ER 96 Staff Testimony

FINANCIAL INSTRUMENTS IN A RESTRUCTURED CALIFORNIA ELECTRICITY INDUSTRY: AN ASSESSMENT

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INTRODUCTION

One of the **ER 96** Committee's policy objectives for restructuring California's electricity industry is to establish open and transparent spot electricity markets which allow for efficient pricing that reflects supply and demand conditions. Given the time and interlocational variability of short-run demand and supply for electricity, the need arises for complementary tradeable financial forward instruments to hedge both temporal and interlocational spot price uncertainty. Well-designed price hedging instruments should efficiently reallocate and value market price risk among electricity market participants.

Spot markets complemented by financial hedging instruments may be viewed as a substitute to today's long-term bilateral contracts, where both price and performance are specified in advance. The combination of these two market types may, in the future, supplant a significant number of today's long-term contractual arrangements. Therefore, to adequately assess the feasibility and benefits of a competitive electricity market requires an examination of both spot and financial contract market activity.

In particular, an assessment is needed on the likely competitive health of the proposed complementary financial contract markets.[1] For example, non-competitive financial contract market activity may distort the underlying spot market resulting in inefficient market price signals.[2] However, active participation in well-designed competitive financial contract markets may help mitigate the exercise of spot market power. Staff notes that the interaction between spot markets and contract markets is at the forefront of research.[3] Nonetheless, the proposed restructured California electricity industry comprises both market types.

The **ER 96** Committee's concern for establishing long-run efficiency also requires going beyond the analysis of spot electricity markets. An efficient spot electricity market is not so much a necessity for short-term efficiency gains. Rather, it provides a necessary, although not sufficient, framework for efficient long-run competitive contractual arrangements. "Paradoxically, the most important reason to create open, dispatch-based spot energy markets is not to improve short-run system operations, but to facilitate competition in the long-run markets for contracts."[4]

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1 The exercise of market power is not only relevant to spot markets, but also to contract markets, including markets for financial hedging instruments.

2 Kahn, E., Outhred, H., and Bushnell, J., "Bulk Power Market Study", University of California Energy Institute, October 25, 1994, ch. 4, p. 11-12. Under Contract to the California Energy Commission, Contract No. 700-93-003. Docket No. 93-ER-94.

3 Kahn, E., Outhred, H., and Bushnell, J., "Bulk Power Market Study", University of California Energy Institute, October 25, 1994, ch. 2, p. 9-10. Under Contract to the California Energy Commission, Contract No. 700-93-003. Docket No. 93-ER-94.

4 Ruff, Larry, "Stop Wheeling and Start Dealing: Resolving the Transmission Dilemma", Electricity Journal, June 1994, page 27.

Efficient spot price risk mitigating instruments may be required for bankability of generation projects by independent power producers. Because interlocational hedging instruments, such as transmission capacity contracts (TCCs), reflect the physical operations of the network, they will impact investment incentives. Therefore, the search for efficient investment signals should address the role of financial hedging instruments and the necessity for establishing workable competition for these instruments. The implementation details of these markets may determine whether or not the correct signals for efficient generation and transmission investments will be conveyed to market participants.

This paper examines the financial instruments that have been proposed to promote efficient short-run and long-run economic activity in a restructured California electricity industry. The financial instruments include: (1) the New York Mercantile Exchange's (NYMEX's) futures contracts, contract for differences (CFDs) and other financial forward contracts to hedge temporal price uncertainty; and (2) independent system operator (ISO) administered transmission congestion contracts (TCCs), developed by William Hogan [5], and combinations of local forward contracts[6] to hedge interlocational price uncertainty.

Since the features, and hence effectiveness, of each financial instrument are linked to the nature of the spot market each hedges, meaningful analysis of these instruments requires discussion of the two alternative spot market making processes that have been proposed and considered. For example, CFDs and TCCs were initially designed for a spot market administered by an ISO. However, NYMEX has argued that its futures and options contracts' success would require a different complementary spot market design that would not rely on administered uniform prices obtained from a bidding process.[7] It has expressed concern regarding the potential for market power abuse within such a spot market framework.

Therefore, this paper also attempts to address and assess NYMEX's and marketers' concerns by reviewing an alternative spot market making model which has elements that may be more favorable for the successful implementation of a futures contract. This alternative spot market design was developed by Felix Wu and Pravin Varaiya [8], and will be referred to as the "Coordi-

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5 Hogan, William, "Contract Network for Electric Power Transmission", Journal of Regulatory Economics, Volume 4, Number 3, September 1992, and Hogan, William, "Electric Transmission: A New Model for Old Principles," The Electricity Journal, March 1993.

6 Oren, S., Spiller, P., Varaiya, P., Wu, Felix, "Nodal Prices and Transmission Rights: A Critical Appraisal", PWP-025, December, 1994 Citing: Outhred, H., "Resolving Network Issues in Implementing A Bulk Electricity Market in the Western United States," University of New South Wales, Australia.

7 NYMEX Response to 1994 CPUC OIR & OII on Restructuring California's Electricity Services Industry and Reforming Regulation.

8 Wu, Felix, and Varaiya, Pravin, "Coordinated Multilateral Trades for Electric Power Networks: Theory and Implementation. POWER Working Paper 031 (PWP-031), June 1995.

nated Multilateral Trading (CMT)" spot market model[9]. Its distinguishing feature is that it relies only on generator/load quantity, not reservation price[10] nominations to the ISO. The proposal argues that parties, provided with ISO information on their contributions to congestion and losses, will generate efficient spot prices through a multilateral trading process.

Staff believes that the recent CPUC order[11] and WEPEX filings[12] have incorporated elements from the both the CMT and pool-based spot market designs in fashioning the two scheduling markets (day-ahead and hour-ahead)[13] that will be effective for the next five years.

For example, two elements of the CMT design are apparent in the scheduling markets. First, the day-ahead market will allow market participants to resubmit their schedules to the ISO, if the first submitted total schedule is not feasible. This will allow market participants, through a multilateral trading process, to converge to feasibility. If the resubmitted schedules are not

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9 Staff notes that the CMT paradigm does not propose an explicit mechanism to optimally price and allocate congested transmission capacity. If the convergence process implied by a multilateral trading process does not achieve feasibility, much less optimality, then the ISO has no method to efficiently allocate and price congested transmission capacity. Also, even the convergence process does not contain explicit details on how congested transmission capacity is to be traded and priced among the market participants. The authors state that congestion costs, or transmission pricing, will be addressed in forthcoming papers. Because of this, any proposal that relies solely on this approach would resort to an arbitrary allocation and pricing mechanism to a congested network.

Staff has received "A Market Mechanism for Electric Power Transmission", Hung-Po Chao and Stephen Peck, Journal of Regulatory Economics; 10:25-59, 1996. This paper proposes a market mechanism (trading process) to optimally price and allocate rights to a congested transmission network. However, Staff has not fully assessed the authors' proposal and invites comments on this paper.

10 A supplier's reservation price is the minimum price he is willing to accept to provide an additional unit of good or service. A consumer's reservation price is the maximum price he is willing to pay for an additional unit of good or service.

11 CPUC Decision 95-12-063 (December 20, 1995), as modified in Decision 96-01-009 (January 10, 1996)

12 Pacific Gas & Electric Company, San Diego Gas & Electric Company, and Southern California Edison Company, FERC Docket Number EC-1663-000.

13 Note that the WEPEX filings refer to the two scheduling markets (day-ahead and hour ahead) as forward markets. Staff will refer to both markets as spot markets, considering them 'ex ante' spot markets. The real-time imbalance market is an 'ex post' spot market. It is believed that agents will choose the most attractive market in which to trade. Staff ask parties to comment on the degree to which agents may substitute between the two scheduling markets (day-ahead and hour-ahead). That is, what are the technical constraints that would impede substitution between the day-ahead and hour-ahead markets? In addition, what is the feasibility of participants (e.g., hydro resources) to bypass the scheduling markets and trade solely in the real-time market? These questions are most relevant after the five-year transition period is over.

feasible, then the ISO will make the necessary adjustments.[14] Trading opportunities between the day-ahead and hour-ahead markets may also be possible. The second included CMT design element allows bilateral contracting parties the choice of revealing their reservation prices to the ISO. Only quantity nominations are required.[15]

The eventual spot market design, after the five year transition period, is difficult to envision. It will reflect market participants' preferences and included market elements not yet realized.

However, Staff believes that an efficient real-time, imbalance, or residual energy market requires the ISO have information on reservation prices from all parties. That is, economic efficiency requires reservation prices be disclosed by all parties, including independents working through their own scheduling coordinators, to the ISO so as to achieve a least-cost and transparent process. As such, the ISO should directly be involved in the real-time market price determination process.[16]

If NYMEX's past submittals provide a guide, then the emerging futures markets will most likely grow around the CMT market elements of the scheduling markets. In doing so, futures trading may, through its price discovery function, assist in revealing prices in these markets. Should NYMEX's fears about market power abuses in a pool-based spot market not be realized, then futures trading may fully mature and include all of California's market participants.

OVERVIEW

The central technical arguments of this testimony are contained in pages 6 -16. Subsequent sections provide illustrations, definitions and more in-depth explanations.

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[14] The information the ISO has at its disposal may not be adequate to reach an optimal solution. For example, it can only use information from the 'preferred schedule' of the power exchange (PX) members when modifying the infeasible schedule (i.e., optimizing over a subset of all PX generators cannot lead to a lower-cost solution than optimizing over the entire set). In addition, the ISO may not have the necessary reservation price information from bilateral contracting parties to efficiently price congestion.

Note also that to be accepted by the ISO, the adjustments made by the scheduling parties only require feasibility be obtained, not optimality.

[15] Staff invites comments on how quantity nominations, instead of reservation price nominations, to the ISO could result in efficient outcomes for the scheduling and real-time imbalance markets. How could a well-functioning futures market help reveal locational spot prices, which by definition include congestion prices, absent the involvement of the ISO in the price determination process?

[16] Staff requests comments on whether 'ex post', 'ex ante', or a combination of these spot prices are more likely to be referenced in hedging price risk.

Underlying California's proposal for a restructured electricity industry are a set of three locational spot markets - two scheduling markets and one real-time imbalance market. Open and transparent spot markets allow for efficient pricing that reflects supply and demand conditions. However, implementation of locational electricity spot markets that reflect system congestion and losses also create temporal and interlocational market price uncertainty for suppliers and consumers. Therefore, market participants will require complementary tradeable financial forward instruments to hedge both temporal and interlocational spot price uncertainty. Well-designed price hedging instruments should efficiently reallocate and value market price risk among electricity market participants.

Liquid financial markets, which require a proliferation and diversity of industry participation, may mitigate generator spot market abuses. Active and broad trading of financial forward contracts would efficiently reflect "cost expectations that incorporate market consensus with respect to investment opportunities and future efficiency improvements." [17] Since these competitively determined prices would be made available to all participants, they would remove the incentive of generating companies to inflate spot prices. For example, if consumers faced artificially inflated spot prices, they could easily purchase financial forwards and lock in prices at more favorable rates. With these forward contracts in place, a dominant generator would have no incentive to inflate spot prices. Staff emphasizes that this function may only hold for deep locational spot markets which are required for varied and active commercial participation in the complementary financial instruments.

Well-functioning competitive financial forward markets, in conjunction with efficient spot market prices, may provide bankability and the proper incentives for generation investments. "In theory, the economic incentives for investment can be provided by the spot market in energy and its associated financial instruments if electricity demand becomes sufficiently responsive to price through such mechanisms as interruptible load." [18] By facilitating entry conditions, this function would also provide additional pressure on existing generators not to artificially inflate spot prices.

Mitigation of Temporal Price Uncertainty

Lessons drawn from other industries demonstrate that hedging temporal spot price uncertainty require a localized deep spot market. For example, tradeable standardized financial forward contracts, such as the New York Mercantile Exchange's (NYMEX's) futures and options contracts, have been successful in the gas and oil industries. A successful futures market requires varied and active commercial participation in the spot or cash market. As such, the Com-

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[17] Oren, S., "The Role of Financial Instruments in a Competitive Electricity Market". Paper presented at EPRI conference, San Diego, March 1996, page 7-1.

[18] Borenstein, S., Bushnell, J., Kahn, E. and Stoft, S., "Market Power In California Electric Markets", University of California Energy Institute (UCEI), November 30, 1995. CEC Interagency Contract #700-93-003, page ii.

modity Futures Trading Commission (CFTC) recently approved NYMEX's application to trade futures and options on the futures at two locations, Palo Verde and COB.[19] Futures trading began at both locations on March 29, 1996, and options on the futures contracts on April 26. Initial futures trading shows that COB's trading volume exceeds that of Palo Verde.

Staff is concerned with the implications of the deliverability requirement of futures contracts. NYMEX's futures contract requires that transmission capacity be guaranteed to fulfill the contract's obligations. As surplus capacity had been identified for both Palo Verde and COB, NYMEX proceeded with its contract applications. The CFTC referred to this surplus in approving both contracts.[20] Staff is uncertain as to what arrangements will be needed when transmission becomes constrained in the vicinity of the futures contract's trading market area. Will excess transmission capacity be reserved for the sole purpose of fulfilling the deliverability requirements required for futures trading? Does this imply that electricity traders holding futures instruments will have priority over other market participants during congested periods? How will transmission capacity be defined, priced, and allocated under congested conditions?[21]

Contract for Differences (CFDs), used to hedge temporal price uncertainty in the United Kingdom's pool-based spot market, are also being proposed for California. However, sole reliance on these non-standardized financial instruments may not lead to the necessary liquidity for efficient temporal risk allocation and hence mitigation. In fact, "No financial instrument can be viable without sufficient liquidity and proliferation of customized instruments may result in 'thin markets' with insufficient liquidity. It is not surprising that only a small fraction of new futures and derivatives in stock and commodity markets develop sufficient liquidity to become viable."[22] A balanced mix of broad commercial and speculative participation is necessary to ensure that price risk can be laid off on either the long or short side of the market.

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19 Commodities Futures Trading Commission's (CFTC's) Approval of NYMEX's Applications for Proposed Electricity Futures Contract for Delivery at Palo Verdes and at COB, January 25, 1996 and January 31, 1996, respectively.

20 Commodities Futures Trading Commission's (CFTC's) Approval of NYMEX's Applications for Proposed Electricity Futures Contract for Delivery at Palo Verdes and at COB, January 25, 1996, p. 28-30 and January 31, 1996 p. 12-15, respectively.

21 Staff is aware that, historically, only one to two percent of open positions have been settled by physical delivery. Nonetheless, what amounts of reserved transmission capacity will be required to accommodate futures trading? How will this capacity be defined and priced, considering that quantifying transmission capacity must consider the entire network?

22 Oren, S., "The Role of Financial Instruments in a Competitive Electricity Market". Paper presented at EPRI conference, San Diego, March 1996, page 7-14.

Mitigation of Interlocation Price Uncertainty

Since NYMEX's futures and options contracts are locational specific and, as such, only hedge temporal price uncertainty, parties will need to arrange for hedging services between their particular location and the spot market location served by NYMEX's and other temporal instruments. NYMEX refers to this interlocational price differential as 'locational basis'. NYMEX states, "In theory, the price relationship between two different geographical areas will be based on the cost of transportation between them. However, sudden local shifts in supply and demand can temporarily distort this price relationship. The extent to which these changes in relative market conditions are predictable will determine the hedged firm's exposure to locational basis risk."[23]

Therefore, because of the physical characteristics of an electricity network and implementation of an economic system based on locational spot markets, there is also a need to hedge interlocational spot price uncertainty. Interlocational price uncertainty arises since the amount of congestion and losses between any two locations within the grid cannot be perfectly predicted. This is because congestion and losses between any two locations depend on system-wide conditions, determined by all participants' simultaneous actions in the network.

Transmission Congestion Contracts (TCC)

There are various market-based proposals to hedge interlocational spot price uncertainty. One proposal would rely on the independent system operator (ISO) to allocate a congested system and award the resulting financial congestion property rights, transmission congestion contracts (TCCs), among industry participants.[24] Under this scheme, the ISO would first collect revenues from all consumers based on their locational market clearing prices, then pay all generators their locational market clearing prices. Those parties who did not participate in the power exchange would have to pay congestion rents to the ISO equal to the locational price differences. Under congested conditions, the resulting 'merchandising surplus'[25] would subsequently be distributed to all TCC holders.

The agents who held these financial property rights, or rights to congest, would be hedged against uncertain interlocational spot prices. The proposal's appeal is that the diversified ISO would be able to cover all TCC holders without incurring any risk. All TCC holders, regard-

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23 The New York Mercantile Exchange. Obtained on March 26, 1996 from the internet. Internet Address: http:/www.nymex.com/contract/electric/how.html, March 26, 1996.

24 Hogan, William, "Contract Network for Electric Power Transmission", Journal of Regulatory Economics, Volume 4, Number 3, September 1992, and Hogan, William, "Electric Transmission: A New Model for Old Principles," The Electricity Journal, March 1993.

25 During congested periods, revenues collected from consumers would be greater than payments made to generators. This difference has been referred to as 'the merchandising surplus'.

less of the locations of their trades, would face equal risk mitigation premia. This approach would support non-discriminatory transmission access at comparable prices.

TCCs as originally defined by William Hogan were based on a system of nodal spot markets. The difference between any two nodal marginal costs efficiently prices short-run congestion costs incurred and caused by a pair of transacting parties who traded across the two nodes. A TCC defined over two nodes would, therefore, represent an efficiently priced property right. It would provide a perfect hedge against internodal price variation.

However, a mechanism to initially allocate TCCs has not been satisfactorily developed. For example, the Western Power Exchange (WEPEX) filings[26] would have the transmission owning utilities (TOUs) hold the TCCs for their existing customers. These customers would thereby be credited against their transmission access charges. It is not clear if the filings include end-use customers that rely on TOU lines to purchase electricity from independent generators, municipal utilities, and out-of-state suppliers.

The WEPEX filings's treatment of TCCs may weaken their short-run efficiency properties. In order for a TCC to efficiently define and price a congestion property right, it is necessary that the local spot prices over which the TCC is defined are also efficiently derived. For example, during intra-zonal congested periods, constrained-on generators will be paid their respective bid prices, whereas other intra-zonal generators will be paid 'the intra-zonal uncongested market clearing price'. Consumers within a zone will pay 'the intra-zonal uncongested market clearing price' plus an uplift charge, which will be an average of all constrained-on generators' bid prices. If TCCs are to be defined over zonal prices, then Staff is uncertain as to which zonal price will be referenced when a non-PX member wishes to hedge.

Furthermore, a zonal market clearing price that is defined as the marginal cost of the last generator dispatched raises more questions. Is this generator one of the intra-zonal constrained-on generators? If so, then what is the meaning of 'the intra-zonal market clearing price'? Second, when systems need to be redispatched to accommodate congested periods, the marginal cost of meeting an increment of load is often a function of more than one generator. That is, one generator may need to be decremented while another may need to be simultaneously incremented to meet additional load.

Therefore, zonal TCCs defined over the above pricing schemes raise many questions. Staff is unable to reconcile the above and requests comments and clarification.

Combinations of Local Financial Forward Contracts

An alternative market-based proposal to hedge interlocational price risk would rely on combinations of local financial forward contracts where agents hold opposite positions in the forward market. Since a TCC is equivalent to a pair of financial forward contracts, this proposal would

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[26] Pacific Gas & Electric Company, San Diego Gas & Electric Company, and Southern California Edison Company, FERC Docket Number EC-1663-000.

merely separate a TCC into two forward instruments. The first is a long forward contract which gives the holder the right to sell future power at a given location for a pre-determined price. The second is a short forward contract which gives the holder a right to buy future power at another location for a pre-determined price. This approach, advocated by Oren et al., [27] argues that separating a TCC increases transferability among trading agents and therefore the liquidity of the instruments. Staff asks whether PG&E and SCE are considering this approach when they propose a market mechanism, other than TCCs, to hedge interlocational price risk.

However, there remain questions regarding this alternative approach. First, what would become of the ISO collected congestion revenues? Second, should the ISO not be the entity to collect congestion revenues, then what is the feasibility of having a private insurance company collect and disburse those revenues? In this case, this monopolist/monopsonist would be an additional entity that would have to be regulated. In addition, proper coordination protocols with the ISO would be required, thereby creating a cumbersome arrangement of scheduling coordinators, ISO, and congestion revenue collector and disburser. Third, if private markets do develop to hedge interlocational risk, then the Humbolt region and San Francisco Peninsula may have very thin markets in local forwards, and thus will have to pay higher risk premia than would other zones. Agents in the Humbolt region may very well be left with no means to hedge interlocational price risk between their area and COB, for example.

Financial Instruments and Long-Run Efficiency

CFDs and TCCs

Agents wishing to build new power plants will require some degree of certainty on their anticipated income stream to obtain the necessary project financing. For example, an independent power producer (IPP) who wishes to obtain financing to construct a power plant may draw a CFD with respect to his locational spot price. Should this generator draw a CFD with respect to his customer's locational spot price, he would need a TCC to hedge the locational spot price difference. Mitigating price risk would therefore ease entry, thereby increasing the long-run elasticity of electricity supply.

Bushnell and Stoft have shown that combining a CFD and TCC effectively removes all price risks associated with temporal and locational price variability, when hedging coverage match spot quantities. This hedging provides bankability for generation projects. "If trading parties own a TCC between their trading nodes (in the right direction), and if its power rating, R, is

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[27] Oren, S., Spiller, P., Varaiya, P., Wu, Felix, "Nodal Prices and Transmission Rights: A Critical Appraisal", PWP-025, December, 1994 Citing: Outhred, H., "Resolving Network Issues in Implementing A Bulk Electricity Market in the Western United States," University of New South Wales, Australia.

equal to the power they trade, q, then they are perfectly insured....In this case, the combined CFD and TCC provides the same level of bankability as the standardized bilateral contract." [28]

There have been various claims[29] and rebuttals[30] that TCCs would also provide a foundation for efficient price signals and incentives for transmission investments. The claims have subsequently been shown to hold only under some restrictive assumptions and require additional considerations.[31]

For example, the investment incentive claims depend on the mechanisms developed by which parties will ultimately receive the TCCs upon upgrading the grid. In addition, even if properly allocated[32], the TCC mechanism may not be sufficient to motivate efficient investment. That is, further information may be required on the changes in the grid modifiers', and other parties', locational prices. Since any upgrade will impact the system, coalitions of impacted parties will need to form to make efficient collective decisions. There may also be cases where parties who benefit from upgrades have no incentive to pay for it. Regulatory oversight may be required. However, should this approach, as originally envisioned by William Hogan, be complemented with oversight, it provides a promising method to deal with the complications due to the spatial nature of electricity.

Staff notes that the recent WEPEX filings raise questions regarding the efficacy of TCCs in providing efficient investment signals. Should San Diego Gas & Electric's (SDG&E's) proposal be adopted, then a solid foundation may be in place to allow the successful development of

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28 Bushnell, J., Stoft, S., "Transmission and Generation Investment In a Competitive Electric Power Industry". PWP-030, May, 1995. For the California Energy Commission, Interagency Agreement 700-93-003, page 9.

29 Garber, D., Hogan, W., and Ruff, L., "Poolco: An Independent Power Pool Company for an Efficient Power Market." The Electricity Journal, September 1994.

30 Oren, S., Spiller, P., Varaiya, P., Wu, Felix, "Nodal Prices and Transmission Rights: A Critical Appraisal", PWP-025, December, 1994

31 Bushnell, J., Stoft, S., "Transmission and Generation Investment In a Competitive Electric Power Industry". PWP-030, May, 1995. For the California Energy Commission, Interagency Agreement 700-93-003. Bushnell, J., Stoft, S., "Electric Grid Investment Under a Contract Network Regime", UCEI, PWP-034, CEC Contract # 700-93-003. Bushnell, J., Stoft, S., "Grid Investment: Can a Market Do the Job?", The Electricity Journal, January, 1996.

32 Bushnell and Stoft have explicitly specified Hogan's proper allocation rule. This rule states that the total quantity of TCCs always remain feasible. That is, if the existing set of TCCs is feasible, then any modification to the grid must be reflected by a new set of TCCs which also must be feasible. (When the set of TCCs corresponds to a feasible dispatch, the set is said to be feasible.)

They also specify additional conditions that must be met for the TCC mechanism to provide an efficient grid investment signal. The strongest is that TCCs must match the dispatch for all agents. However, 'feasibility' and 'matching', as the authors point out, are not sufficient to address all possible contingencies.

TCCs, since they would be defined over the appropriate nodes. However, should Pacific Gas & Electric's (PG&E's) and Southern California Edison's (SCE's) proposal be adopted, then TCCs, as originally designed, may be rendered meaningless as tools for investment. For example, Bushnell and Stoft have shown that TCCs must correspond to a feasible dispatch and must also match dispatch for TCC holders, to play an efficient role in grid investments. Clearly, this will not be the case if SCE's and PG&E's proposal is adopted.

Futures Contracts

The establishment of an active futures market may also assist in the bankability of generation projects. "... with a sufficiently liquid futures market, financing of projects through long term supply contracts (e.g. contracts between utilities and IPPs) can be replaced by simply selling energy futures (or forwards) and raise capital for the building of the facility." [33]

Futures markets would perform this bankability function through two mechanisms. First, futures would mitigate price uncertainty. Second, an active and broad secondary market in futures would provide a stream of expected future prices of spot electricity. This may provide a dependable forecast of future prices, because it would reflect market participants' expectations. However, the effectiveness of these two mechanisms may depend on the length of the electricity futures contracts. Perhaps, as market participants become more confortable with these instruments, NYMEX may succeed in extending futures to cover 5 or more years.

Since futures are only temporal hedging instruments referenced to one particular location, complete bankability may require the additional development of risk mitigation instruments between an investor's location and the futures' trading location. This may include either implementing a complementary market for TCCs, or combining pairs of financial local forward contracts. If either of these hedging approaches were successful, then bankability for generation projects would significantly increase.

Financial Instruments and Market Power

Market power may be exercised in both the spot market for electricity and financial markets. Because of the interaction of two market types, the competitive health of each must be considered when assessing the feasibility and benefits of a competitive electricity market.

Various researchers have argued and demonstrated the efficacy of well-functioning contract markets in mitigating spot market power abuses. [34] For example, Newbery argues that if a

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[33] Oren, S., "The Role of Financial Instruments in a Competitive Electricity Market". Paper presented at EPRI conference, San Diego, March 1996, page 7-2.

[34] Newbery, David, M. "Electricity Power Sector Restructuring: England and Wales". Presented at the 'POWER Conference on Electricity Industry Restructuring'. Berkeley, California, March 15, 1995. Green, R., and Newbery, D., M., "Competition in the British Electricity Spot Market", Journal of Political

generator sells CFDs which exactly matches its dispatch, then it has no incentive to inflate its bid price to the pool. This is because its revenue has already been established by the CFD strike price. Kahn et al. discuss two studies which demonstrate that risk-neutral duopolists who are able to contract in a forward market will have the incentive to reduce the mark-up over marginal cost in the spot market. "The forward market is thus created not for the usual reason of risk hedging, but as a strategic variable in a duopoly game. If a seller can lock in forward market commitments, he can lower price in the spot market."[35]

However, the competitive health of the contract markets in California is required before these instruments provide the necessary element for spot market efficiency and efficient generation investments.[36] Bushnell and Stoft argue that if there exist a concentration of buyer market power in the hands of large distribution companies (Discos), then CFDs and other contracts would command a premium. For example, if a Disco has generation affiliates, then it would not have the incentive to buy CFDs from an independent power producer. To the extent that marketers, other wholesale purchasers, and end-use customers can easily issue financial forwards (CFDs, etc.), this will introduce efficient market competition on the buying side of the contract markets. In this sense, all these players need direct access to the spot market. However, in the initial years, there may be a problem of buyer concentration as large Discos with their residential customers will dominate the landscape.

An agent with spot market power may employ the futures market as a mechanism to exercise his market power. For example, an owner of a significant amount of hydro resources, who has purchased futures contracts (the agent is 'long' on the market), may simultaneously withhold energy from the market and choose not to close his position financially. This would in effect force the sellers of futures (the 'shorts') to either deliver at a higher spot price or pay a premium to settle their contracts. In either case, the futures' seller is forced to pay the inflated spot price at the time of settlement. "Using storage is a way that longs can simultaneously enter the cash market and influence spot prices that shorts may face in having to deliver on their contracts to the longs."[37]

Economy, Volume 100, no. 5. Kahn Edward P., Outhred, Hugh, and Bushnell, James, "Bulk Power Market Study", October 25, 1994, University of California Energy Institute (UCEI), CEC contract #700-93-003. Borenstein, S., Bushnell, J., Kahn, E., and Stoft, S., "Market Power in California Electric Markets", November 1995, UCEI.

[35] Kahn Edward P., Outhred, Hugh, and Bushnell, James, "Bulk Power Market Study", October 25, 1994, University of California Energy Institute (UCEI), CEC contract #700-93-003, ch 2, p. 9.

[36] Borenstein, S., Bushnell, J., Kahn, E. and Stoft, S., "Market Power In California Electric Markets", University of California Energy Institute (UCEI), November 30, 1995. CEC Interagency Contract #700-93-003, pages 33-39.

[37] Kahn, E., Outhred, H., and Bushnell, J., "Bulk Power Market Study", University of California Energy Institute, October 25, 1994, ch. 4, p. 11-12. Under Contract to the California Energy Commission, Contract No. 700-93-003. Docket No. 93-ER-94.

The deliverability condition of a futures contract which requires transmission capacity may have unknown negative implications during congested periods. For example, would a futures trader who decided to close his position physically have priority on a congested transmission network? Does that imply discriminatory access to the grid? Moreover, if an agent held a futures contract and had influence over congestion in the transmission network, would this give him a mechanism to exercise market power through the demand of excess deliveries?

Design of Complementary Spot Market

There has been general agreement that efficient locational spot prices are required for a restructured electricity industry. A locational spot price would reflect marginal costs and benefits at that particular location, and additionally, reflect all network externalities imposed by generators and/or loads at that particular location. However, the disagreement centered on how these locational spot prices should be derived.

For example, NYMEX argued that its futures and options contracts' success would require a complementary spot market design that would not rely on administered uniform prices obtained from a bidding process.[38] NYMEX expressed concern that a multi-attribute bidding system that was immune to gaming could not be designed. Futures contracts require that spot market prices not be open to manipulation by spot energy market participants. Speculators would not willingly participate in such a market.

Therefore, Staff attempted to address and assess NYMEX's and marketers' concerns by reviewing an alternative spot market making model which may be more favorable for the successful implementation of a futures contract. This alternative spot market design is the CMT spot market model, developed by Felix Wu and Pravin Varaiya[39]. Its distinguishing feature is that it relies only on the disclosure of generator/load quantity nomination information to the ISO.

Since the CMT regime would not require parties to reveal their reservation prices, it would rely on the following iterative process: (1) contracted parties would first submit schedules to the ISO for dispatch; and (2) should the totality, or some subset, of the first submittal not be feasible, the parties, using ISO provided information on all parties' contribution to system congestion and losses, would enter into multilateral trading arrangements and resubmit revised schedules until feasibility was achieved. It is in this iterative process that arbitragers, marketers and brokers, would assist in the convergence to a feasible set of schedules. In addition, it is argued that in the process of searching for a feasible solution, parties will seek the best deals. In doing so, the outcome will be that marginal costs will equate across all locations adjusted for congestion and losses.

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38 NYMEX Response to 1994 CPUC OIR & OII on Restructuring California's Electricity Services Industry and Reforming Regulation.

39 Wu, Felix, and Varaiya, Pravin, "Coordinated Multilateral Trades for Electric Power Networks: Theory and Implementation. POWER Working Paper 031 (PWP-031), June 1995.

This process, it is argued, would easily converge to feasibility and optimality. The multilateral trading process would determine short-term prices, not the power exchange. As stated earlier, NYMEX would clearly prefer this approach, which does not rely on a spot price formation process that involves multi-attribute bidding and computer simulations, to generate a unique spot price.

Also, since the convergence process relies on arbitraging price spreads and increases price risk, marketers and brokers would benefit. Staff believes that this may be a another significant element in explaining NYMEX, ENRON and other marketer's aversion to the price formation process of a pool-based spot market.

Wu, Varaiya, and Outhred argue that financial forward contract markets would develop at each location and consequently, when used in combinations, could hedge interlocational price uncertainty. They argue that this would be preferable to having TCCs, which they claim are redundant instruments each comprising a long and short forward contract. Within this framework and assuming the convergence process is efficient, they argue that spot price transparency could be obtained by an active futures market in one or two locations in the WSCC region, combined with other financial forward contracts at the remaining locations. However, as discussed above, such financial markets may not develop for constrained small local sub-markets such as the San Francisco Peninsula and Humbolt region.

The CMT's model's reliance on convergence to feasibility and optimality raises many questions and concerns. Is this a feasible approach, considering this process is to be repeated hourly and daily with intermediaries, such as brokers and marketers, participating in the buy-sell process? Staff notes that the CMT supporters admit that the convergence approach is a topic that needs further research[40].

In addition, the CMT paradigm does not propose an explicit mechanism to efficiently price and allocate congested transmission capacity. While individual traders may have the necessary network information to develop non-discriminatory rules to price and allocate a congested tranmission system, no such rules have been specified by the authors. Because of this remaining unresolved issue, sole reliance on the CMT model would imply an arbitrary allocation and access to a congested network. Staff has recently received "A Market Mechanism for Electric Power Transmission", by Hung-Po Chao and Stephen Peck, to be published in the Journal of Regulatory Economics, July, 1996. The paper proposes a trading mechanism which will optimally price and allocate a congested transmission network. However, Staff is not prepared to comment on its findings.

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[40] POWER conference, March 15, 1996.

As discussed in the introduction, Staff believes that the recent CPUC order [41] and WEPEX filings[42] have incorporated
elements from the both the CMT and pool-based spot market designs in fashioning the two scheduling markets (day-ahead and hour-ahead) that will be effective for the next five years.

FOUNDATION FOR LOCATIONAL SPOT PRICING

One of the objectives of restructuring California's electricity industry is to provide energy at least cost, while accommodating the constraints of the grid. This section provides the simplest construct to illustrate the constrained least cost dispatch problem. The solutions include spot prices which differ by location (locational spot pricing). Locational pricing creates the need for interlocational hedging.

The 3-node examples (each with two generating nodes, A and B, and one demand node, C) in this paper rely on a simple linear program construct, shown below, to illustrate the results of the constrained least-cost dispatch problem. Staff makes the simplest economic and physical assumptions without loss of generality.

Objective: Choose G_A and G_B to minimize TGSC = $MC_A * G_A + MC_B * G_B$.

Where: G_A and G_B are generation amounts,
TGSC = Total Generation System Cost,
MC_A and MC_B are the constant marginal costs of G_A and G_B.

Subject to:

(1) $G_A + G_B$ = Price Inelastic Demand.
(Supply equals demand condition)

(2) Flow on line A-C = $2/3 * G_A + 1/3 G_B$
Flow on line A-B = $1/3 * G_A - 1/3 G_B$
Flow on line B-C = $1/3 * G_A + 2/3 G_B$
(Relationship among flows and injections obeys Kirchoff's Law)

(3) Flows on line A-C, A-B, and B-C cannot exceed a specified amount.
(Capacity constraint of lines A-C, A-B, and B-C)

The solution of this exercise provides: (1) the constrained least-cost dispatch, G_A^* and G_B^*; (2) optimal locational prices; (3) minimum total generation system cost; (4) optimal congestion prices; (5) minimum system congestion cost; and (6) optimal allocation of system congestion costs to transacting parties.

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41 CPUC Decision 95-12-063 (December 20, 1995), as modified in Decision 96-01-009 (January 10, 1996)

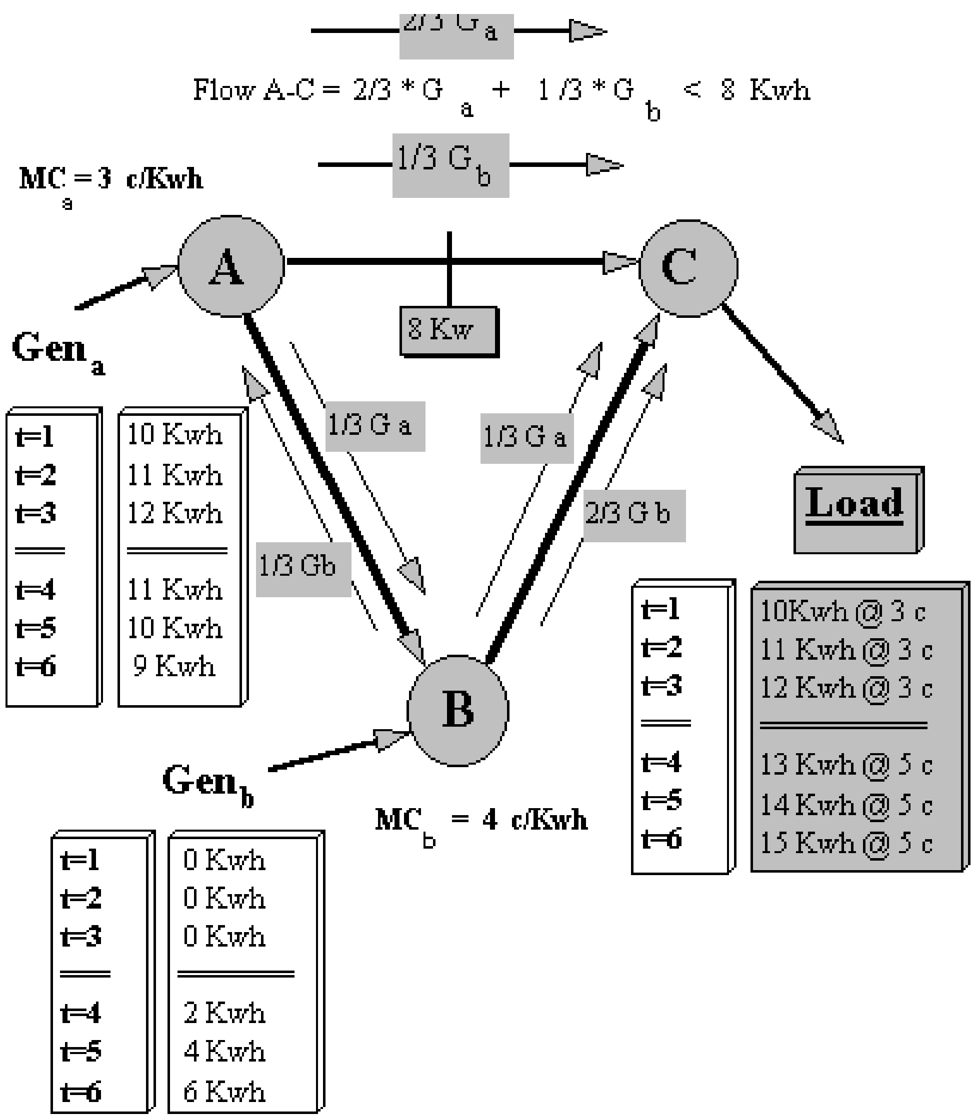
42 Pacific Gas & Electric Company, San Diego Gas & Electric Company, and Southern California Edison Company, FERC Docket Number EC-1663-000.

LOCATIONAL SPOT PRICING/NEED TO HEDGE BETWEEN LOCATIONS - TWO EXAMPLES

This section develops two examples which demonstrate that implementation of locational spot market pricing, to reflect network congestion, will lead to price variability between locations. Risk averse industry participants will, therefore, require interlocational price hedging instruments, in addition to instruments to hedge their own local prices (temporal hedging).

Figure 1 illustrates the case of interlocational price variability arising from changes in demand for a three zone system. For simplicity, the following assumptions are made: (1) This is a DC flow system; (2) there are no losses; (3) and each line has equal admittance. Line A-C has a capacity limit of 8 Kw.

Figure 1



It is also assumed that there are two generators, one at location A and one at location B. The load center is at locatio n C. Each generator has one capacity block (constant marginal cost). The generator at location A can generate at a marginal cost of 3 ¢/Kwh and the generator at location B generates at a marginal cost of 4 ¢/Kwh. The figure illustrates the change in marginal cost at the load center as demand increases from 10 Kwh, at t = 1 (time period 1), to 15 Kwh, at t = 6 (time period 6). Note the corresponding generation amounts to meet load at the respective time periods. For example, at t = 6, generator A injects 9 Kwh and generator B injects 6 Kwh.

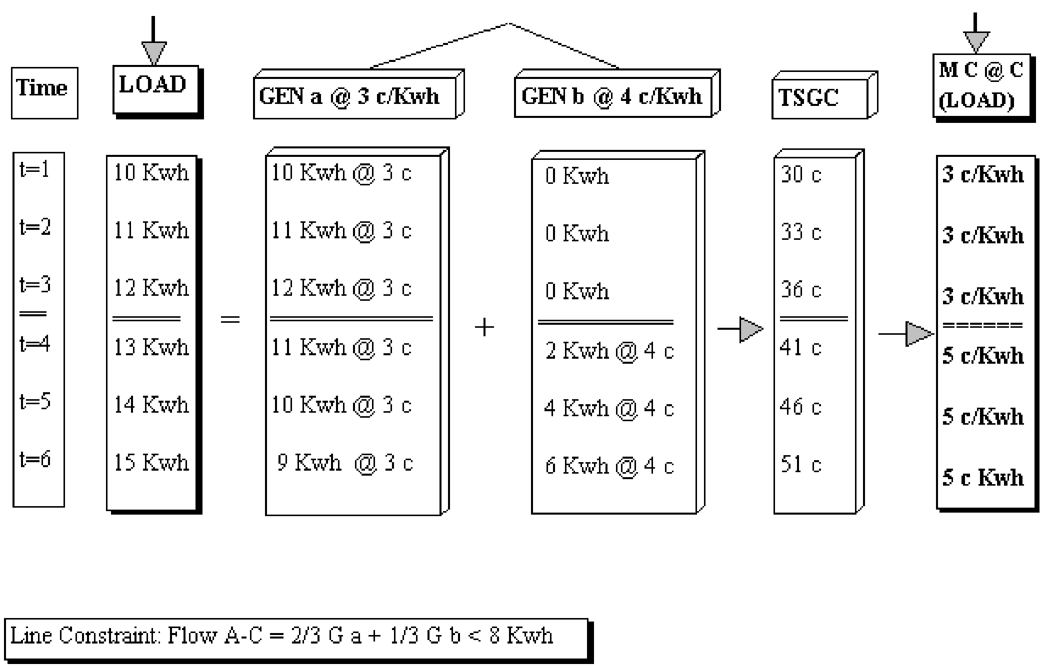
Given the above assumptions, an easy relationship between injections and flows can be established. Kirchhoff's law states that there is an inverse relationship between the power flows resulting from a given injection and the distance that the power must travel. So for every Kw of power injected at each location, 2/3 travels along the shorter path, while 1/3 takes the longer path. For example, of the 1 Kw injected at location A, 2/3 Kw would travel along line A-C and 1/3 Kw would travel along the lines A-B and B-C.

Because of the principle of superposition, simultaneous injections at location A and B would produce resulting flows that can be simply added up on each respective line. For example, 9 Kw injected at A would result in a flow of 6 Kw on line A-C, and 6 Kw injected at B would produce a flow of 2 Kw on line A-C. The total flow on line A-C, therefore, would be 8 Kw.

Referring to **Figures 1 and 2**, one can see that as demand in zone C increases from 10 Kwh to 11 Kwh to 12 Kwh, it can feasibly draw each additional increment of power entirely from the cheaper generator A (3¢ power), and therefore incurs a marginal cost of 3¢ for each increment.

Figure 2

However, as demand increases from 12 to 13 Kwh, generator A (3¢ power) must be decremented by 1Kwh, while the more expensive generator B (4¢ power) is incremented by 2 Kwh. This



is because generator A cannot feasibly inject any more power into the system, since this would violate the constraint on line A-C, and must be decremented by 1 Kw to allow generator B to meet the additional demand. As a result, the 13th unit power of demand has a marginal cost of 5¢.[43]

The demand node faces price variability because of the capacity constraint on line A-C. The demand price is equal to the marginal cost of meeting the last increment of demand.[44] Suppose generator A offers a contract for differences (3 c/Kwh for 9 Kwh) to a consumer at location C. If the marginal cost at C increases to 5 c/Kwh, then the generator must pay the consumer 2 c/Kw to meet the contract terms. The consumer is thereby provided with a perfect price hedge. However, generator A assumes the risk of interlocational price fluctuations and will require an additional hedging instrument to protect him against uncertain congestion costs.

Figure 3 illustrates the case when there is price variability at both the supply and demand location. For example, a generator at location A may face price volatility and uncertainty at location A and a load at location C may face price volatility and uncertainty at location C.

Suppose that location A has many generators, including generator X. Suppose that generator X initially draws up a fixed price contract with a consumer at location C. Furthermore, suppose that the generator agrees to reference the contract price to the consumer's spot price. That is, the generator will guarantee a contract price of 3¢/Kwh (the generator's marginal cost) and agrees to pay the consumer the difference if the consumer's spot price goes above the contract price.

Suppose that a least cost dispatch subsequently results in a market clearing price of 2¢/Kwh at location A and a marginal cost of 6¢/Kwh at the consumer's location. The contract then obligates the generator to pay the consumer 3¢/Kwh. The consumer, therefore, pays only his contract amount, 3¢/Kwh. The contractual arrangement has, in effect, provided a perfect hedge to the consumer.

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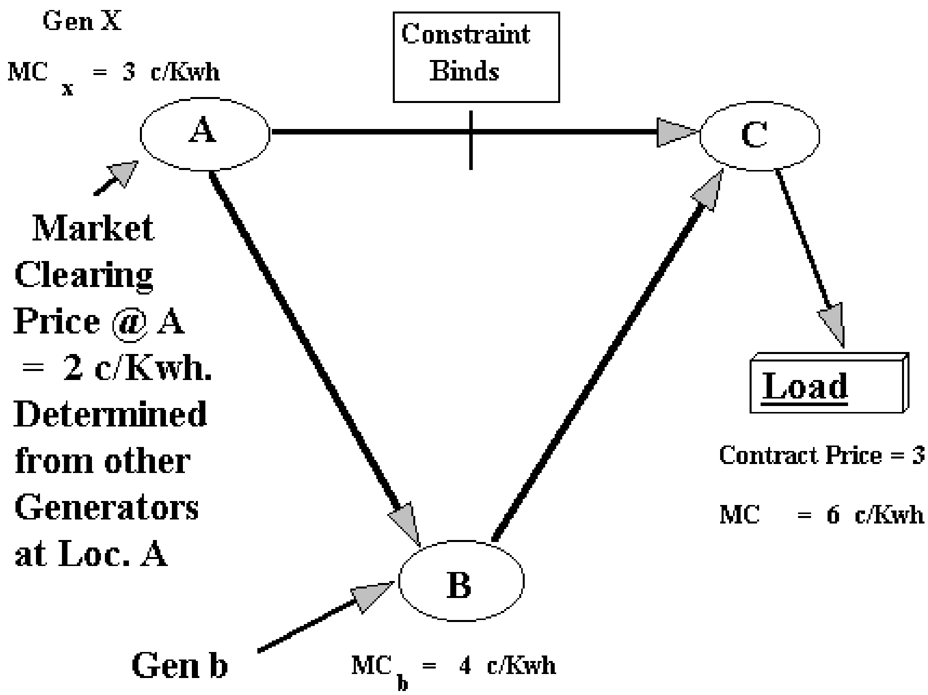
43 Besides demonstrating how locational prices are determined, this simple example also illustrates the network externality effects of loop flow. As load continues to increase, it can only be met by simultaneously incrementing generator B and decrementing generator A. It is apparent that, in this case, controlling loop flow would not be an optimal solution. Load is already being supplied feasibly at least cost.

44 It is important to note that the marginal cost of incremental load relies on cost information from both generator A and B. That is, to meet the last increment of load requires simultaneously incrementing generator B and decrementing generator A. To simply cost the last increment of load at the marginal cost of the last generator incremented (generator B @ MC = 4 c/Kwh) would clearly lead to under-pricing.

Figure 3



However, this arrangement has left the generator with a loss. Since the market clearing price at location A is only 2¢/Kwh, the generator will not run and instead fulfill its obligation by buying at his locational spot price. This leaves the generator with a net loss of 2¢/Kwh (i.e., generator X's revenue is 3¢/Kwh, whereas its cost is 2¢/Kwh plus the 3¢/Kwh it reimburses the consumer).

This example demonstrates that the generator will incur a price (profit) risk if it draws its contract with respect to the consumer's location spot price. Similarly, if the contract was referenced to the generator's spot price, then the consumer would incur the price risk. The question then becomes what mechanism is available so that both agents can hedge their price risk simultaneously?

The lesson that can be drawn from these two examples is as follows: A temporal hedging instrument, such as a CFD or a futures, is referenced to a particular spot market location. As such, a market participant who is not at that location will face an additional price risk. For example, a buyer who has a COB or Palo Verde futures, but depends on power that is distant from either COB or Palo Verde, must hedge the uncertainty between the locational spot price prevailing at either COB or Palo Verde and the local marginal cost of power he purchases (what he has to pay). A power producer who has a futures contract, but whose marginal cost does not predictably correlate with that of the spot price at a futures location, will also need an additional price hedge. This interlocational price risk must, therefore, be addressed.

DEFINITION OF FINANCIAL INSTRUMENTS

Contract for Difference

A contract for differences (CFD) is a temporal price hedging financial contract drawn by two parties, say a generator and consumer. The contract is for a specified quantity of contracted power and can be referenced on the spot price at either the generator's or consumer's location. The holder of the contract has agreed to either pay or receive the difference between the specified contract price and the locational spot price that results at the time of the transaction.

A CFD is defined as follows:

$$CFD = Q_C * (P_C - P_S)$$

Where:
- Q_C = Contracted amount of power.
- P_C = Contract price
- P_S = Spot price prevailing at time of actual dispatch. This spot price can either be the consumer's or the generator's local spot price. So, if the CFD is referenced to the consumer's spot price, it means that the consumer's local spot price is used to execute the contract. Similarly, if the CFD is referenced to the generator's spot price, then the generator's local spot price is used to execute the contract.

If the contract (CFD) price is referenced to the consumer's spot price, and if at the time of the transaction the consumer's spot price is above the contract (CFD) price, the generator will pay the consumer the difference. If the spot price at the consumer's location is below the contract price, then the consumer will pay the generator the difference in prices. The result is that the consumer has a guarantee that he will only pay the contract or strike price, no matter what the spot price is. However, this arrangement lays the price risk entirely on the generator.

If the contract (CFD) price is referenced on the generator's locational spot price, then the generator is guaranteed a revenue equal to the contract price, and the consumer bears the price risk between the two locations.

Figure 1 shows that there is price variability at the consumer's location. If generator A draws up a CFD with consumer C that references location C's spot price, then the consumer is perfectly hedged. The generator, on the other hand, bears a price risk that requires an additional hedging instrument. If the CFD references location A, then the consumer has no hedge.

One benefit of relying on a spot market for residual energy is that payment for under-generation and over-consumption is settled at the spot price. This is in contrast to relying on penalty payments required by performance contracts.

Transmission Congestion Contract[45]

A transmission congestion contract (TCC), developed by William Hogan, is an interlocational price hedging contract. A TCC is held by one party and pays the contract holder, for every unit of power specified in the contract, the price difference between a given pair of locations. The counter-party to a TCC is the independent system operator (ISO). "The possibility of congestion, whether on the entire network or between any single pair of nodes, produces uncertain income streams. This imposes risks both on the payers of the congestion costs and the collectors of congestion payments. In a nodal spot market there is a natural counter balance of risk between the market operator (ISO) and individuals holding CFDs."[46]

A TCC is defined as follows:

$$TCC = Q * (P_K - P_L)$$, for locations K and L.

Where: Q = Contracted amount of power.
P_K = Spot price prevailing at location K at time of actual dispatch
P_L = Spot price prevailing at location L at time of actual dispatch.

The ISO collects revenues from all PX consumers priced at their respective locational spot prices and pays all PX generators amounts priced at their respective locational spot prices. The ISO also collects congestion payments from non-PX parties based on local marginal cost differences. When the system is congested, the ISO will have a surplus, known as 'the merchandising surplus'. The ISO subsequently disburses this surplus to all TCC holders. Hogan has shown that for any feasible set of existing TCCs[47], the ISO will have enough surplus to meet its obligations to TCC holders.

When a CFD is drawn with respect to the generator's locational spot price, then the consumer has the incentive to purchase a TCC. When a CFD is drawn with respect to the consumer's locational spot price, then the generator would have the incentive to purchase a TCC. Note that for a consumer and generator to both hedge this additional interlocational price risk, a third party must enter and buy this risk. In the case of Hogan's TCC, the third party is the ISO.

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45 Staff realizes that the transmission-owning-utilities are to hold TCCs on behalf of their customers. Short-run congestion payments will contribute to unamortized transmission capacity, thereby reducing access fees accordingly. However, to simplify Staff's illustration of the mechanics of TCCs, it is assumed that CFDs are referenced to the consumers' local spot price and <u>TCCs are held by generators</u>.

Furthermore, the mechanics assume that no distinction is made between inter-zonal and intra-zonal pricing; and that consumer payments are based on local marginal cost pricing, not on the marginal cost of the last generator incremented or decremented.

46 Bushnell, J., Stoft, S., "Transmission and Generation Investment In a Competitive Electric Power Industry". PWP-030, May, 1995. For the California Energy Commission, Interagency Agreement 700-93-003, page 11.

47 When the existing set of TCCs corresponds to a feasible dispatch, the set is said to be feasible.

We can use **Figure 1** to illustrate how interlocational price variability can be perfectly hedged using CFDs and TCCs. Furthermore, this example can also provide a framework for illustrating the mechanism by which the ISO collects revenues from consumers, pays generators, and disburses excess congestion revenues to TCC holders.

Assume that generator A contracts for 9 Kwh at 3 c/Kwh with a consumer at location C. Futhermore, this transacting party A-C draws up a CFD with respect to the consumer's local spot price. Therefore, whatever the spot price at location C, the consumer is perfectly hedged.

For example, suppose that at the time of dispatch, generator A injects 9 Kwh and receives 3 c/Kwh from the spot market, generator B injects 6 Kwh and receives 4 c/Kwh, and all consumers at C take 15 Kwh and pays 5 c/Kwh to the spot market. The CFD drawn up by A-C would obligate generator A to pay his consumer at C, 2 c/Kwh. The net effect is that the consumer ends up paying only 3 c/Kwh for 9 Kwh. However, note that the generator assumed the price risk.

Suppose generator owned a TCC that paid him the difference in spot prices between locations A and C (2 c/Kwh) for his injected power, then he too would have a perfect hedge. The generator's risk would then be transferred to the ISO. Therefore, the combination of a CFD, referenced to the consumer's spot price, and a TCC in the hands of the generator provide perfect hedging to both parties.

The remaining issue is whether the ISO has adequate revenues to pay all TCC holders. Looking at **Figure 1** again, and assuming that total load is 15 Kwh. Also assume that generator A has a TCC defined over locations A and C for 9 Kwh, and generator B has a TCC defined over locations B and C for 6 Kwh. Generators A and B have also drawn CFDs that referenced location C with their consumers.

At the time of dispatch, the ISO collects 75 cents (15 Kwh * 5 c/Kwh) from all consumers. The ISO also pays generator A, 27 cents (9 Kwh * 3 c/Kwh), and generator B 24 cents (6 Kwh * 4 c/Kwh), for a total of 51 cents. The merchandising surplus (i.e., receipts minus payments) is, therefore, 24 cents.

The ISO subsequently pays generator A, 18 cents (the value A's TCC) and generator B, 6 cents (the value of B's TCC). Note that this 24 cents is exactly equal to the merchandising surplus. In fact, Hogan has proved that the ISO would always have adequate revenues (the issue of revenue adequacy), if the existing set of TCCs corresponded to a feasible dispatch. This simple example assumes that the set of TCCs reflects a feasible dispatch.

It is important to point out that the ISO should not be in position to dispatch the network with the objective to maximize the merchandising surplus. Wu et al. have argued that the ISO could increase the merchandising surplus by resorting to inefficient dispatching. All parties agree on this point, and as such, point to the need to separate the magnitude of the merchandizing surplus from the ISO's profit calculations.

Futures Contracts[48]

A futures is a standardized contract to deliver or receive a certain quantity of a commodity at some stated time in the future. Price, quantity, grade, location and time of future delivery are all stated in the contract. Note, however, that the only point of negotiation is the price. All other terms and conditions are pre-specified, thereby making it a standardized contract. A futures contract is therefore not specifically drawn to tailor the needs of any particular set of traders. This in effect maximizes transferability and hence liquidity. That is, other parties, including speculators, can purchase and resell the contract in the secondary market.

Under such conditions, the price that results in the secondary market can be the proper price in the sense that it represents the results of the decision of many market participants. "The objective in designing a futures contract is to define all the terms associated with transacting business for a particular commodity so that the only remaining point of negotiation is price. This objective facilitates one of the important economic functions of futures markets which is price discovery."[49]

Futures contracts relate to a specific month, several of which are traded at any one time. When the actual month of delivery arrives, all outstanding contracts must be settled by delivery of the commodity or by an offsetting contract.

The main justification of the futures contract is that it permits specialization between two elements of the economic process -- the function of holding commodities (or other assets) and the function of bearing the risk of price changes. Futures serve to redistribute uncertainty over the population, from hedgers who wish to minimize price risk to speculators who wish to assume it.

Hedging is the taking of equal and opposite positions in the spot and futures markets, with the hope that this will prevent a loss due to price fluctuations. A hedger attempts to have neither a net asset or long position (in which more of something is owned than owed) nor a net liability or short position (in which more of something is owed than owned). A successful hedger's net worth, is therefore, unaffected by price changes.

The seller of a contract on a commodity exchange does not normally intend to deliver the actual commodity nor does the buyer intend to accept delivery; each will, at some time prior to the date of delivery specified in the contract, cancel out his or her obligation by an offsetting purchase or sale. In fact, historically, less than one to two percent of futures contracts have been fulfilled by actual delivery, whereas ninety-eight to ninety-nine percent have been cancelled by offsetting transactions before the delivery month.

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48 The appendix presents a more detailed discussion of NYMEX's futures and options contracts.

49 Kahn, Edward, "Electricity Futures: Feasibility Issues and Their Relation to Wholesale Power Markets", June 23, 1994, page 2.

The futures and cash markets tend to parallel one another and to converge as the delivery month approaches. The parallel movement occurs because factors that effect either a rise of fall in cash prices usually affect futures prices in much the same manner. Futures prices cannot be under or over priced relative to the cash price, at least not for very long. Arbitragers looking for profits, buy low and sell high in the cash and futures market. A strong parallel relationship makes hedging possible and advantageous; because both markets move together, the losses incurred in one are offset by profits made in the other.

Since price correlation between the futures and cash markets permits hedging, the weaker the correlation, the weaker is the hedging instrument.

The relationship between cash and futures prices is such that at any point in time the futures price and spot price should only differ due to the cost-of-carry. The cost-of-carry of a futures contract comprises interest, insurance, and commission (cost-of-carry also include storage costs for a commodity such as wheat) that are incurred from holding the contract until settlement. The convergence of the two markets as the delivery draws near occurs because carrying charges converge.

Options Contracts

Options contracts are also tradeable instruments which grants the holder the right, but not the obligation, to either buy or sell an underlying security, such as a NYMEX futures contract, or commodity at an agreed upon price at some future point in time. The agreed upon price is known as the strike price and is established at the time of purchase. The future point in time at which the option may be exercised is known as the expiration date. The buyer of the option pays a fee or premium to the seller. A call option gives the holder the right to purchase the underlying property at some future date, and a put option gives the holder the right to sell the property at some future date.

Those who hold call options and sell put options expect the price of the underlying futures contract to rise. Those who hold put options and sell call options expect the price of the underlying futures contract to fall.

Options can be held in isolation. They can also be held in combination with other options and/or underlying property. NYMEX's options contracts are options to buy or sell futures contracts. Speculators and hedgers both participate in the options market. Since options contracts are tradeable, the holder has the flexibility to sell the contract in a secondary market.

ROLE OF FINANCIAL INSTRUMENTS

Price Uncertainty Hedge - Alternative Proposals

The implementation of locational spot markets for electricity will lead to temporal and interlocational price variability. Risk averse industry participants will therefore require price hedging services. Consumers may prefer a fixed stream of payments to fluctuating prices, and producers may prefer a fixed stream of revenues instead of relying on the random spot market. A perfect hedge decreases the information cost faced by producers and consumers that would otherwise exist with variable market conditions.

As spot markets mature, financial hedging instruments will develop to complement or may even replace long-term fixed-price and quantity contracts. In fact, deep spot markets combined with complementary financial hedging instruments may be viewed as a substitute to today's standard bilateral contracts, or physical forward contracts, that specify both financial and physical performance. "A forward contract may be implemented as a combination of physical delivery at the spot price and a purely financial Contract For Difference (CFD) which entitles or obligates the holder (the power purchaser) to receive or pay the difference between the spot price and strike price. The combination has the effect of purchasing the power at the strike price."[50]

Assuming first that all locational prices are equal, then there would exist only temporal price uncertainty. In this case, a CFD or other long financial forward contract would provide a successful hedge. Futures contracts would provide a hedge only at specified locations, COB and Palo Verde. However, besides temporal spot price uncertainty, unpredictable levels of transmission congestion and losses produce uncertain spot price differences between any two given locations. Therefore, generators, distribution companies, marketers, consumers and other participants will require financial instruments that provide both temporal and interlocational spot price hedging functions.

There are different proposals to hedge temporal and interlocational spot price uncertainty. Complete hedging may be accomplished either by combining a CFD with a TCC [51], or by simply combining pairs of financial local forward contracts [52].

Contract for Differences (CFDs) and Transmission Capacity Contracts (TCCs)

An independent power producer (IPP) who wishes to secure a constant revenue stream may draw a CFD with respect to his local spot price. Should this generator draw a CFD with respect to his customer's locational spot price, he would need a TCC to hedge the locational

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[50] Oren, S., "The Role of Financial Instruments in a Competitive Electricity Market". Paper presented at EPRI conference, San Diego, March 1996, page 7-3.

[51] Hogan, W., ibid. Bushnell, J., Stoft, S., "Transmission and Generation Investment In a Competitive Electric Power Industry". PWP-030, May, 1995. For the California Energy Commission, Interagency Agreement 700-93-003, pages 3-12.

[52] Oren, S., Spiller, P., Varaiya, P., Wu, Felix, "Nodal Prices and Transmission Rights: A critical Appraisal", PWP-025, December, 1994 Citing: Outhred, H., "Resolving Network Issues in Implementing A Bulk Electricity Market in the Western United States," University of New South Wales, Australia.

spot price difference. An industrial consumer who wishes to establish a constant payment structure could draw a CFD with respect to his local spot price. If this consumer draws a CFD with respect to the IPP's local spot price, then he would need a TCC to hedge the additional price risk.

Bushnell and Stoft have shown that combining a CFD and TCC effectively removes all price risks associated with temporal and locational price variability, when hedging coverage match spot quantities. The following example, where the contracted amount equals the dispatched and consumed spot amounts, illustrates the mechanism whereby a generator and consumer can hedge against uncertain spot prices: A generator at location A wishing to sell power to a large industrial consumer at location B will face an uncertain spot price at his location as well as the consumer's location. If the generator draws a CFD with the consumer with respect to the consumer's locational spot price, then the generator will face a risk associated with respect to the locational price differences. In this case, the generator would have an incentive to purchase a TCC which would allow him to hedge against any future congestion cost. The TCC would, in effect, transfer the remaining risk to the ISO.

Should the CFD be drawn with respect to the generator's locational spot price, then the consumer would have the incentive to purchase the TCC. "In summary, the problem of how to mitigate the risk of congestion charges most economically, deserves considerably more attention, but the matching of collection rights with network usage appears to satisfactorily address the bankability problem."[53]

A third option would be for the generator and consumer to draw a CFD with respect to some weighted average of their spot market prices. In this case, both agents would have the incentive to purchase a share of a TCC, and thereby obtain perfect insurance against price uncertainty.

Considering recent developments in the restructuring process, the implication for the successful implementation of a CFD/TCC regime is unknown. Efficient pricing of locational spot energy forms the foundation for the definition, and hence effectiveness of Hogan's TCCs. The CPUC Order pays all generators the market clearing prices at their respective location. However, consumer payments are averaged according to as-yet unspecified zonal criteria. First, Staff is not aware of efforts to analyze the consequences of this averaging approach to the ISO's revenue adequacy. That is, it is unknown whether the ISO will have enough merchandising surplus to fulfill all of its contractual obligations to holders of TCCs. Second, Staff questions the claim that TCCs will efficiently define, allocate and price congestion if locational spot prices are averaged for any agent in the system.

The recent WEPEX filings, as proposed by SCE and PG&E, raise additional doubts concerning the efficacy of TCCs. The proposal significantly departs from efficiently pricing

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[53] Bushnell, J., Stoft, S., "Transmission and Generation Investment In a Competitive Electric Power Industry". PWP-030, May, 1995. For the California Energy Commission, Interagency Agreement 700-93-003, page 12.

locational spot energy and defines TCCs over this inefficient pricing scheme. For example, generators are paid the market clearing prices in their respective zones during uncongested intra-zonal periods. For intra-zonal congested periods, the constrained-on generators are paid their bid prices. The language also implies that the marginal cost of meeting an increment of load is the marginal cost of the last generator dispatched. This is clearly an inefficient pricing scheme (See **figures 1, 2 and 3**). Furthermore, during these congested periods, zonal customers pay the uncongested market clearing price plus an uplift, which is the average of all constrained-on generator bids. TCCs defined under this pricing scheme clearly will not represent efficiently priced congestion property rights. Therefore, the development of an efficient tradeable hedging instrument is highly doubtful.

Combinations of Local Financial Forward Contracts

Alternatively, a pair of locational forward contracts could perform the same function as the combined CFD/TCC approach. When an agent buys a long forward, the agent agrees to buy a certain amount of power at some future date at a price negotiated today. The party is betting that the spot price will be higher than the contract strike price. If an electricity consumer enters a long forward, he is in fact locking in the price for a future purchase.

When an agent buys a short forward, the agent agrees to sell a specified quantity at some future date at a price negotiated today. The party is betting that the spot price at the future date will be lower than the contract's strike price. If a generator enters into a short forward, he in fact is locking the price for future delivery.

Therefore, by entering into a pair of long and short forward contracts each with respect to their different locations, a consumer and generator can obtain the same level of hedging as obtained by using the CFD/TCC approach.

Oren et al. argue that a TCC is, in fact, a redundant instrument since it is equivalent to a combined long and short local forward contract (plus a fixed annuity). That is, a TCC represents the right to inject at one node and the right to take-out at another node at fixed prices. They argue, furthermore, that since there will be fewer locational forward contracts required than TCCs to hedge interlocational price uncertainty, standardization will be more likely and consequently liquidity will be increased.[54]

Increased standardization would, Oren et al. argue, increase the likelihood that secondary markets would develop thereby inviting the participation of speculators. Speculators are necessary to remove price uncertainty from the hedging parties. In doing so, risk would be re-allocated from risk averse participants (hedgers) to risk taking participants (speculators). This transfer of risk would thereby reduce risk and the price of risk to market participants.

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[54] Oren, S., Spiller, P., Varaiya, P., Wu, Felix, "Nodal Prices and Transmission Rights: A critical Appraisal", PWP-025, December, 1994

The following example shows how speculators in markets for long and short forwards may mitigate spot price volatility: A speculator at location A buys a long forward and thereby agrees to buy one MW next year at today's negotiated price. He is betting that next year's spot price will be higher than the contract's strike price. When the contract matures, he buys low (contract price) and sells high (the spot price). At the same time, a speculator at location B buys a short forward and thereby commits to sell one MW next year at today's negotiated price. He is betting that next year's spot price will be lower than the contract's strike price. When the contract matures, he buys low (spot price) and sells high (contract price). The effect of these transactions is to reduce spot price fluctuations and hence spot price risk faced by electricity market participants.

However, it is questionable whether all the individual local financial markets would have the necessary liquidity to mitigate risks for all parties at reasonable costs. Liquidity could be obtained if the counter-party to an interlocational hedging agent were an insurance company. This company would have the ability to pool all system interlocational risks. However, staff questions whether a private company would have the incentive to pool all network price risks in order to provide affordable or even efficient interlocational insurance pricing to all participants in the grid. Therefore, this alternative interlocational financial hedging proposal may not successfully provide access to a congested transmission system at comparable prices. Furthermore, since the ISO will collect congestion rents (December 1995 CPUC Order, and WEPEX Filings), policy makers will then need to address the issue of allocating the already collected funds. A possible remedy would have the ISO be the counter-party to these individual forward contractual arrangements.

A third option would rely on, say, a generator buying a put option from the ISO and a consumer simultaneously buying a call option from the ISO. So if transmission is constrained between the two agents, then the generator would exercise his option with the ISO and the consumer would exercise his option with the ISO. In this case, even though the generator may not generate, it would receive revenue determined by the strike price of the put option, and the consumer would receive electricity from the grid at a price determined by the strike price of his call option. Note that the call and put options approach may not work without the ISO as the counter-party. For example, a constrained generator may not be able to find a counter private party at his location willing to assume the risk.

The last option would have the ISO be the counter-party to all CFDs. That is, if all generators sold CFDs with respect to their locational prices to the ISO, then each generator would hedge both temporal and interlocational risk. Similarly, if all consumers entered into a CFD with respect to their locations with the ISO, consumers would also hedge both temporal and interlocational risk.

Staff notes that dividing TCCs into its component parts, with the subsequent need to ensure that all parties pay fair market interlocational risk premia, may require the ISO to be the counter-party to both temporal and interlocational hedging activity. This may entirely remove private markets from providing price risk mitigation services, which will not be politically acceptable. Therefore, liquidity requirements for both temporal and interlocational hedging may require private markets to address temporal risk mitigation needs, and the ISO, through the

TCC mechanism, to address interlocational risk mitigation needs. In fact, Hogan's approach accomplishes this balance.

At issue will be the sufficient availability of these hedging instruments to all parties on a non-discriminatory basis. Barriers should not exist for agents who wish to participate in the markets for financial instruments. Moreover, these instruments should be made available to all traders at prices which efficiently reflect the amount of risk that is mitigated. In this sense, these financial markets should involve as many participants as possible to provide the necessary liquidity to efficiently manage risk. Staff's main concern is with the availability of these instruments at efficient or even affordable risk mitigation costs to those who operate or consume in liquid areas.

The total quantity of TCCs, as proposed by Hogan, reflects a feasible dispatch. So, all active parties could conceivably be covered. However, staff is not aware of analyses on the establishment of TCC secondary markets. Since they are designed for two specific nodes and specify contracted amounts of power, transferability will be limited to those agents who trade between those two nodes. Also, Staff is not aware of a mechanism to standardize these instruments to maximize transferability across the entire grid. However, it is apparent that since the ISO is the counter-party, standardization is not required for least cost risk mitigation for an existing set of TCC holders. On the other hand, standardization may be needed to maximize participation of future non-grid modifying participants who want to hedge interlocational price risk.

Financial Instruments Provide Bankability for Generation Investments

Agents wishing to build new power plants will require some degree of certainty on their anticipated income stream to obtain the necessary project financing. For example, an independent power producer (IPP) who wishes to obtain financing to construct a power plant may draw a CFD with respect to his locational spot price. Should this generator draw a CFD with respect to his customer's locational spot price, he would need a TCC to hedge the locational spot price difference.

Bushnell and Stoft have shown that combining a CFD and TCC effectively removes all price risks associated with temporal and locational price variability, when hedging coverage match spot quantities. This hedging provides bankability for generation projects. "If trading parties own a TCC between their trading nodes (in the right direction), and if its power rating, R, is equal to the power they trade, q, then they are perfectly insured....In this case, the combined CFD and TCC provides the same level of bankability as the standardized bilateral contract." [55]

The establishment of an active futures market may also assist in the bankability of generation projects. "... with a sufficiently liquid futures market, financing of projects through long term

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[55] Bushnell, J., Stoft, S., "Transmission and Generation Investment In a Competitive Electric Power Industry". PWP-030, May, 1995. For the California Energy Commission, Interagency Agreement 700-93-003, page 9.

supply contracts (e.g. contracts between utilities and IPPs) can be replaced by simply selling energy futures (or forwards) and raise capital for the building of the facility." [56]

Futures markets would perform this bankability function through two mechanisms. First, futures would mitigate price uncertainty. Second, an active and broad secondary market in futures would provide a stream of expected future prices of spot electricity. This may provide a dependable forecast of future prices, because it would reflect market participants' expectations. However, the effectiveness of these two mechanisms may depend on the length of the electricity futures contracts. Perhaps, as market participants become more comfortable with these instruments, NYMEX may succeed in extending futures to cover 5 or more years.

Since, futures are only temporal hedging instruments referenced to one particular location, complete bankability may require the additional development of risk mitigation instruments between an investor's location and the futures' trading location. This may include either implementing a complementary market for TCCs, or combining pairs of financial local forward contracts. If either of these hedging approaches were successful, then bankability for generation projects would significantly increase.

Hogan's TCCs Define and Price Transmission Congestion Property Rights & May Assist in Providing Efficient Signals for Grid Investments

Perhaps, the most crucial contribution to the restructuring proposals is provided by Professor William Hogan's TCC, a financial instrument. A TCC is defined as the 'right' to inject electric energy at one location and remove it at another location without incurring any congestion costs.

Economic theory argues that an efficient market requires that property rights be well-defined. Otherwise, market participants would not have the proper incentives to efficiently price the good or service. In the case of electricity, when transmission capacity is constrained, supply or demand of energy by any agent impacts all other grid participants (Individual trades also impose loss externalities on the network). This congestion externality effect has to be internalized and priced accordingly. The first step to internalizing this congestion externality is to develop well-defined property rights to a congested network which can be efficiently priced. Once this objective is achieved, a proper allocation mechanism for 'rights to congest' can be developed. TCCs represent tradeable financial property rights to a congested transmission network, which as a byproduct, also provide an interlocational price hedging function.

TCCs and Short-Run Efficiency

The claim that TCCs efficiently define and price congestion property rights rests on the following argument: the value of a unit of TCC held by two transaction parties, defined as the present

[56] Oren, S., "The Role of Financial Instruments in a Competitive Electricity Market". Paper presented at EPRI conference, San Diego, March 1996, page 7-2.

discounted value of the expected stream of locational price differences, reflects the per unit cost of system congestion imposed by the transacting parties trading over the two relevant locations.

Staff assessed the claim of short-run efficiency. Suppose there is single constrained line on a network. All transacting parties have simultaneously contributed to this constraint. Also, this constraint simultaneously imposes a cost on all transacting parties. The per unit megawatt cost to the whole system from this constrained line is called the shadow price of that constraint. Each set of transacting party therefore has contributed a portion to this shadow price, and must consequently pay a cost equal to their contribution to this shadow price.

Figures 4 and 5 illustrate this argument. Suppose that in this congested system there exist a set of bilateral parties who are transacting power from location A to location C. The claim is that their per unit megawatt contribution to system congestion is equal to the difference in the marginal cost at locations A and C. In fact, using a DC power flow approximation with no network losses, one can show that the marginal cost differential between A and C is indeed

Figure 4

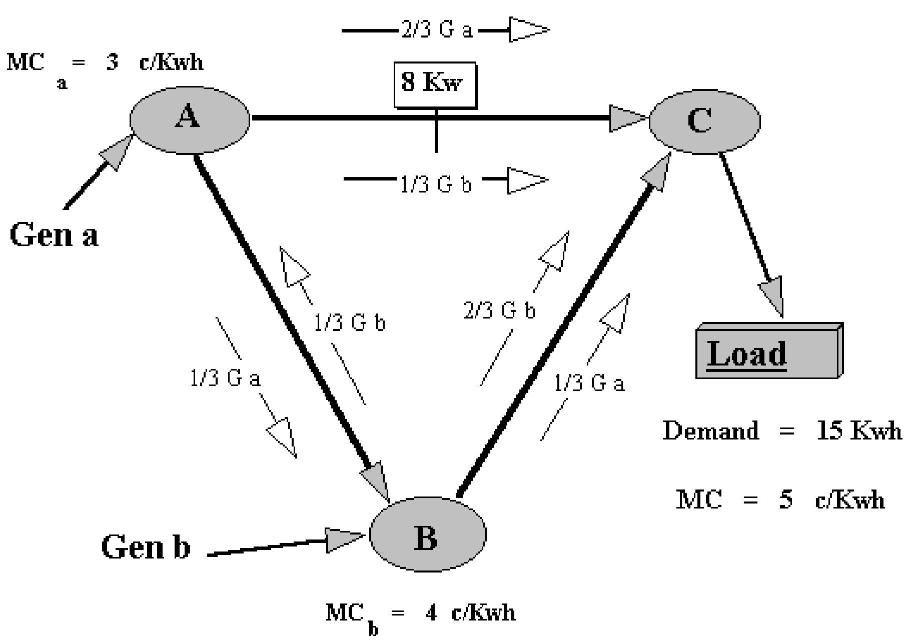
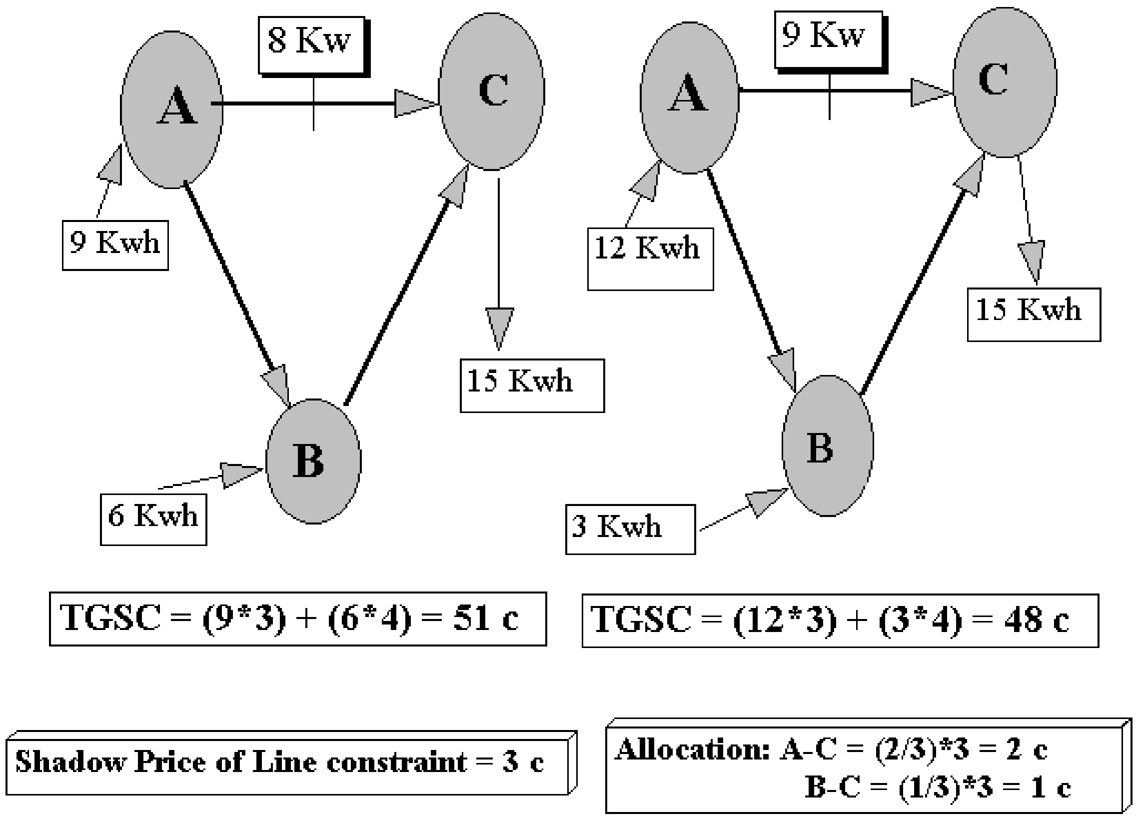


Figure 5



equal to the shadow price of the constrained line adjusted by the relative contribution to the constraint (shift factor element of A_ C) of the transacting parties who are trading between A and C. This therefore demonstrates that the difference in marginal cost between two locations used by a pair of transacting parties is indeed equal to the congestion cost they impose on the system. It would stand to reason that the price of a congestion property right defined by the difference in local marginal costs is efficient.

Figure 4 shows that when the system is congested, the marginal cost differential between locations A and C is 2¢, and the marginal cost differential between location B and C is 1¢.

Figure 5 shows that the shadow price of the constrained line is 3¢. The shadow price of the constraint is derived by relieving the constrained line by 1 Kw and calculating the reduction in total generation system cost (TGSC). This 3¢ network congestion cost is simultaneously created by transacting parties A-C and B-C. The relevant question then is, what is the relative contribution to this 3¢ congestion cost by the transacting parties A-C and B-C? That is, how can this congestion cost be efficiently allocated between the two sets of transacting parties?

Figure 4 shows that 2/3 of the flow over the constrained line is due to generator's A injection. Similarly, 1/3 of the flow over the constrained line is due to generator's B injection. An efficient method to allocate the 3¢ congestion cost would use this information. Therefore, generator A and his customer at location C are causing and should pay (2/3 * 3¢) or 2¢ per Kw of power transacted. Similarly, generator B and his customer are causing and should pay (1/3 * 3¢) or 1¢ per Kw of power transacted. **Figure 5** summarizes how the shadow price is allocated. This is equivalent to the difference in marginal costs at the respective locations. This demonstrates that a TCC defined over two locations and priced as the difference in marginal costs, efficiently defines and prices a congestion property right.[57]

However, Oren, Spiller, Varaiya, and Wu dispute that the marginal cost differential efficiently defines and prices a congestion property right.[58] To argue this point, they use the case of power flowing from a high cost to a low cost location when the system is congested.

Figure 6 illustrates an example of a generator, at location B, that injects power at a high cost location (5¢) and a load that removes power from a lower cost location (4¢). In fact, by placing a constraint between the two generators, the price at the load will equal the average of the two generators' marginal costs after the transmission constraint binds.

First, note that generator B is providing an externality benefit to the system by injecting power. That is, without generator B, generator A can only generate up to 24 Kw before line A-B is constrained. When generator B comes on line, it frees up capacity on line A-B, so that generator A can increase generation beyond 24 Kw.

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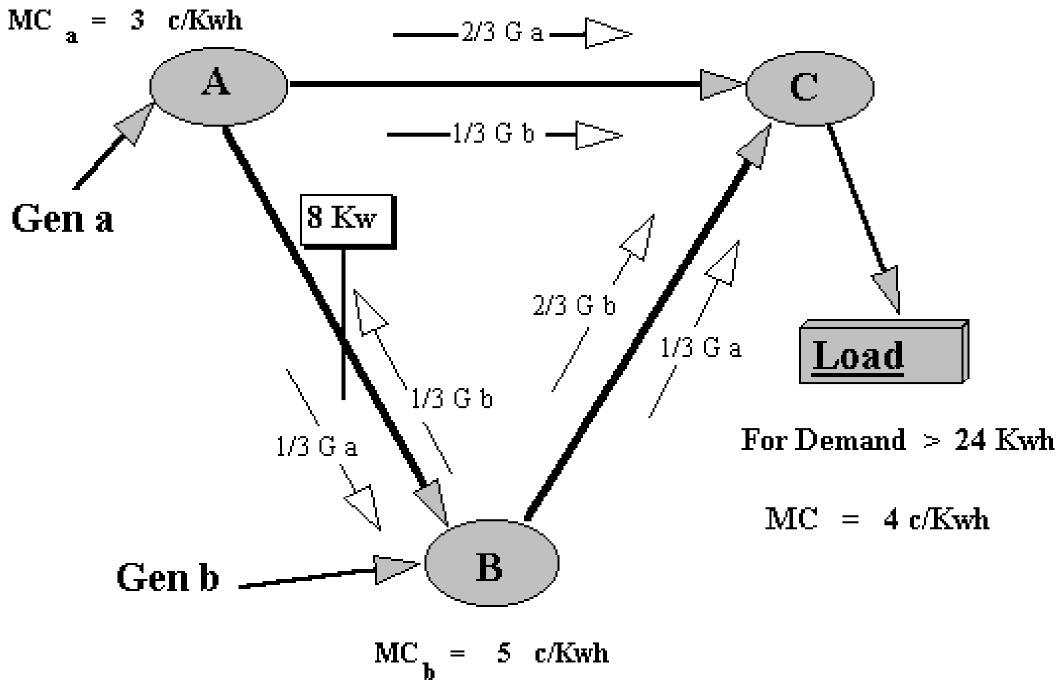
[57] In order for a TCC to define and efficiently price congestion rights, it is necessary that the local spot prices <u>over which the TCC is defined</u> are themselves efficiently derived. Staff questions whether present proposals to price spot energy are efficient. For example, during intra-zonal congested periods, constrained-on generators will be paid their bid prices, whereas other generators will be paid the zonal uncongested market clearing price. The examples that staff presents in this report show that this is not an efficient pricing approach. Therefore, a TCC defined over this pricing approach would not efficiently define, allocate and price congestion rights. Also, a TCC defined over an average (average of uplift charge) zonal consumer price is clearly not efficiently defined nor priced.

> The zonal pricing scheme would be maintained until, "intra-zonal congestion reaches a threshold level significantly below the level required to justify the construction of new facilities,..."(Rebuttal Comments on "Effects of Restructuring On Reliability", SCE, June 25, 1996). Although the argument for this approach relies on implementation considerations, the approach creates a wedge between efficient pricing and actual pricing. It is this wedge that may undermine efficient congestion pricing and hence the efficiency properties TCCs.
>
> Should TCCs be defined over nodal locational prices, then efficient short-run congestion allocation and pricing would be maintained. However, Staff requests comments on whether a TCC, so defined, would offer an effective hedge when used in conjunction with the above zonal spot energy pricing scheme.

[58] Oren, S., Spiller, P., Varaiya, P., Wu, Felix, "Nodal Prices and Transmission Rights: A critical Appraisal", PWP-025, December, 1994 ; "Nodal Prices and Transmission Rights: A Critical Appraisal", The Electricity Journal, April, 1995; and in Letters to the Editor, Response to Kritikson, J., Dawson, P., and Ballance, J.,W., The Electricity Journal, August/September, 1995.

Figure 6



Second, if generator B were to hold a TCC with respect to the B-C intake-outake pair, then it would be forced to pay the ISO since his TCC would be negatively valued. The generator would then have an incentive to remove the link, even though it provided a benefit to the system. In this instance, Oren et al. question the validity of using locational marginal cost differentials to efficiently price marginal congestion. Generator B and link B-C is benefiting the system yet, generator B would have to pay the ISO 1¢/Kwh and, therefore, have an incentive to destroy link B-C. After all, an efficient price should contain sufficient information to provide proper incentives for both short-run and long-run economic behavior.

However, Staff believes Hogan's approach efficiently prices short-run congestion costs. It reflects short-run opportunity cost pricing. The negative price gradient, in the above example, merely indicates that an injection at location B is relieving system congestion, and as such, is reflected by transacting parties B-C's negative congestion payment. The corresponding TCC efficiently confers a property right to the constrained network by providing a perfect price hedge whether congestion costs are negative or positive.

TCCs and Long-Run Efficiency in Transmission Investments

Staff feels that Hogan's congestion pricing mechanism is not sufficient to provide efficient long-term price signals for transmission upgrades. It must be supplemented with additional conditions, information and arrangements. This does not undermine the argument that TCCs could play a positive long-run role in a restructured industry. Locational pricing and TCCs represents the most advanced proposal that addresses congestion pricing, allocation and therefore efficient hedging.

Oren, Spiller Varaiya, and Wu fail to consider the impact on the rest of the system, and possible formation of coalitions of impacted agents, when contending that a negative TCC holder would have an incentive to destroy the corresponding link. "While TCCs address the problem of investment in generation, an issue crucial for the development of a competitive market, they also impact a second crucial issue, investment in the grid itself. The makeup of the network can have a significant influence on the underlying value of the assets connected to it." [59]

For example, since generator B, in **Figure 6**, is clearly providing an external benefit to the system and destruction of the line B-C would adversely impact others, then it is possible for generator A to compensate generator B.

The point, however, is that although the marginal cost differential between two locations is sufficient to price short-run congestion, it is not sufficient to provide efficient long-run signals. Moreover, since agents collectively contribute to system congestion, any investment to relieve the constraints would require a coalition of impacted individuals. A further complication arises in cases where a coalition of investors who undertake a given upgrade will not fully realize all of the benefits from that upgrade. The party who did not contribute to the investment, yet realized its benefits, would be a free rider.

Current research demonstrates that, under certain conditions, TCCs may play a significant role in providing the necessary incentive for efficient grid investments.[60] Bushnell and Stoft provide the necessary conditions that reduce the possibility that detrimental changes to the network would be undertaken when parties have negative TCCs. They argue that always maintaining a feasible set of TCCs[61] will go a long way in mitigating detrimental grid modifications. Requiring that the set of TCCs also match dispatch (approximate matching may be sufficient), would go even further.

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[59] Bushnell, J., Stoft, S., "Transmission and Generation Investment In a Competitive Electric Power Industry". PWP-030, May, 1995. For the California Energy Commission, Interagency Agreement 700-93-003, page 2.

[60] Bushnell, J., Stoft, S., "Transmission and Generation Investment In a Competitive Electric Power Industry". PWP-030, May, 1995. For the California Energy Commission, Interagency Agreement 700-93-003, pages 23-35. Bushnell, J., Stoft, S., "Electric Grid Investment Under a Contract Network Regime", UCEI, PWP-034, CEC Contract # 700-93-003. Bushnell, J., Stoft, S., "Grid Investment: Can a Market Do the Job?", The Electricity Journal, January, 1996.

[61] When a set of TCCs corresponds to a feasible dispatch, the set is said to be feasible.

Bushnell and Stoft show that if (1) The total quantity of TCCs, both before and after a grid modification, reflect a feasible dispatch, and (2) "If contracts match dispatch for the system as a whole, then anyone who makes a detrimental modification to the grid will receive new contracts that will have a negative value." As a result, no outside parties and "groups whose contracts match its dispatch will have the financial incentive to make a detrimental modification to the grid". They rely on a stronger condition when they state, "If the system is completely contracted (i.e., TCCs match dispatch for each individual) then no individual or group will have a financial incentive to make a detrimental modification to the grid." [62] Although contracts will almost never match dispatch, the authors argue that approximate matching may be adequate. The authors, however, do point out the uncertainties of the network properties in a mixed pool and physical contract market.

Therefore, Bushnell and Stofts' results relies on the fact that should the negative TCC holder destroy his link, he will not only be impacted by adverse price changes at the locations in which he is selling/buying, but would also be required to obtain a TCC (to maintain feasibility) that would require him to internalize the negative impact he imposes on the grid.

It must be pointed out that there exist much misunderstanding regarding the investment incentive properties of TCCs. TCCs, once in the hands of agents, do not provide an incentive to invest. Instead, those who do not have TCCs and consequently have to pay congestion charges have the incentive to invest in either generation or under certain circumstances, the grid itself. However, these agents would not undertake the investment if they were not assured that they would receive a well-defined and efficiently priced property right - 'the right not to have to pay congestion fees', the TCC. In addition, congestion payments are clearly not enough to amortize transmission capital. The transmission network is a natural monopoly since it is subject to economies of scale over the relevant range. Therefore, "...at the optimal investment level, short-run transmission pricing will not recover all investment costs" [63].

The recent WEPEX filings, as proposed by SCE and PG&E, raise doubts concerning the long-run efficacy of TCCs. The proposal significantly departs from efficiently pricing locational spot energy and defines TCCs over this inefficient pricing scheme. For example, generators are paid the market clearing prices in their respective zones during uncongested intra-zonal periods. For intra-zonal congested periods, the constrained-on generators are paid their bid prices. Furthermore, during these congested periods, zonal customers pay the uncongested market clearing price plus an uplift, which is the average of all constrained-on generator bids.

How will TCCs be defined under this pricing scheme? Which zonal price will the TCC of a non-TOU customer or independent power producer reference? Will the TCC reference the

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[62] Bushnell, J., Stoft, S., "Grid Investment: Can a Market Do the Job?", The Electricity Journal, January, 1996, p. 3.

[63] Spiller, P., "Implementing Transmission Open Access: With Special Emphasis on Chile's Experience", PWP-024, November, 1994, page 2, Citing Schweppe, F.C., Caramanis, M., Tabors., R.D., and Bohn, R.E., " Spot Pricing of Electricity", Kluwer Academic Publishers, 1988.

intra-zonal unconstrained market clearing price or the bid price of the last constrained-on generator during congested intra-zonal periods? TCCs, as defined in this case, will not support efficient investments in the grid. As discussed earlier, efficient incentives require that the total quantity of these instruments reflect a feasible dispatch, and that agents' set of injections and consumptions approximate the concurrent dispatch. This will clearly not be the case.

In summary, the following issues concerning TCCs need further consideration: (1) How will the initial allocation process of TCCs treat non-TOU customer market agents?; (2) If they are to be defined over zones, then which price would be referenced? Would it be the zonal unconstrained market clearing price or the bid price of the last constrained-on unit?; (3) How will a TCC's price reflect times of underutilization of lines? These instances would result in additional revenues to the TCC owners; (4) The discussion of the secondary markets in TCCs is not complete. In this regard, the method to standardize and price TCCs, which is required for trading between two sets of different zones, is an issue that needs further consideration. However, staff realizes that trading among parties within a given zonal set is not problematic.

(5) What are the implications of negative TCCs? Would negative TCC holders be required to pay the ISO, to assure revenue adequacy? A negative TCC implies a negative locational price gradient (high-priced generator to low-priced consumer). A trade occurring across this gradient would, by definition, benefit a congested system. So, if it is argued that the difference in locational prices efficiently prices the contribution to or relief of system congestion, then why is additional information and consideration required to evaluate the investment incentives associated with this scheme to price congestion?; (6) What are the implications for existing TCC holders when transmission upgrades are undertaken? This may be especially problematic in the Stoft and Bushnell example of a 'mixed expansion', that is, an expansion that both deletes from and adds to the original feasible dispatch set.

The case of negative TCCs and grid modification externalities that cannot be internalized by a market mechanism point to the need for coalitions of agents and government oversight to address grid investment issues.

Financial Instruments And Spot Market Power

Market power may be exercised in both the spot market for electricity and financial markets. Because of the interaction of two market types, the competitive health of each must be considered when assessing the feasibility and benefits of a competitive electricity market.

Various researchers have argued and demonstrated the efficacy of well-functioning contract markets in mitigating spot market power abuses.[64] Newbery argues that if a generator sells

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[64] Newbery, David, M. "Electricity Power Sector Restructuring: England and Wales". Presented at the 'POWER Conference on Electricity Industry Restructuring'. Berkeley, California, March 15, 1995. Green, R., and Newbery, D., M., "Competition in the British Electricity Spot Market", Journal of Political Economy. Volume 100, no. 5. Kahn Edward P., Outhred, Hugh, and Bushnell, James, "Bulk Power

CFDs which exactly matches its dispatch, then it has no incentive to inflate its bid price to the pool. This is because its revenue has already been established by the CFD strike price. Furthermore, if this generator bid a price above its marginal cost, it would risk not being dispatched and consequently lose the difference between the pool market clearing price and its marginal cost. In fact, if the generator's position in the CFD market was greater than its dispatched quantity, then it would have to purchase the residual amount from the pool. This scenario would provide an incentive for the generator to bid below its marginal cost to lower the spot market clearing price. Newbery states, "...the extent of market power that a generator has in the spot market is measured by the excess of its supply at the SMP (short-run marginal price) of that period over its CfDs. Its incentive to bid a supply function above the schedule of short-run avoidable costs is thus decreasing in the volume of CfDs signed." [65]

The availability of deep spot markets combined with liquid financial markets may promote entry of independent power producers (IPPs), and thereby provides another mechanism to mitigate spot market power. Therefore, if an IPP does not face impediments to signing financial forwards to hedge both temporal and interlocational price uncertainty (TCCs or a combinations of local forwards), then it could more easily issue low-cost debt to finance the purchase of the plant. With this price hedge, potential new entrants would avoid the risk of retaliatory pricing.

However, the competitive health of these contract markets is required before these instruments provide the necessary element for spot market efficiency and efficient generation investments.[66] Bushnell and Stoft argue that if there exist a concentration of buyer market power in the hands of large distribution companies (Discos), then CFDs and other contracts would command a premium. For example, if a Disco has generation affiliates, then it would not have the incentive to buy CFDs from an independent power producer. To the extent that marketers, other wholesale purchasers, and end-use customers can easily issue financial forwards (CFDs, etc.), this will introduce efficient market competition on the buying side of the contract markets. In this sense, all these players need direct access to the spot market. However, in the initial years, there may be a problem of buyer concentration as large Discos will dominate the landscape.

Adequate standardization of CFDs or any financial forward contract would decrease the incentive to exercise spot market power. Standardization increases tradeability and hence liquidity. This also minimizes market power in the financial markets.

Market Study". University of California Energy Institute (UCEI). CEC contract #700-93-003. Borenstein, S., Bushnell, J., Kahn, E., and Stoft, S., "Market Power in California Electric Markets", UCEI,

65 Newbery, N., "Power Markets and Market Power", The Energy Journal, Vol. 16, No. 3, 1995, p. 48.

66 Borenstein, S., Bushnell, J., Kahn, E. and Stoft, S., "Market Power In California Electric Markets", University of California Energy Institute (UCEI), November 30, 1995. CEC Interagency Contract #700-93-003, pages 33-39.

The ownership structure of the transmission capacity contracts (TCCs) will also impact the likelihood that generation market power will be exercised. How these financial instruments, which confer transmission congestion property rights to the holder, are initially allocated and eventually traded will have a significant impact on existing generators and potential new entrants. For example, it has been proposed that existing transmission owners be granted TCCs on behalf of their customers. Since existing transmission owners may also maintain ownership of generating facilities, how will this impact competing IPPs? How will this scheme impact consumers who purchase power from IPPs, Municipals, and out-of-state power producers? A clear vision of the nature and detail of the functional and operational separation among generation, transmission, and distribution is clearly needed.

If the electricity market in the Western region consisted of only one or two deep spot markets, then it would be easy for staff to conclude that the implementation of an active futures market at each location may be sufficient to provide the necessary discipline on spot market power. This conclusion is based on the fact that futures markets comprise many independent and varied interests. The force of competition alone from these financial markets may be enough to mitigate spot market power in the underlying commodity. However, considering the locational nature of electricity, active futures trading may be a beginning only. Active and competitive complementary instruments would be required to address the spatial dimension of electricity, as well.

The deliverability condition of a futures contract which requires transmission capacity may have unknown negative implications during congested periods. For example, would a futures trader who decided to close his position physically have priority on a congested transmission network? Does that imply discriminatory access to the grid? Moreover, if an agent held a futures contract and had influence over congestion in the transmission network, would this give him a mechanism to exercise market power through the demand of excess deliveries?

An agent with spot market power may employ the futures market as a mechanism to exercise his market power. For example, an owner of a significant amount of hydro resources, who has purchased futures contracts (the agent is 'long' on the market), may simultaneously withhold energy from the market and choose not to close his position financially. This would in effect force the sellers of futures (the 'shorts') to either deliver at a higher spot price or pay a premium to settle their contracts. In either case, the futures' seller is forced to pay the inflated spot price at the time of settlement. "Using storage is a way that longs can simultaneously enter the cash market and influence spot prices that shorts may face in having to deliver on their contracts to the longs."[67]

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67 Kahn, E., Outhred, H., and Bushnell, J., "Bulk Power Market Study", University of California Energy Institute, October 25, 1994, ch. 4, p. 11-12. Under Contract to the California Energy Commission, Contract No. 700-93-003. Docket No. 93-ER-94.

Standardized Financial Instruments And Efficient Information on Expected Future Prices

Standardized financial instruments traded in efficient secondary markets provide appropriate signals of future prices to market participants, including investors. Standardized financial instruments are required to invite broad and active participation to obtain the liquidity necessary to establish deep financial secondary markets, and hence efficient price signals.

Standardizing a financial forward contract defines all the terms and conditions of a transaction. The only remaining consideration is price. This characteristic maximizes diversity in demand and supply interests, including speculators. Speculators are necessary to remove price uncertainty from the hedging participants who are directly involved in trading a particular commodity. It is in this transfer, or re-allocation of risk, from risk averse participants (hedgers) to risk-taking participants (speculators) that efficient pricing of risk is obtained.

Futures contracts are standardized instruments which are traded in a parallel secondary market administered by an exchange, such as NYMEX. As such, a well-functioning futures market could provide market participants with efficient future price information wherever the instrument is actively traded.

As presently designed, CFDs may not reach the level of standardization required for efficient secondary markets to develop. "In the UK, CFDs play an important role as risk management instruments allowing buyers and sellers to hedge against fluctuations in the pool prices. The CFD market, however, has limited participation (primarily buyers and sellers of power) and has not expanded to the point that would attract speculative trade which could produce the cash and liquidity that will support efficient investment. To meet that goal a futures market with standardized instruments that will invite broader participation is needed." [68]

Since TCCs will be offered by the diversified ISO, who will bear no risk, standardization may not be crucial to provide successful hedging in the initial stages of restructuring. However, the lack of standardization across a given grid may limit transferability of these instruments. Standardization and transferability among parties for a set of two locations may suffice to provide information on future prices.

Presently, the proposal is to price the initial allocation of TCCs at the Present Value of the expected stream of benefits (i.e., the expected stream of locational price differentials). This would reflect the maximum amount that a rational economic agent would be willing to pay for such an instrument. It is argued that any subsequent buyer would not pay more than this amount.

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[68] Oren, S., "The Role of Financial Instruments in a Competitive Electricity Market". Paper presented at EPRI conference, San Diego, March 1996, page 7-3.

However, it is unknown whether subsequent pricing of TCCs would equal a present discounted stream of market determined benefits. Once the TCCs are initially allocated, which may result in an allocation to a concentrated number of agents, then asking prices in secondary markets may well exceed the true market benefits. The lack of system-wide standardization may also segment any future secondary market. That is, there may develop sub-markets for TCCs defined over two locations. Without administration over the secondary market by the ISO or regulatory body, TCC holders may extract economic rents from competitors wishing to purchase these instruments. Note that this problem would manifest itself when non-holding TCC entities, who did not upgrade the system, wanted merely to trade through the congested system. It is problematic that initial rules will be developed to account for all non-grid modifying future potential traders.

Furthermore, "...in the case when the value of a TCC is greater than power transacted, it will result in additional revenue to the TCC owner. The potential additional revenue should be accounted for in the purchase price of the TCC. This occurs during times of underutilization of a line by the TCC owning trading parties."[69]

If combinations of local financial forward contracts are substituted for TCCs, Staff doubts that standardization, liquidity and hence efficient pricing of interlocational risk will be obtained for all locations.

DESIGN OF COMPLEMENTARY SPOT MARKET

Since the features, and hence effectiveness, of each financial instrument are linked to the nature of the spot market each hedges, meaningful analysis of these instruments requires consideration of the two generic spot market making processes that have been considered. For example, CFDs and TCCs are financial instruments designed for a spot market administered by an ISO. NYMEX has argued that futures and options contracts would not survive under such a spot market regime, but may flourish under a construct similar to that of the proposed 'Coordinated Multilateral Trading'[70] (CMT) spot market regime. This theory is incomplete since it has not explicitly addressed transmission congestion pricing. Wu and Varaiya state that they will address this issue in forthcoming papers. In any case, they still are in disagreement with Hogan's approach to pricing transmission congestion.

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69 Bushnell, J., Stoft, S., "Transmission and Generation Investment In a Competitive Electric Power Industry". PWP-030, May, 1995. For the California Energy Commission, Interagency Agreement 700-93-003, pages 10-11.

70 Wu, Felix, and Varaiya, Pravin, "Coordinated Multilateral Trades for Electric Power Networks: Theory and Implementation. POWER Working Paper 031 (PWP-031), June 1995.

There is general agreement that efficient locational spot prices, as developed by Schweppe et al.[71], are required for a restructured electricity industry. A locational spot price would reflect marginal costs and benefits at that particular location, and additionally, reflect all network externalities imposed by generators and/or loads at that particular location. These external effects would include network congestion and losses imposed on the system by the activity at a particular location. This ensures that an agent at a particular location would pay (receive) a marginal cost (benefit) that would reflect all the costs (benefits) she imposes on (provides to) the system.

However, the disagreement centers on how locational prices should be derived. There have been two theoretical generic proposals for locational spot price formation processes. The first, as envisioned in the original POOLCO proposal, consisted of a system of locational 'pool-based' spot markets in which a central entity, the ISO, received marginal cost and benefit bids and used a computer algorithm to generate market clearing locational spot prices. In the process, this entity also performed the economic dispatch function. Subsequently, the economic function of calculating market clearing locational spot prices, through a bidding system, was vested with a power exchange, which then would provide its list of least-cost generators to the ISO for actual dispatch. Nonetheless, the spot price formation process is still administered centrally for the major utilities. This approach requires that the major utilities reveal their marginal cost and benefit information.

The second theoretical limiting case is for a spot market design is provided by the 'CMT' model proposed by Felix F. Wu and Pravin Varaiya.[72] The CMT regime would not require parties to reveal their reservation prices. Instead it would rely on the following iterative process: (1) contracted parties would first submit schedules to the ISO for dispatch; and (2) should the totality, or some subset, of the first submittal not be feasible, the parties, using ISO provided information on all parties' contribution to system congestion and losses, would enter into multilateral trading arrangements and resubmit revised schedules until feasibility was achieved. It is in this iterative process that arbitragers, marketers and brokers, would assist in the convergence to a feasible set of schedules. In addition, it is argued that in the process of searching for a feasible solution, parties will seek the best deals. In doing so, the outcome will be that marginal costs will equate across all locations adjusted for congestion and losses. This scheme would require complementary deep local forward markets to fully reveal equilibrium locational spot prices.

This process, it is argued, would easily converge to feasibility and optimality. The multilateral trading process would determine short-term prices, not the power exchange. NYMEX would clearly prefer a spot price formation process that does not involve multi-attribute bidding, with the possible inherent gaming strategies, and computer simulations to generate a unique spot

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71 Schweppe, F., M. Caramanis, R. Tabors and R. Bohn, "Spot Pricing of Electricity", Kluwer Academic Publishers, 1988.

72 Wu, F., and Varaiya, P., "Coordinated Multilateral Trades for Electricity Power Networks: Theory and Implementation, PWP-031, June, 1995.

price. It is clear, however, that since the convergence process relies on arbitraging, marketers and brokers would benefit.

Wu, Varaiya, and Outhred argue that forward contract markets would develop at each location and consequently, when used in combinations, could hedge interlocational price uncertainty. They argue that this would be preferable to having TCCs, which they claim are redundant instruments. Within this framework and assuming the convergence process is efficient, it may be possible that spot price transparency could be obtained by an active futures market in one or two locations in the WSCC region, combined with forward contracts at the remaining locations. However, Staff questions whether the necessary liquidity would develop in the San Francisco Peninsula and Humbolt regions.

The CMT's model's reliance on convergence to feasibility and optimality raises many questions and concerns. Is this a feasible approach, considering the process is to be repeated daily with intermediaries, such as brokers and marketers, participating in the buy-sell process? The issue of convergence is a topic that needs further research, as was pointed out at the March 15 POWER conference[73].

Steve Stoft has demonstrated that both spot market arrangements would theoretically integrate and produce optimal spot locational prices if bilateral contracted parties were required to bid their demand curve for transmission (i.e., their willingness to pay to transmit through a congested network)[74]. William Hogan makes a stronger argument. He states that even if bilateral contracting parties are merely required to pay the congestion costs equal to the locational price differences resulting from the prices derived by the power exchange, then the result would be equivalent to a least cost dispatch[75].

CONCLUSION

The CPUC decision and WEPEX filings present California with a patchwork of elements from two spot market designs - a pool-based spot market, and the "Coordinated Multilateral Trading (CMT)" spot market model, proposed by Felix Wu and Pravin Varaiya.

Each alternative spot market supports a unique set of financial instruments. CFDs and TCCs were designed for locational spot markets administered by an ISO, while the New York Mercantile Exchange (NYMEX) has argued that its futures and options contracts would not succeed in such a spot market structure. NYMEX and other marketers have supported a spot market design that, Staff believes, approximates the CMT spot market model. In view of this,

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73 POWER conference, March 15, 1996.

74 Stoft, S., MEMO to WEPEX Transmission Protocols and Services team, November 15, 1995.

75 Hogan, William, "A Wholesale Pool Spot Market Must BE Administered by the Independent System Operator: Avoiding the Separation Fallacy", The Electricity Journal, December, 1995.

it has been difficult to assess the effectiveness of the proposed financial instruments. What follows is Staff's assessment of likely developments and the concerns and questions that remain.

Initially, NYMEX's standardized futures and options contracts will be the primary temporal hedging instruments. They will develop around that segment of the spot market fashioned around some variant of the CMT paradigm. Notwithstanding NYMEX's concerns, it is unknown whether these instruments will succeed if the spot market formation process is defined by a power exchange administered pool-based spot market. If a pool-based spot market indeed discourages the necessary speculators, then the NYMEX contracts may fail. However, since elements from both spot market processes are required to be in place for the medium term only, it may be possible that these contracts may play a significant role in determining the ultimate spot market design which best complements them.

Staff is concerned with the implications of the deliverability requirement of futures and options contracts. The New York Mercantile Exchange's (NYMEX's) futures contract requires that transmission capacity be guaranteed to fulfill the contract's obligations. As this surplus capacity has been identified, the Commodity Futures Trading Commission (CFTC) approved NYMEX's application to trade futures at Palo Verde and COB. [76] Staff is uncertain as to what arrangements will be needed when transmission becomes constrained in the vicinity of the futures contract's trading market area. The implication is that excess system transmission capacity will need to be reserved for the sole purpose of fulfilling the deliverability conditions required for futures trading. This approach may be inefficient from a network perspective.

Since NYMEX's futures and options contracts are locational specific and, as such, only hedge temporal price uncertainty, parties will need to arrange for hedging services between their particular location and the spot market location served by NYMEX's instruments. NYMEX refers to this interlocational price differential as 'locational basis'.

Clearly, there will arise a need to hedge this locational basis. Two options exist to accomplish this task. The first would involve private market provided zonal forward financial contracts as envisioned by Outhred and Oren. The second option would involve implementing an ISO-administered TCC scheme referenced to the two NYMEX spot markets. In addition, it may even be possible to integrate ISO-administered locational financial forward contracts with the two actively traded futures contracts. Therefore, a possible framework would perhaps include two actively traded futures contracts, at COB and Palo Verde, complemented by ISO-administered financial forwards or TCCs to hedge the interlocational risk between either COB or Palo Verde and an industry participant's location.

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[76] Commodities Futures Trading Commission's (CFTC's) Approval of NYMEX's Applications for Proposed Electricity Futures Contract for Delivery at Palo Verde and at COB. Application by NYMEX for Designation As a Contract Market in Palo Verde Electricity Futures, and Application by NYMEX for Designation as a Contract Market in COB Electricity Futures. Received Per Standing Order from John Wheeler, CFTC.

ISO-administered TCCs, in concept, hold promise in addressing the need to hedge interlocational price uncertainty. However, questions remain on a method for initially allocating theses instruments. Ownership of these instruments is perhaps the most significant issue. How will non-TOU customers agents be treated in the initial allocation? Details on establishing secondary markets in which TCCs can be traded also remain sketchy. Dividing TCCs into separate financial forward contracts to increase tradeability in the secondary market needs further study.

Whatever scheme is chosen, two issues must be addressed. First, all parties must be able to obtain interlocational hedging services at comparable premia. Private markets may not be able to accomplish this since the necessary liquidity may not exist for all locations or zones. Second, policy makers must consider that the ISO will already have collected congestion rents. Therefore, if it is not the entity that provides interlocational hedging services, then what will be done with these funds?

There have been various claims and rebuttals that TCCs would also provide efficient incentives for transmission investments. William Hogan's TCC proposal to create financial rights to a congested transmission network not only hedges locational price uncertainty, but also claims to provide efficient signals to transmission upgrades.[77] This claim has been disputed[78] and subsequently shown to hold only under some restrictive assumptions.[79]

This investment incentive claim depends on the mechanisms developed by which parties will ultimately receive the TCCs upon upgrading the grid. In addition, even if properly allocated, the TCC mechanism may not be sufficient to motivate efficient investment. That is, further information on the changes in the grid modifiers', and other parties', locational prices will be required.

For example, it has been shown that a TCC, a financial property right, may have a negative value. Consequently, the financial property right holder may have an incentive to destroy the underlying physical asset, although this asset may provide a benefit to the system. This perverse incentive has been addressed by Bushnell and Stoft. They argue that further infor-

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77 Garber, D., Hogan, W., and Ruff, L., "Poolco: An Independent Power Pool Company for an Efficient Power Market." The Electricity Journal, September 1994.

78 Oren, S., Spiller, P., Varaiya, P., Wu, Felix, "Nodal Prices and Transmission Rights: A critical Appraisal", PWP-025, December, 1994

79 Bushnell, J., Stoft, S., "Transmission and Generation Investment In a Competitive Electric Power Industry". PWP-030, May, 1995. For the California Energy Commission, Interagency Agreement 700-93-003. Bushnell, J., Stoft, S., "Electric Grid Investment Under a Contract Network Regime", UCEI, PWP-034, CEC Contract # 700-93-003. Bushnell, J., Stoft, S., "Grid Investment: Can a Market Do the Job?", The Electricity Journal, January, 1996.

APPENDIX

Futures & Options Contracts[1]

The Commodity Futures Trading Commission (CFTC) recently approved NYMEX's application to trade futures and options on futures at Palo Verdes and COB.[2] Futures trading began at both locations on March 29, 1996, and options on the futures contracts were launched on April 26. Initial futures trading shows that COB's trading volume exceeds that of Palo Verde.

A futures is a standardized contract to deliver or receive a certain quantity of a commodity at some stated time in the future. Price, quantity, grade and time of future delivery are all stated in the contract. Note that the only point of negotiation is the price. All other terms and conditions are pre-specified, thereby making it a standardized contract. A futures contract is therefore not specifically drawn to tailor the needs of any particular set of traders. This in effect maximizes transferability and hence liquidity. That is, many more parties can participate than if transactions were unique to a particular set of trading agents.

Under such conditions, the price that results can be the proper price in the sense that it represents the results of the decision of many thousands of market participants. "The objective in designing a futures contract is to define all the terms associated with transacting business for a particular commodity so that the only remaining point of negotiation is price. This objective facilitates one of the important economic functions of futures markets which is price discovery."[3]

For example, there was no visible and widely quoted benchmark price prior to the introduction of futures markets in the oil industry. Often, quoted prices were were later modified and discounted. This rendered them useless in making decisions. Customers of major oil companies would buy the product at substantially different prices. In addition, the cash (spot) prices quoted in one market were usually not representative of prices in other geographic locations. The oil futures price, on the other hand, now is obtained in a central marketplace

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1 Staff expresses its appreciation to Brad Leach of NYMEX for providing the literature on which this discussion is based. Staff also thanks John Wheeler of the Commodities Futures Trading Commission (CFTC) for providing Staff with requested material.

2 Commodities Futures Trading Commission's (CFTC's) Approval of NYMEX's Applications for Proposed Electricity Futures Contract for Delivery at Palo Verdes and at COB, January 25, 1996 and January 31, 1996, respectively.

3 Kahn, E., "Electricity Futures: Feasibility Issues and Their Relation to Wholesale Power Markets", June 23, 1994, page 2.

and is representative of a standardized quantity and quality of petroleum product. Even individuals who do not directly participate in the market benefit from this benchmark price information.

Options contracts are also tradeable instruments which grants the holder the right, but not the obligation, to either buy or sell an underlying security, such as a NYMEX futures contract, or commodity at an agreed upon price at some future point in time. The agreed upon price is known as the strike price and is established at the time of purchase. The future point in time at which the option may be exercised is known as the expiration date. The buyer of the option pays a fee or premium to the seller. A call option gives the holder the right to purchase the underlying property, and a put option gives the holder the right to sell the property.

Options can be held in isolation. They can also be held in combination with other options and/or underlying property. Therefore, speculators or hedgers both participate in the options market. NYMEX's options contracts are options to buy or sell futures contracts. Those who hold call options and sell put options expect the price of the underlying futures contract to rise. Those who hold put options and sell call options expect the price of the underlying futures contract to fall. Since options contracts are tradeable, the holder has the flexibility to sell the contract in a secondary market.

The Black-Scholes model provides a tool to value options contracts traded in the secondary market. Generally, there are five relevant parameters for options valuation: "share price, time to expiration, exercise price, share price volatility as measured by its standard deviation (expressed as a percentage of share price), and the discount rate." [4]

Futures contracts relate to a specific month, several of which are traded in at any one time. When the actual month of delivery arrives, all outstanding contracts must be settled by delivery of the commodity or by an offsetting contract. Any seller of a contract who has not closed out his position by choosing to make delivery may do so on any trading day he selects during the month in question. Each purchaser not electing to accept delivery may sell a contract for that month and thus cancel out his net position and pass the notice on to the buyer of the contract.

No one is certain what commodity prices will be in the future. Therefore, futures trading provides a way to establish a form of price knowledge leading to continuous price discovery. Futures prices reflect not only current cash prices (and the factors that affect them), but also expectations of future spot prices. It is this function that may assist in revealing spot prices resulting from a CMT approach.

The main justification of the futures contract is that it permits specialization between two

[4] Carter, Jim, "Valuing Options for Electric Power Resources", The Electricity Journal, April, 1995.

elements of the economic process -- the function of holding commodities (or other assets) and the function of bearing the risk of price changes. They serve to redistribute uncertainty over the population, from hedgers who wish to minimize price risk to speculators who wish to assume it. Without the futures contract anyone who held stocks of goods in the course of business would have to take the risk of changes in the price of these goods. By selling futures that mature in the month when he expects to sell his stock, the holder removes from his calculations any uncertainty about the future price of the goods at the time when he expects to sell them.

The operations of speculators on both sides of the market result in a greater volume of transactions than the actual volume of physical transactions. This makes for a more continuous market. The speculators are constantly on the alert for abnormal spreads between different futures exchanges or between different delivery months on the same exchange. The seller of a contract on a commodity exchange does not normally intend to deliver the actual commodity nor does the buyer intend to accept delivery; each will, at some time prior to the date of delivery specified in the contract, cancel out his or her obligation by an offsetting purchase or sale.

The reason for this behavior is clear enough. The parties do not wish to enter into the physical operations of marketing but to engage in one of its aspects, namely the assumption of risk involved in the change of price. In fact, historically, less than one to two percent of futures contracts have been fulfilled by actual delivery, whereas ninety-eight to ninety-nine percent have been cancelled by offsetting transactions before the delivery month. In the few instances where delivery of commodities is actually made, it is accomplished by means of receipts authorizing the delivery of the commodity from a source approved by the exchange.

Hedging is the taking of equal and opposite positions in the spot and futures markets, with the hope that this will prevent a loss due to price fluctuations. A hedger attempts to have neither a net asset or long position (in which more of something is owned than owed) nor a net liability or short position (in which more of something is owed than owned). A successful hedger's net worth, is therefore, unaffected by price changes.

The futures and cash markets tend to parallel one another and to converge as each delivery month expires. The parallel movement occurs because factors that effect either a rise of fall in cash prices usually affect futures prices in much the same manner. The relationship between cash and futures prices is such that at any point in time the futures price and spot price should only differ due to the cost-of-carry. This strong parallel relationship makes hedging possible and advantageous; because both markets move together, the losses incurred in one are offset, for the most part, by profits made in the other. The convergence of the two markets as the delivery draws near occurs because carrying charges converge. The cost-of-carry of a futures contract comprises interest, insurance, commission and storage costs that are incurred from holding the contract until settlement.

The cost-of-carry concept determines the price of a futures contract relative of the prevailing price of the cash commodity. Futures prices cannot be under or over price relative to cash price, at least not for very long. Arbitragers looking for profits, buy low and sell high in the cash and futures market. This activity ensures that cash and futures prices differ, on average, only by the cost of carrying the futures contract to term. In addition, this activity ensures that cash and futures prices move in tandem. This price correlation permits hedging. The weaker the correlation, the weaker is the hedging instrument.

All futures trading in the United States on organized exchanges is under the regulation of the Commodity Exchange Act of 1922. Under this law, the U.S. Commodity Exchange authority designates contract markets as such, licenses firms and brokers, and exercises powers over nonmembers using futures markets. Among the requirements imposed by the authority are the daily reporting by the exchange of all transactions and restriction on the aggregate amount of the commodity any one trader may control. Customers' funds, deliveries, market manipulation and member conduct have been subject to rigid regulatory activity. Price manipulation and other speculative excesses were substantially minimized under the law.

The exchanges maintain active compliance and market surveillance programs to enforce trading rules and to detect any evidence of market manipulation. If evidence of market manipulation is uncovered, exchanges possess a wide range of powers to remedy the situation. These powers include the right to order a given participant to reduce or even eliminate his or her position, to substitute alternative delivery points or additional supplies (i.e., by broadening quality specifications), or even impose cash settlement in place of physical delivery (assuming that the contract calls for such delivery).

A futures market only works in conjunction with a competitive spot market. A competitive spot market is one in which the price at which a commodity can be sold or bought is not capped, either on an actual cost, formula or index basis, but instead is allowed to settle according to the negotiations of the parties to the transaction. Buyers and sellers must be free to enter into transactions, where terms and conditions are worked out to mutual satisfaction. Negotiation may be bilateral or multilateral, but each participant is free to negotiate on their own behalf and in their own best interest. That is, cash market terms and conditions are freely negotiated, and not specified.

The necessity of having a regime of freely negotiated market terms and conditions to establish a futures market is so crucial that NYMEX feels that spot market terms and conditions in the United Kingdom are too constrained and should not be followed. For example, NYMEX argues that limiting delivery periods to half-hour increments is not reflective of free commercial activity. In addition, NYMEX has voiced its opposition to Hogan's administered uniform pricing approach.[5]

To qualify for futures trading on exchanges, a commodity should possess certain characteristics such as sufficient future supply, substantial demand (liquidity), widely diversified supply and demand interests and have some inevitable and natural price variation to encourage hedging and to attract speculators. The last two criteria point to the necessity of the absence of market power. That is, implementation of a futures market requires that there be many independent agents on both the demand and supply sides with roughly equal access to the market who lack the power to either control access or influence the freely fluctuating spot market price.

Varied and active commercial participation is necessary because it helps ensure that all available supply and demand information is incorporated into the futures price, making it a good, if not the best, indicator of the commodity value. A balanced mix of broad commercial and speculative participation is also necessary to ensure that price risk can be laid off on either the long or short side of the market.

Price volatility is perhaps the most important criterion for it provides the basic economic justification for futures trading, which is to attract speculators and provide protection to the hedger against adverse price fluctuations. Uncertain supply and demand are generally the causes of price volatility and therefore are generally present when price volatility is found.

Sufficiency in future supply assures futures buyers. In some cases, it assures those who may choose to settle their accounts with physical delivery. However, "...sufficient deliverable supplies is the Catch 22 of futures trading. If there are not sufficient deliverable supplies of the commodity meeting the quality specifications of the contract, futures trading will fail. However, there must be some uncertainty about the sufficiency of supplies if the previous condition is to be met. In the United State, this dilemma is heightened by the regulatory requirements of the Commodity Futures Trading Commission (CFTC), whose fear of market squeezes at times forced the exchange to overstate deliverable supplies in order to gain governmental approval."[6]

Ed Kahn argues that the deliverability aspect of futures contracts is among the most important areas of concern[7] for successful implementation of electricity futures. As discussed above, the convergence of futures prices to spot prices is a fundamental feature of futures markets.

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5 NYMEX Response to 1994 CPUC OIR & OII on Restructuring California's Electricity Services Industry and Reforming Regulation.

6 "Energy Futures, Trading Opportunities for the 1990s", John Elton Treat, Editor, 1990.

7 Ed Kahn, ibid., June 23, 1994

The settlement price requires a mechanism for determining the appropriate spot price in the case of a cash settlement, or a delivery location with an active competitive spot market in the case of settlement with offsetting contracts.

Ed Kahn continues, "One of the paradoxes of futures markets is that the delivery mechanism must be highly reliable and certain, and if this is the case, then no one will use it. The reason for this paradox is that only with a high degree of confidence in the integrity of delivery will market participants accept that futures price converge to the spot price." [8]

The sufficiency requirement is addressed by appropriately choosing a delivery location. In this regard, the necessary conditions for a viable delivery location are that there must be uniform access; there must be low cost rates to transmission; principles of fairness at the location must be established; and there must be substantial traffic.

NYMEX staff indicated that the marketer had established that an electricity futures market was region or location specific. This is because spot markets are region or location specific as the level and nature of risks, and hence risk assessments, are not homogeneous across regions. For example, the risk assessment associated with a given delivery point, such as the California-Oregon Border (COB) on the Northwest intertie and Palo Verde that links the Southwest, will vary according to the generation resource compositions which transmit across it -- hydro intensive Pacific Northwest and British Columbia region trading with gas intensive California vs. coal intensive Desert Southwest region trading with California. As such, NYMEX sees the Western System Coordination Council (WSCC) area as comprising two subregions.

Access to the spot market via wholesale transmission access has been proceeding at a rate adequate enough to attract power marketers. Electric Clearinghouse, INC. (ECI), a power marketer based in Houston, Texas, in its June 8, 1994 response to the CPUC order, stated that, "it had been following developments in the electric industry since 1989. ECI chose not to enter market at that time due to the lack to sufficient unbundled generation and the lack of open-access transmission. However, when the Energy Policy Act of 1992 ("EPAct") mandated the wheeling of bulk power, it became clear to ECI that electricity industry would soon be going through the same type of transition, that is to an unregulated commodity market, that the gas industry has been through over the last 10 years."

"For example, once the interstate natural gas pipelines began carrying gas for third parties, that is, began acting as transportation agents without a position on either side of a transaction, buyers and sellers could choose with whom to do business. This brought competition to what

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[8] Kahn, E., "Electricity Futures: Feasibility Issues and Their Relation to Wholesale Power Markets", June 23, 1994, page 4..

had been essentially a closed market." [9]

ECI and other marketers, such as NYMEX, have been satisfied with the manner in which FERC has been busy in utilizing its "carrot and stick" approach to convince utilities to file open access transmission tariffs and to join or form Regional Transmission Groups (RTG's). "In recent electric orders, FERC has also transplanted comparability of service principles from the gas industry to the electricity industry, essentially putting utilities on notice that they must provide transmission for third parties pursuant to tariff terms, conditions and prices which are comparable to the transmission service embedded in the utilities' sales of electricity." [10]

Lastly, marketers have stressed the need to unbundle electricity services so that electricity becomes more of a commodity, similar to natural gas. This would allow them to repackage the services into more varied products to better meet the different needs of customers.

When NYMEX was considering the WSCC region to introduce its futures instrument, much of the discussion centered on how flexible the delivery terms should be. As discussed above, effective futures trading requires that all terms and conditions be specified and standardized so that only prices remain to be negotiated. Any uncertainty, other than price, would undermine the primary functions of a futures contract. "The difficulty with flexibility in delivery terms is that it introduces valuation ambiguities into the product...The emerging discussion at the NYMEX is that valuation problems are most important, so a firm, 'inflexible', commitment would be the most appropriate product. This product would be delivered over the hours of a single month designated as peak times by WSCC convention." [11].

Also, the effectiveness of a futures market would be greatly diminished should there any be multiple futures contracts. Standardization facilitates both competition and price transparency. The function of a standardized contract in providing liquidity to the cash market is analogous to the role a currency plays in facilitating the functioning of an economy. Multiple currencies in an economy would create inefficiencies in an economy. Therefore, and electricity futures contract needs to be based on firm energy.

An electricity industry which relies solely on a futures contract would not have the wherewithal to hedge interlocational price uncertainty. Futures contracts would have to be complemented by either TCCs, combined local financial forward contracts, or a combination

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[9] R. Patrick Thompson, president, NYMEX, speech at the Energy Daily Electricity Futures Conference, Washington, D.C., 10/23/92.

[10] ECI Response to 1994 CPUC OIR & OII on Restructuring California's Electric Services Industry and Reforming Regulation.

[11] Ed Kahn, ibid., June 23, 1994, page 5.

of put and call options drawn with respect to the ISO. In this sense, NYMEX's futures contracts may need the ISO to complement its temporal hedging function. Note that an ISO centered or administered congestion cost or interlocational hedging service would in effect spread all parties' interlocational risk across the whole grid. Interlocational risk management would therefore be pooled for all parties.

In addition, the deliverability condition of a futures contract requires excess transmission capacity be made available should a futures contract holder choose to close his position physically instead of financially. Should this occur, NYMEX expects the party, following WSCC protocol, to arrange for delivery. Therefore, the party's futures contract may cease to be a futures contract the day before delivery and become a physical bilateral contract. In this case, even though futures trading per se does not fall under FERC's jurisdiction but may fall under the securities exchange commission's (SEC's) jurisdiction, the party's decision for physical delivery would place him under FERC's jurisdiction. This scenario has unknown implications.

mation[80] on the changes in the grid modifiers, and other parties', locational prices should also be considered. That is, the negative TCC holder, who is also a trader, will face adverse changes in his nodal prices from destroying his asset. However, this argument implies that a TCC does not hold complete information required of an efficiently priced long-term property right. Also, since any upgrade will impact the system, coalitions of impacted parties will need to form in order to make collective decisions. The 'free rider problem' adds another complication. Regulatory oversight will obviously be required.

The evolving California spot market design (i.e., the evolution to zonal pricing, bid payments to intra-zonal constrained-on generators, and uplift payments by all zonal consumers) departs significantly from Hogan's original concept thereby raising serious questions on how to appropriately define and price TCCs. Furthermore, the positive incentive properties associated with these financial instruments may no longer apply.

Witness Qualifications for PHILIPPE AUCLAIR

Philippe Auclair is employed by the California Energy Commission as an Electric Generation System Specialist in the Electricity Resource Assessment Office within the Energy Forecasting and Resource Assessments Division. Mr. Auclair is currently working on electricity restructuring issues. He holds a Bachelors of Science from the State University of New York at Albany, and a Masters of Art in Economics from the University of California, Davis.

80 The following conditions are required for decreasing perverse incentives: (1) the set of TCCs should always be feasible (i.e., correspond to a feasible dispatch), and (2) contracts match dispatch for all agents.