Utah State average monthly demand (2,500 MW). At first blush, it would appear that sufficient capacity to permit importation of electricity exists. There are, however, several factors to consider before drawing this conclusion. They are: all loads and resources must participate; prior contractual relationships are eliminated; the WSCC transmission system is uncongested; the interaction of generation with transmission to ensure reliability must not complicate transmission capability; must not exceed import capability; and access must be open and fair. Unless these conditions hold, imports cannot be assumed available to constrain PacifiCorp's dominant position.

Most transmission -- the import paths -- into Utah load centers is owned by PacifiCorp. Access to PacifiCorp's transmission system is governed by Federal Energy Regulatory Commission Orders 888 and 889, which require PacifiCorp to adhere to codes of conduct and comparable tariffs for all wholesale use (even their own) of the pathways. But PacifiCorp has long-term contracts with other utilities which govern access to about 800 megawatts of its transmission lines into Utah. Thus, under FERC open access tariffs and assuming retail competition, PacifiCorp's transmission pathways could provide between 2,245 MW and 3,045 MW of import capability.⁽¹⁸⁾

If only PacifiCorp loads were opened to retail competition, imported generation may be able to compete with PacifiCorp's unconstrained generation for much of PacifiCorp's Utah load. Local generation, however, will be required to meet peak demand. Further, WSCC transmission congestion, local voltage requirements and Utah load growth will lessen the ability to rely on imported electricity over time.

In our opinion, effective competition in the market relevant to Utah will require importation of electricity from the outside. But the transmission system limits the amount that can either come into the area or, if generated within, move out of it. PacifiCorp owns 85 percent of

the generation capacity which can serve Utah without encountering this limitation, giving it a dominant position in the absence of imports and the ability to exercise horizontal market power. We conclude that transmission system limitations are a barrier to entry.

2. Transmission Access.

Since PacifiCorp owns 85 percent of the unconstrained generation and 60 percent of the import capability, it has an incentive to limit transmission access. The latitude PacifiCorp might have to exercise its transmission ownership and access advantage will depend on the rules of market design. Rules governing transmission access include independence of transmission system operation, transmission pricing, participation by publicly-owned utilities, and obligation to serve requirements. Each is discussed.

A. Transmission Operation Under FERC Order 888 Versus Independent System Operation: In an attempt to mitigate market power of incumbent generation in wholesale power markets, FERC requires investor-owned utilities (IOUs) to file and *use* transmission tariffs for all wholesale transactions. Unfortunately, complaints before FERC suggest that IOUs continue to control the transmission grid to favor their own wholesale transactions.⁽¹⁹⁾ For example, in a complaint against PacifiCorp, Utah Associated Municipal Power Systems (UAMPS) argued at FERC that PacifiCorp (1) refused to provide firm transmission services from resources needed to serve UAMPS' loads on terms and conditions comparable to those it provides to itself and to others, and (2) failed to maintain functional separation between its merchant and transmission functions in order to favor its own generation in providing transmission services.⁽²⁰⁾ For such reasons, analysts argue that the transmission system must be independently *operated and governed* if entry barriers presented by combined ownership of transmission and generation are to be reduced. Some industry experts argue that independent ownership -- perhaps even public ownership -- will be required. Since transmission access is a key to entry, it must be available on an equal basis to all market participants. Otherwise, we find, retail competition will not be effective. We are not convinced that FERC's open access tariffs and codes of conduct will be sufficient for this in retail competition. Quite likely, independent transmission operation will be necessary.

B. Obligation to Serve: FERC rules currently allow utilities to reserve transmission capacity for retail service obligations and existing wholesale contract obligations. The remaining capacity, termed Available Transmission Capacity (ATC), must be offered publicly at tariffed terms and conditions. It is not clear how this program would function in the event of retail competition and thus how much import capability might then be available. If Available Transmission Capacity were to be calculated by an independent party like an ISO, the advantage of transmission ownership might be reduced. It is also unclear what the rules would be if a retail access pilot program were to begin. PacifiCorp had been involved in one attempt to establish an independent system operator called IndeGO; its rules would have eliminated the native load (retail customers in the certificated territory) reservation when a retail pilot was approved by a state.⁽²¹⁾ This approach could increase competitive access but would have uncertain impacts on native load customers. FERC rules state only that retail loads which are allowed retail wheeling access come under FERC transmission jurisdiction and therefore native loads may continue to have capacity reservations.⁽²²⁾ We conclude care will be required to ensure that partial retail access does not increase the incumbent utility's ability to manipulate Available Transmission Capacity.

C. Role of Publicly-Owned Utilities: Publicly-owned utilities are neither investor-owned nor non-utility generators. In Utah, they serve 19 percent of retail electricity requirements. Four of them, Intermountain Power Agency, Deseret Generation and Transmission, UAMPS and UMPA⁽²³⁾ own transmission into Utah load centers. If these utilities fully participate in a competitive market, between 4,300 MW and 5,100 MW of imported electricity could be available to compete with the 2,900 MW of unconstrained generation to serve the 3,600 MW of total peak load in Utah, subject to local voltage requirements. To the extent that problems in the private use of these public utility facilities can be resolved, the transmission barrier might be limited, enhancing the opportunity for entry which might then discipline the incumbent utility's prices until load exceeds import capability.

D. Transmission Pricing: The economics of imported power will be determined in part by how transmission service is priced. Transmission services are currently provided by each transmission owner and priced to recover each owner's transmission costs. Rates are set by the FERC to equal each utility system's average transmission cost, and each system that must be crossed to deliver power from a generator to a Utah consumer will receive payment at the FERC tariff price. A Utah consumer would have to pay two or more transmission owners ("pancaked" transmission rates) to deliver electricity from a supplier other than PacifiCorp.

Pancaked rates reduce economic efficiency and restrict entry. Suppliers that must cross fewer independently owned transmission systems to reach Utah consumers have an economic advantage. Since PacifiCorp owns virtually all of the high-voltage transmission within Utah needed to deliver bulk power to end-users, it reaps the benefits of this advantage. Most generation sources outside Utah must cross several transmission systems, raising the cost of delivered power. This is a barrier to competitive entry.

Efforts are underway to reduce the barrier by pricing transmission and managing congestion more efficiently. One approach would price transmission at a single "postage stamp" or "license plate" price for an entire geographic zone. This rate would be a single "access rate" allowing consumers to buy from any generation source in the zone. The approach is not without problems as costs may shift among utilities unacceptably when low- and high-cost transmission rates are averaged to produce a single rate. The IndeGO proposal faced this difficulty.⁽²⁴⁾ Nevertheless, we conclude that efficient transmission pricing will be essential to competition in Utah. A further concern with current transmission pricing is the fiction that power flows along designated contract paths. Competitive use of the system will require pricing that reflects actual flows in order to manage congestion and to send appropriate price signals to users of and investors in the system.

2. Infrastructure Placement Favors Incumbent Generation Facilities.

Facilities have been constructed by incumbent firms in order to serve the electricity requirements of growing populations cost-effectively. The incumbent's plants will be sited in the best locations and will be directly connected to load centers by transmission sized for that purpose. The incumbent public utility also has the power of eminent domain, and is able to enhance placement of facilities by taking property for the public good. Clearly, a superior ability to site generation and transmission facilities, to obtain emissions allowances, and to locate generation plant at the fuel source, is an entry barrier. These advantages are difficult and costly for a new entrant to replicate.

3. Economies of Scale.

Economies of scale occur when a larger plant has lower per unit costs than a small scale plant. Research indicates that the minimum efficient scale for a combined cycle combustion gas turbine is between 240 and 750 MW.⁽²⁵⁾ At 400 MW, this would be about 16 percent of Utah's 1996 average demand of 2523 MW and 11 percent of the 3650 MW peak demand. Though it may appear that six to nine comparable, single-plant firms could compete in Utah based on minimum efficient plant scale, other factors determine the minimum efficient size of the firm. It is the optimum size of the firm that will determine the number of firms that can effectively compete for market demand. Moreover, consolidation of plant ownership appears to be the industry's preferred organization. Thus, an entrant facing an incumbent which owns a diverse portfolio of generation plants faces an entry barrier.

Single-station generators are at a competitive disadvantage compared to incumbent monopoly providers like PacifiCorp, which own a number of generation plants of various kinds. A portfolio of generation plants confers superior risk management. Single generators face proportionately larger risks in writing firm contracts to customers. For example, if the entire output of a plant is committed in contract when an outage occurs and spot prices are high, financial loss to replace the power can be high. Review of the Midwest price spikes of June 1998, illustrates this point. If as a result power marketers who operate on very thin margins are forced to exit the market, the result is market consolidation. Thus a firm like PacifiCorp with a broad portfolio of resources and much of its fixed cost covered by firm contract has an advantage that will help it to retain a high market share. Such a firm could bid low prices into the spot market because most of its cost is recovered through contracts, thus sending price signals to new investors which may understate the value of capacity and restrict entry. Single generators also may have trouble selling retail hedging (forward or "futures") contracts since the output profile of the plant does not match the usage profiles of most consumers.

The advantage of incumbent resource portfolio ownership may pose a significant entry barrier. PacifiCorp owns a diverse portfolio of resources. Though economies of plant scale are not an entry barrier, an efficiently sized firm may be required for sustained entry. The need to mitigate risk suggests that firms owning but a single plant may be few. If so, the number of independent firms in the market will be lower than expected and the market more concentrated, regardless of the minimum efficient size of a generation plant unit.

4. Information.

A truly competitive market requires the free-flow of information. The costs of acquiring market information can restrict entry. Incumbents are likely to benefit from superior knowledge of systems operations and consumer demand. In the past, firms have cooperated and have had knowledge of each other's plant costs, maintenance scheduling and outages. This knowledge could be of value to incumbent firms in determining bid strategies, establishing contractual positions and future bidding strategies. Large incumbents in a competitive market would have knowledge of their own contract positions, and from the wider hedging market (futures) may have superior knowledge of the positions of others. This could reduce the risks faced by the incumbent, preserving its market position. In order to offer attractive bids to win a customer, a new entrant will need to know consumer hourly demands. If access to this information is not available or costs more than it does for the incumbent, it will pose an entry barrier.

Simulation of a Utah Competitive Power Market

As discussed earlier, competitively priced imports could lessen PacifiCorp's dominant position in Utah if supply is available and able to reach Utah consumers. A key question, therefore, is whether an imported economic supply can reach Utah consumers.

In order to estimate the role imports could have in a competitive market relevant to Utah, the Division engaged LCG Consulting to simulate a competitive market in the Western Systems Coordinating Council (WSCC) area.⁽²⁶⁾ LCG considers the effect that transmission, generation losses, and supply cost would have on the geographic scope of a competitive electricity market that includes Utah. This is important because the market structure for electricity will depend on the geographic size of the market.⁽²⁷⁾ For example, if the whole WSCC area (the entire west) is the market, then market structure would be a loose oligopoly. Many analysts hold that effective competition is possible in this market structure. Analysis of 1995 data study suggests that PacifiCorp's share of a market this large might be just 9 percent. When the market is smaller, perhaps limited to the Northwest Power Pool Area, the market structure, based on 1995 generation output, is a tight oligopoly. PacifiCorp's share would be 21 percent. Market power abuse is more likely in such a market structure.⁽²⁸⁾

The geographic size of the market which includes Utah varies hourly. Its size is dependent on transmission capability and pricing, losses during transmission, and the interplay of supply cost and demand levels. Market power analysis begins with a definition of the product and a measure of the market's geographic scope. LCG defines the product as electricity, and includes all ancillary products required to insure its reliability even though separate markets for each ancillary service may at some point develop. In the model, all ancillary services required to maintain reliability are provided. Generators are assumed to earn revenues from them based on opportunity cost -- the market price for energy. Three

scenarios, each based on a number of assumptions, which simulate a competitive retail market in Utah are modeled.⁽²⁹⁾

Scenario One models ideal conditions for effective competition in the West. By assuming "perfect" competition (an academic construct meaning, among other things, that all suppliers are price takers and cannot unilaterally affect price or collude to do so), Scenario One is the baseline for our examination of market structure and market power. Since transmission access and efficient transmission pricing will be essential to retail competition in Utah, Scenario One assumes that both an independent system operator (ISO) and efficient (single-zone, postage-stamp pricing for the entire West so electricity could be moved from anywhere in the West to Utah at a common rate) transmission pricing are in place. Scenario One is the extreme case. It also assumes that all generation, whether privately or publicly owned, participates as full competitors for all loads in the West. Prior contractual relationships are eliminated, so any plant is free to sell wherever it can compete. Scenario One assumes that behavior is cost-based and thus presents a baseline from which market power pricing behavior can be evaluated.⁽³⁰⁾

In this Scenario, market clearing prices are set by an auction process (like the California power exchange). Hourly supply offers from participating generators are matched with hourly demand bids from participating customers to establish an equilibrium between supply and demand. Supply bids are based on the short-run variable cost of production, plus start-up and no-load costs, prorated over the year in a manner which is dependent on plant type.⁽³¹⁾ No assumptions about the recovery of capital cost are made. All plants compete based on going-forward fixed and variable costs, consistent with economic theory. No assumption about plant retirements is made. Elasticity of demand is not modeled; rather, demand bids are capped at \$160 per megawatt hour to reflect the ability of some loads to curtail consumption when price reaches the average cost to run a simple cycle gas turbine over a short period of time. When price continues to be high and further load curtailments are not available, LCG performs an investment analysis to add appropriate plant capacity.⁽³²⁾ Differences in market clearing prices from one load area to another are a function of supply, demand, physical transmission capability, and the cost of generation losses which occur when electricity is transmitted from generators to loads. LCG uses an "optimal power flow" model. Thus, there is no unscheduled power flow (loop flow). Congestion payments are assumed to be transfer payment among parties and occur in financial contracts outside the model.

This scenario produces the largest geographic market possible, and is therefore the most competitive outcome. Conditions for the presence of market power are the least likely.

In Scenario Two, LCG adds an economic transmission constraint to mimic the effects of transmission rate "pancaking." Scenario Two modifies Scenario One by assuming that three independent system operators form, with single-zone transmission pricing within each zone, and a \$3 per megawatt hour wheeling charge to transport power into the consumer's zone. This Scenario only partially captures the current level of pancaking because the simulation only aggregates the many utility territories into three zones operated by ISOs. It is intended to be an optimal view of a market structure facing efficiency losses due to inferior transmission pricing practice. There is a California zone, a Desert Southwest zone, and a Pacific Northwest plus Rocky Mountain states zone which includes Utah. IPP is considered to be in the California ISO zone.

Scenario Three is Scenario One modified to exclude publicly-owned utilities from full participation in retail competition. In this scenario, publicly-owned utilities serve jurisdictional loads at embedded-cost-based rates. Surplus generation is offered to the competitive auction process at incremental fuel costs, much like the current wholesale market today. Thus, IPP continues to observe its current contractual commitments and sells only surplus power into the competitive market.

The effects of these three cases on market price and market size are determined. The potential for horizontal market power over a 12-year study period is then inferred by comparing the geographic scope of the market to previous market structure analyses.

1. Geographic Scope of the Market

A delivered-price test (in the spirit of the Department of Justice and Federal Trade Commission Horizontal Merger Guidelines, and FERC's merger policy competitive analysis screen) is employed to identify the geographic scope of the relevant electricity market. This means that the competitive prices produced in the LCG study are used to define geographic electricity markets, based on a five percent price difference from a Utah consumer's perspective.⁽³³⁾ Market prices that are more than five percent higher or lower than Utah prices are assumed to represent distinct market areas outside the zone of Utah consumer choice. Areas where price is within five percent of Utah competitive prices are considered to be in Utah's relevant market. If and when transmission congestion exists, generation sources having prices more than five percent lower than Utah cannot reach Utah and therefore are not part of the relevant market. Where transmission congestion does not exist, such sources are part of the market. Areas where price is more than five percent higher than Utah have higher cost generation that, absent market power, would not be required to meet Utah consumer demand. Additionally, when transmission congestion exists and price is more than five percent higher, additional flows of power out of Utah cannot occur.

The prices in fourteen areas of the WSCC are examined. These fourteen areas are the eleven states in the WSCC (with California partitioned into two areas, north and south), and the British Columbia and Alberta provinces of Canada.⁽³⁴⁾ The relevant market is identified using the five percent rule.⁽³⁵⁾

Model results show that the geographic scope of the electricity market varies substantially, both daily and seasonally. It is largest, reaching the entire WSCC for the 12-year period studied, during weekdays in March. It is smallest in September, when it is either Utah only or Utah plus a few other areas, in all years. Sixty percent of daytime, weekday hours, the market is restricted to half of the WSCC area. It is the entire WSCC but 10 percent of the time. During months of low local demand -- March, April, and October -- the geographic scope of the market during daytime, weekday hours is largest, and includes thirteen of the fourteen areas 60 percent of the time. During months of Utah's highest demand

for electricity, July through September plus December, the daytime, weekday market is less than half of the WSCC area 85 percent of the time. When the geographic scope of the market during weekdays in the months of Utah's highest demand is less than the entire WSCC area, cheaper power from the outside cannot reach Utah consumers because of transmission limitations. It is then that market power is of greatest concern because PacifiCorp will have a large market share and the greatest opportunity to exercise it.

In the evening and weekend hours of low demand, the market is much smaller than it is during the high demand hours most of the months and years modeled. Five months of each year, the geographic scope includes Utah and one or two other areas only. For 28 percent of the months modeled, Utah is an isolated market.

That the market is smaller during hours of low demand may seem counter-intuitive. It, however, is a result of transmission congestion constraining the movement of power *out* of Utah. Because large thermal plants in Utah and Wyoming produce electricity at very low cost, this power is in great demand during low demand hours in areas of the West more dependent on hydro-electric power. During low demand hours, Pacific Northwest and California hydro facility owners refill their dams and purchase electricity to serve customers. Since the thermal plants in the Utah/Wyoming area are among the cheapest in the WSCC, power flows westward to the point of transmission constraint, and this ultimately separates the market. During these times, the market is relatively small, and PacifiCorp will have a sizeable share of it. If it exercises market power and raises prices to Utah consumers, the limit would be the price of imported power. Thus, while market power is shown to be of concern even during times of low demand, it is greatest during *hours* of high demand in the *months* of high demand.

Though the simulation which produces these results is based on assumptions about fuel prices, hydro conditions, technical efficiencies, demand growth, and plant costs, we find the results to be conservative: the geographic size of the market during high hourly and monthly demand may even be smaller than we show here. There are several reasons. First, since this study was conducted, a new line rating by WSCC eliminated about 200 MW of import capability from the north into Utah. This path can import low-cost hydro power from the Pacific Northwest so that a reduction in transmission on this path effectively reduces the size of the market. Second, the study assumes that 800 MW of transmission currently under contract would be available to serve competitive loads. Because holders of contract rights may use them to sell into the Utah market only when profitable, this capacity may or may not be available. Hence, the study has assumed that about 1,000 MW of import capability will be available which may not be. Third, additional contractual commitments are likely to complicate results. For example, PacifiCorp has a contract with the Bonanza plant which may compromise the ability of these owners to act as competitors. Fourth, private use restrictions on publicly owned facilities may restrict availability of transmission access to Utah markets. Finally, there are interactions between generation output and transmission capabilities caused by system reliability requirements. These have not been captured in the model and would further limit competitive imports to Utah.

2. Effect of Scenario Assumptions on Market Price and Size⁽³⁶⁾

Unless there is a single independent system operator as is assumed in Scenario One, the electricity market will be "balkanized" by wheeling charges; lower-cost areas will have lower market prices and higher-cost areas have higher prices. The reason is that the averaging of rates which will occur in the single ISO case is reduced in a multiple-ISO scenario. The simulation shows that Utah prices will be lower when the market is balkanized, by three - four percent, than when it is not.

Impacts on market size of the single versus multiple ISO cases vary from small to large by time of day, month and year. For example, market size during high demand hours in August, 1999, is the same in both cases. Although price is lower in the multiple ISO case, Utah geographic market scope includes the same states -- Washington, Oregon, Idaho, and Montana. Due to transmission limitations, additional, cheaper power from Wyoming and Colorado is unable to compete for Utah loads. California, Nevada, Arizona and New Mexico have prices more than five percent higher than Utah, suggesting that cheaper Utah power cannot move into that area. Therefore, the markets are separated. This August 1999 market is thus fairly small. According to an analysis of producers in 1995, a similar sized market would produce a tight oligopoly market structure.

Alternatively, in December 1999, the geographic market for electricity during high demand hours is much smaller in the three-ISO case than the single-ISO case. With one ISO, it is the entire West except for Colorado and Wyoming, but with three ISO zones the market that includes Utah includes Washington, Oregon, Idaho, Nevada, Arizona and New Mexico. Thus, the effect of having three rather than one ISO zone reduces market size. The opportunity to exercise market power is greater.

The effect on market size and price of excluding all publicly-owned utilities from full participation (except for surplus power sales) in western retail competition is small. Price is about one percent lower and geographic scope is about the same as in Scenario One because the surplus sales participation by the publicly-owned utilities will be at incremental fuel cost. Still, our analysis suggests that market concentration will be higher in this Scenario because the share of output in the competitive market would include mostly investor-owned utilities and only this fringe participation by publicly-owned utilities. The opportunity for market power abuse is increased.

3. Role of Transmission Investment and Congestion Cost

The LCG study states that when the hourly flow on the transmission network is unconstrained, the market clearing prices throughout the WSCC will be the same. But with congestion, meaning that certain lines in the system have reached a maximum flow constraint, the market prices will differ between the areas connected by these lines. This imposes a congestion cost on the overall system. As the LCG simulation held transmission investment constant during the study period, we did not evaluate these costs to determine when expansion of transmission might be the economic alternative. But preliminary review of congestion costs suggests that in most cases they are too low to warrant more transmission investment. It is cheaper to incur the congestion cost than to upgrade or build lines.

According to the Western Interconnection Biennial Transmission Plan, recent transmission investments planned or under construction in the WSCC range from \$75/kW to \$487/kW. LCG's calculations show that by 2004, some congestion costs for lines connecting Utah to external markets may be in this range. For example, the transmission line connecting western Colorado to eastern Utah shows congestion costs of \$240/kW in 2004 increasing to \$465/kW in 2007. We do not know whether the congestion on this path could be relieved at this cost. Also, the relative cost of generation and transmission complicates the issue. With new transmission, however, market size would expand and the latitude for the exercise of market power would decrease.

4. Implications for Market Power Abuse

For much of the year, PacifiCorp's market share is likely to continue to be high due to regional transmission constraints and to differences in the cost of electricity in subregions. Our analysis relies on an earlier analysis of 1995 data to infer that, when the entire West is the geographic scope of the market, a loose oligopoly emerges. When the market is less than half of the West, PacifiCorp's share is large and the market structure may be more concentrated than a loose oligopoly.

Impacts of market power abuse differ in peak and off-peak hours.⁽³⁷⁾ In off-peak hours, market power abuse could be capped at the price of imports from higher cost areas. In peak hours, however, the effects of market power abuse could be checked only by consumer responses to price changes. Since the ability to respond by decreasing the amount purchased varies dramatically from virtually nil in residential and small commercial classes to substantial in the case of large consumers of electricity, the result of market power may well be price discrimination among consumer groups. This means producers may charge higher prices to consumers who have few if any alternatives. Large-volume consumers have more substitutes and face lower costs to respond to unacceptable price increases than do small-volume consumers. Thus, the impact of the price increases due to market power can be expected most to affect small-volume consumers. It is important to remember that small-volume consumers total 98 percent of PacifiCorp's Utah customers. Aside from noting it is likely to occur, our study does not analyze the impact of price discrimination. Further study is warranted. In all cases, however, the exercise of market power will shift wealth from Utah consumers to Utah producers.

The LCG study finds that power plants owned by PacifiCorp give it the ability to set market clearing price in Utah 45 to 60 percent of the time during the study period.⁽³⁸⁾ This conclusion reinforces our concern that the potential for market power is real. Even so, we note that LCG simulation results should be considered a preliminary look at a complex subject. The supply and demand of electricity is an unusually difficult subject, one fraught with uncertainty. A simulation is unlikely to fully capture the strategic pricing behavior of producers in a competitive market. Nevertheless, we are able to conclude that physical transmission constraints will occur and will increase the opportunity for market power abuse.

Mitigation of Market Power

Both vertical and horizontal market power abuse could occur in a restructured power market owing to transmission constraints in the western system, ownership of bottleneck facilities, and pricing of transmission service. The following is a brief introduction to strategies to mitigate the exercise of such market power. Good public policy will depend upon more study of the subject than we have been able to give it.

1. Divestiture of Generation Plant.

If generation plant ownership shares are small, the potential for market power abuse is reduced. Consolidation, however, appears to be the preferred industry structure. Moreover, divestiture may result in efficiency losses. For these reasons, forced divestiture, though sometimes suggested as a solution to market power, may not be the preferred public policy.

2. Formation of an Independent System Operator (ISO).

Independent operation and particularly independent ownership of the transmission system could make this less a bottleneck facility. Efficient pricing of transmission service will in addition broaden the geographic scope of Utah's market. But even if a single independent system operator covers the entire West, the LCG study indicates that concentration is likely to persist in the Utah market owing to transmission congestion throughout the West. Though a single ISO may be a desirable step, indications are that the potential it brings for cost shifting between low- and high-cost states may be a critical stumbling block to implementation.

3. Market Monitoring, Codes of Conduct, Ready Redress, and Penalties for Abusive Behavior.

Market design to ensure that penalties are assigned for market power abuse and are not simply considered a "cost of doing business" could help to deter the exercise of market power. One potential approach would require cost-based rates for existing generation units and market-based rates for new units, until competition for all customer groups is known to be effective. The caveat to this and other rules of market design is, however, that they should not introduce unjustified inefficiency.

4. Price Caps.

In a competitive market, contracts will specify penalties for delivery failure. For events caused by "acts of God," price caps for emergency power could mitigate the exercise of market power without removing the value of price signals necessary for optimal plant investment decisions.

5. Public Investment in Transmission Facilities.

The LCG simulation results in annual average prices in some neighboring markets approaching 30 percent lower than Utah. Still, the model indicates that investment in new transmission facilities to alleviate the constraint and open the markets is not profitable. Public investment in transmission in order to broaden the markets for the purpose of curtailing market power abuse therefore may be beneficial.⁽³⁹⁾ Further study would be required to estimate the benefits and costs of this approach.

6. Short-Run Consumer Response to Price Changes.

Research has shown that if public policy focuses on increasing the ability of *all* customer groups to respond to price increases, whether by curtailing or interrupting consumption, or by moving to alternatives, the result would help to curtail market power abuse.⁽⁴⁰⁾ Currently, short-run consumer response to a change in price is limited to large consumers who are able to obtain interruptible contracts. In a competitive market, it may be of less interest to a supplier to offer such service. Hence, even this may be limited. For the majority of customers, the short-run ability to respond to price change is extremely limited. Approaches that may increase short-run consumer response to price changes, as a way to mitigate market power abuse, must be examined.

Conclusions

This report addresses the questions on market power put forth by the Legislative Task Force. These include: ascertaining the market relevant for Utah in order to analyze market power, determining whether any electric service provider could exercise market power, and, if so, identifying potential mitigation strategies for state policymakers. After careful study, we conclude that the potential abuse of market power is a serious issue that needs to be addressed by policymakers before effective competition can arise in the Utah electricity market.

We find that the relevant market will vary in geographic size depending on the time of day and month of the year. It ranges from the entire interconnected West to little more than the state's boundaries. As the market size shrinks, the problem of market power expands. We conclude that the clear potential exists for market power abuse through the concentrated ownership of generation and transmission along with the strategic advantages enjoyed by an incumbent utility. The principal firm able to exercise market power in Utah's relevant market is PacifiCorp. Therefore, mitigation options must be investigated and employed before restructuring the Utah market.

The report relies on two types of analysis to reach its conclusions. First, a structural analysis of the number and size of competitors, ease of entry and exit, conditions of supply and demand and the degree of information flow is performed. We identify a number of market barriers that would inhibit competition. These include: large capital requirements, economies of scale and scope, preferential access to knowledge and information, and strategic behavior of the incumbent, including predatory pricing and limit pricing. In particular, transmission capacity may limit competition from imported power. Transmission access may also create barriers to entry as well as inefficient transmission pricing. The current placement of transmission facilities favors incumbent generation and, barring divestiture, may be a difficult advantage to overcome. The second analysis employs a computer simulation of the Western electricity market to identify the relevant size of the market and to determine the ability of a dominant firm to unilaterally rise price. Our conclusions about the relevant size of the market are drawn from the results of this study. Our conclusion that PacifiCorp could benefit from the exercise of market power is supported by the study as well.

We review the various options available for mitigating market power and encourage further consideration of them before restructuring takes place. We express our doubt that anti-trust litigation will solve market power problems once they are manifest. We recommend that policymakers consider the following options: encouragement of the formation of an independent system operator (ISO), promotion of measures to enable better consumer response to rising prices, as, for example, through better metering and rate design. Policymakers should phase deregulation and regulatory change with the appearance of actual competition.

Appendix A

Structural and Simulation Analysis of Restructured Electricity Markets

Empirical research indicates that the firm size (market share) and concentration of the leading firm(s) in a market are positively correlated with profitability. Thus, market power is traditionally associated with concentrated markets. Although the correlation between market structure and market power may not be one-to-one, several structural measures have been advanced as an indication of the potential for market power abuse. The traditional analysis uses the four-firm concentration ratio. If the top four firms share 60% or more of the market, the market structure is referred to as a tight oligopoly and there is potential for market power abuse. If the top four firms share 40% or less of the market, the market is generally considered to be able to support sustainable competition. Four-firm concentration ratios, however, do not capture total concentration

of the market, since it focuses on just the top four firms. The Hirschman-Herfindahl Index (HHI) is a popular measure of total industry concentration.⁽⁴¹⁾ The Department of Justice and the Federal Trade Commission, for instance, define a market as "unconcentrated" if its HHI is less than 1,000; "moderately concentrated" if the market's HHI is between 1,000 and 1,800; and "highly concentrated" if the market's HHI is over 1,800.⁽⁴²⁾ More specifically, in analyzing a potential merger, if the post-merger HHI exceeds 1800, and has changed from a pre-merger level of more than 1000 points, then it is assumed that the merger is "likely to create or enhance market power, or facilitate its exercise."

Recent research in the electric industry indicates that reliance on single dimensional measures of potential market power, such as the HHI, may not "adequately measure market power in the electric industry."⁽⁴³⁾ For example, after simulating the California market one group of researchers came to the conclusion that, "Structural measures of market power, such as the Hirschman-Herfindahl Index . . . have certain general shortcomings, some of which are exacerbated when applied to restructured electricity markets."⁽⁴⁴⁾ More specifically, the Tellus Institute argues that "the HHI is far too simplistic a test . . . First, the HHI is mathematically incapable of taking into account existing unique characteristics of electricity . . . In addition, there is no way of knowing whether an HHI value of 1800 . . . or some other value should be interpreted as thresholds of market power . . . because no adequate empirical studies of the electric utility industry have ever been done to validate these assumptions."⁽⁴⁵⁾ On the contrary, one study conducted by Tellus indicates that firms with relatively small market shares, less than ten percent, have the ability to significantly raise price above the competitive level. As the authors point out, while the ability to sustain these prices declines with the number of firms in the market, "this result contrasts dramatically with observations made in the economic literature that a poolco market with four or five firms would be workably competitive."⁽⁴⁶⁾ In other words, contrary to conventional wisdom, "firms with moderate . . . levels of concentration in generation markets . . . may have the ability to increase generation prices above truly competitive levels."⁽⁴⁷⁾

To see why this may be the case, consider the product supply curve depicted in Figure 1.

Consistent with the notion that electric generation technology is "lumpy," the supply curve is represented by a graph with discrete steps at various levels. (For simplicity, we have limited the number of steps to three.) Each section of the supply curve is assumed to represent an individual generator, each independently owned. That is, the first generator whose marginal cost is represented by the segment labeled MC_1 would be willing to supply electricity as long as the price is at least P_1 ; the second generator represented by the segment MC_2 would be willing to supply electricity as long as the price is at least P_2 ; and finally the third generator would be willing to supply electricity as long as the price is at least P_3 .⁽⁴⁸⁾ If this were a competitive market, then the market clearing price would be set at P_2 and the quantity supplied would be Q_3 ; assuming that the generators are economically dispatched, say by an independent system operator, the first generator would supply Q_1 and the second generator would supply the difference $(Q_3 - Q_1)$. This equilibrium is summarized by the intersection of the demand and supply curves at point A.

In the absence of external restrictions, the second generator has the ability to raise the price above the competitive level. The second generator can do this by restricting its own output to the difference $Q_2 - Q_1$ (total output will be Q_2). If the generator chooses to restrict output in this fashion the market clearing price will rise to P_3 .⁽⁴⁹⁾

The decision to restrict output will depend on the profitability of doing so, which in turn depends on factors including demand and supply elasticities. By restricting its own output, the second generator will lose revenue equal to $P_2 * (Q_3 - Q_2)$ (the shaded area AEQ_2Q_3), but will gain revenue equal to $(P_3 - P_2) * (Q_2 - Q_1)$ (the shaded area $BCDE$). The relative size of the loss and gain will depend on the price elasticity of demand: if the average demand elasticity over the range from points A to B is less than one (inelastic demand), then net revenues will increase; if the average elasticity is greater than one (elastic demand), then net revenues would decrease. Thus, we can see that the elasticity of demand, the ability of consumers to react to price variations, will play an important role in determining whether a generator can exercise its potential market power.

Similarly, the elasticity of supply will play an important role in determining a generator's ability to exercise market power. In the above example, we have assumed that the relative sections of the supply curve representing different generators do not overlap with respect to the output of electricity. Likewise, we have assumed that the production decision for each generator is an all or nothing decision. If either of these assumptions are violated, then an individual generator's ability to exercise market power would be reduced. Other factors including resource availability, transmission and distribution constraints, and product substitutability will also influence the ability of firms to exercise market power.

Single dimensional measures of market power, such as the HHI or four-firm concentration ratio, do not capture adequately all these, and possibly other, factors. Therefore, as critics have pointed out, the use of such indices fails to properly reflect a firm's potential for market power in electricity markets. For this reason, Tellus Institute advocates the use of simulation modeling to directly analyze potential cost-price margins under alternative pricing strategies. In a critique of FERC's merger guidelines, Tellus Institute concludes that simulation modeling is the only way to effectively analyze regional energy markets.⁽⁵⁰⁾ The Berkeley group advances a similar position. They conclude that, "while structural indices appear to be less useful here, directly calculating estimates of competitive equilibria . . . appears to be more feasible for this industry than is generally the case."⁽⁵¹⁾

Appendix B: Bibliography

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1. While the full extent of anti-competitive behavior in the U.S. economy is uncertain, it is known to be extensive. This is especially true where collusion or cooperation in price setting is concerned. As Adam Smith observed, "People of the same trade seldom meet together, even for merriment and diversion, but the conversation ends in a conspiracy against the public, or in some contrivance to raise prices." (*An Inquiry into the Nature and Causes of the Wealth of Nations*, Liberty Classics, Vol. 1, p. 145). This attitude is as prevalent today as it was in Smith's time. "As one experienced executive put it . . . 'the overwhelming majority of businessmen discuss pricing with their competitors.' And still another: 'It's just the way you do business. There's an unwritten law that you don't compete. It's been that way for 50 years.'" (See William G. Shepherd, *The Economics of Industrial Organization*, 4th Ed., Prentice Hall, 1997, pp. 262-63). There is no reason to believe that electricity suppliers, if given the opportunity, will not act in a similar fashion. Simply introducing competition is not necessarily a deterrent to anti-competitive

behavior. While competition does tend to erode dominant-firm market share, and thus the ability to collude, the natural rate of decline in dominant-firm market shares tends to be quite slow. In the U.S. economy the rate of decline has been about one percentage point per year. (See Shepherd, p. 93.)

2. One measure of this markup is the Lerner index. It can be difficult to calculate because detailed information about the firm's marginal costs and the structure of demand is required. This information is not generally available. The price elasticity of demand, for example, cannot be known with certainty. As a result, the index is only an approximation of market power. Analysts therefore often employ measures that are more easily calculated, such as those which rely on firm market share and industry concentration. These measures include the four-firm concentration ratio and the Hirschman-Herfindahl Index. See Appendix A for further discussion.

3. "Market Power, Mergers, and Deregulation in the Electric Industry," Tellus Opinion Paper, Tellus Institute, Online Document, <http://www.tellus.org/e-power.html>. See also Newberry, David M. 1955. "Power Markets and Market Power," *The Energy Journal*, Vol. 16, No. 3.

4. Economic Analysis Subcommittee Report to the Public Service Commission of Utah, Docket No. 96-999-01, September, 4, 1997, pages 19 and 20.

5. Utah Code 76-10-914; 15 U.S.C. § 18. Vertical mergers are also subject to challenge in certain circumstances. Utah code 76-10-903 also prohibits unfair discrimination regarding commodities; it is not clear that electricity is a "commodity."

6. 15 U.S.C. § 1.

7. 15 U.S.C. § 2.

8. This paragraph paraphrases "Market Power in Electricity," Interim Report, February 2, 1998, page 6, presented to the Joint Standing Committee on Utilities and Energy of the Maine Legislature by the Department of the Attorney General and the Maine Public Utilities Commission.

9. Inside F.E.R.C., May 25, 1998, page 3. 1998. McGraw-Hill companies, Inc.

10. Inside F.E.R.C., June 29, 1998. "CMS Energy Chairman sees 'Tight Situation' for Summer Power Supply."

11. Energy Insight, "Midwest Electricity Crisis Offers Painful Lessons." June 29, 1998, © Resource Data International, Inc.

12. Inside F.E.R.C., July 20, 1998, page 3. "Calif. Price Spike Prompts Calls for Cost-Based Ancillary Services." The McGraw-Hill Companies, Inc.

13. Results of several studies range from .3 to 1.5 percentage points per year. See William G. Shepherd, *The Economics of Industrial Organization*, Third Edition (New Jersey: Prentice Hall, 1990), pp 98-99. Industry specific erosion varies considerably. AT&T, a formerly regulated firm with high fixed costs and growing demand, much like electricity, experienced a decline in market share of about 1.5 percentage points per year, based on a 100 percent market share in 1970 and a 60 percent share in 1996. (Shepherd, Third Edition, page 411; Fourth Edition, page 382.) AT&T's market share decline reflects vertical divestiture required in 1984. The long-distance market now resembles a tight oligopoly, and AT&T's market share has remained at about 60 percent since 1989.

14. PacifiCorp has long-term contracts in place which reduce its control of transmission import capability to 44 percent of total transmission capability. The effect on the conclusions in this Report depends on market design. For example, if only PacifiCorp retail markets were opened to competition, then its share of open-access transmission paths into Utah would be 74 percent -- still high. If all paths and loads were opened to competition, 44 percent control would lessen the ability to thwart entry. (See Market Entry Barriers, Section C.)

15. "Options for Market Power Mitigation in the Alberta Power Pool," Final Report Prepared for the Alberta Department of Energy by London Economics, Inc., Cambridge, Massachusetts, January 1998.

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17. The report refers to generation that can reach Utah load without encountering a transmission limitation as "unconstrained." The IPP and Bonanza power plants are not included in unconstrained generation because transmission limits between them and the majority of Utah load exist.

18. The difference in this range reflects the amount of import capability which is committed to utilities in contract over the next twenty years. The additional MW would be available only if the contract rights holders chose to sell their rights rather than use the rights to meet non-Utah commitments.

19. See "Inside F.E.R.C.," June 1, 1998. The McGraw-Hill Companies, Inc. "Open-Access Violators can Expect no Leniency, Commission Signals," for a review of many complaints of transmission access improprieties.
20. FERC Order issued June 29, 1998, in Docket No. EL98-32-000, pages 3 and 4. The order dismissed the part of the complaint that PacifiCorp refused to provide comparable firm transmission services but ruled that PacifiCorp did violate the functional separation requirements of Order Nos. 888 and 889. UAMPS notes that FERC has agreed to reconsider its Order.
21. See footnote 24 for discussion of IndeGO.
22. See FERC Order in ER96-2466, ER97-346, wherein FERC responds to the New York PSC claim that FERC does not have jurisdiction over unbundled retail transmission service.
23. UAMPS and UMPA own about 100 MW of the 650 MW Craig, Colorado-to-Bonanza line. For this analysis, the import capability is superseded by the constraint on the Bonanza-to-Mona line (785 MW). Thus, the Bonanza plant (400 MW) and imports of 650 MW must compete to get through to Mona.
24. INDEGO refers to the Independent Grid Operator draft proposal developed by 21 utility companies operating in Utah, Washington, Oregon, Idaho, Montana, Wyoming, Nevada and Colorado. The proposal was not formally filed with the FERC because of inadequate utility sponsorship. Reasons for abandonment included unacceptable cost shifts and uncertainty over state retail competition initiatives.
25. Gas Turbine World. 1997 Handbook, Volume 18, pp. 25 - 26. A Pequot Publication.
26. The Western System Coordinating Council service territory is one of four interconnected grids in the nation and extends from the northern Canadian border, through all or portions of the fourteen western states, to the northern portion of Baja California, Mexico.
27. Economic Analysis Subcommittee Report to the Public Service Commission of Utah, Docket No. 96-999-01, September 4, 1997, pages 19 and 20.
28. Key features of oligopoly structure are fewness, independence, indeterminacy, strategy and conflicting incentives to collude and compete. The main condition of loose oligopoly is that the leading four firms, combined, have 40 percent or less of the market and collusion among them to fix prices is virtually impossible. Tight oligopoly is where the leading four firms, combined, have 60-100% of the market; collusion among them to fix prices is relatively easy. (Shepherd page 14). William Shepherd notes that loose oligopoly is a broad category ranging from moderate concentration to nearly pure competition. Because it is unable to make collusion stick, loose oligopoly's outcomes approximate effective competition. See Shepherd, third edition page 76. The critical distinction between loose oligopoly and tight oligopoly is whether collusion is likely or not. Theory and empirical research shows that the higher the concentration of firms (the fewer the number of firms), the greater the likelihood that collusion will be successful.
29. The final report is available in its entirety on the Division's web site (<http://www.commerce.state.ut.us>) under Division of Public Utilities 1998 Electric Restructuring Activities.
30. In theory, marginal cost should determine the competitive price. However, "steam generation technology, which dominates electric markets, generally exhibits declining average costs as unit output increases. Therefore, marginal costs are less than average variable costs. This means that marginal cost pricing can fail to recover fuel costs, to say nothing of fixed costs." Thus, this model deviates from marginal cost pricing to include average variable cost and fixed O&M on some plants. This bid above marginal cost is distinct from market power pricing in that it is related to actual cost. See Edward Kahn, "Numerical Techniques for Analyzing Market Power in Electricity," *The Electricity Journal*, July, 1998, Volume 11, Number 6, page 36.
31. Short-run variable costs equal fuel costs plus variable plant operation and maintenance costs. Start-up costs are the fixed costs required to start-up a plant and no-load costs are the costs incurred at low plant efficiencies at minimum operating levels. Again, see Kahn, page 37.
32. See LCG Report for discussion of assumptions regarding new entry.
33. See U.S. Department of Justice and Federal Trade Commission, Horizontal Merger Guidelines, 57 FR 41552 (1992), and FERC Docket No. RM96-6-000, Order No. 592, "Inquiry Concerning the Commission's Merger Policy Under the Federal Power Act Policy Statement," Appendix A, Section B. 3. a.
34. Although the entire WSCC was modeled, LCG has only provided prices to the Division for these market areas at present. The other areas included in the model are Baja Mexico, and small portions of southwestern Texas and South Dakota.
35. The Guidelines suggest a 5 percent price threshold but acknowledge that others may be appropriate. Applicants have the burden of justifying a different price threshold. DOJ Guidelines at 41555.

36. The market clearing price computed in the LCG study is the average price paid to generators rather than the average price paid by consumers. The difference in price is primarily payment for losses so that a buyer's price will be higher.
37. Peak hours correspond to hours of high demand and are generally weekday, daytime hours. Off-peak hours correspond to hours of low demand and are generally nighttime hours and weekends.
38. LCG Consulting, "Final Report Competitive Energy Market Study of the Western System Coordinating Council," July 22, 1998, Prepared for the State of Utah, Department of Commerce, Division of Public Utilities, Report 98WSCC-UDPU -2, pages 2-10 to 2-12. Three owners, PacifiCorp, Intermountain Power Agency and Deseret Generation and Transmission own the units setting market clearing price in Utah 99.6 - 99.9 percent of the time during the entire study period. Collusion among these unit owners is possible.
39. For example, Wisconsin will require additional transmission capacity before it moves to retail competition. See Edison Electric Institute, "Retail Wheeling and Restructuring Report," Volume 4, Number 4, March 1998, pp. 135 - 137.
40. See Severin Borenstein and James Bushnell. "An Empirical Analysis of the Potential for Market Power in California's Electricity Industry." University of California Energy Institute.
41. ⁴¹ The HHI is defined as the sum of squared market shares of all firms in the market: $HHI = \sum S_i^2$ where S_i is the i th firm's market share in percentage terms.
42. ⁴² Use of the HHI presupposes that the relevant geographic and product markets have been identified.
43. ⁴³ "Market Power, Mergers, and Deregulation in the Electric Industry," Tellus Opinion Paper, Tellus Institute, Online Document, <http://www.tellus.org/e-power.html>.
44. ⁴⁴ Severin Borenstein, James Bushnell, Edward Kahn, and Steven Stoft, "Market Power in California Electricity Markets," University of California Energy Institute, Berkeley California, March 18, 1996, p. 33.
45. ⁴⁵ "Market Power, Mergers, and Deregulation in the Electric Industry," Tellus Opinion Paper, Tellus Institute, Online Document, <http://www.tellus.org/e-power.html>.
46. ⁴⁶ Rudkevich, Aleksandr, Max Duckworth, and Richard Rosen, "Modeling Electricity Pricing in a Deregulated Generation Industry: The Potential for Oligopoly Pricing in a Poolco," Tellus Institute, February 24, 1997, p. 14.
47. ⁴⁷ "Market Power, Mergers, and Deregulation in the Electric Industry," Tellus Opinion Paper, Tellus Institute, Online Document, <http://www.tellus.org/e-power.html>.
48. ⁴⁸ According to economic theory, the supply curve in a competitive market is the horizontal sum of the marginal cost curves of all firms in the market. To facilitate the following exposition, we have assumed that the marginal cost of each firm, while different, is constant.
49. ⁴⁹ If the firm tries to restrict output further to raise price above P_3 , generator three would be dispatched (assuming they bid P_3) and generator two may lose part or all of its sales. A study of the PMJ power pool demonstrated that generator two's ability to determine P_3 , generator three's reserve price, required relatively unsophisticated bidding strategies.
50. ⁵⁰ "A Critique of FERC's New Merger Guidelines: Implications for Analyzing Market Power, Mergers, and Deregulation," Tellus Institute, May 30, 1997.
51. ⁵¹ Severin Borenstein, James Bushnell, Edward Kahn, and Steven Stoft, "Market Power in California Electricity Markets," University of California Energy Institute, Berkeley California, March 18, 1996, p. 33.