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RESPONSIBILITIES OF AN INDEPENDENT SYSTEM OPERATOR IN A MARKET WITH BILATERAL CONTRACTS FOR ELECTRIC POWER

by

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EXECUTIVE SUMMARY

The purpose of this report is to increase our understanding of the role that an independent system operator (ISO) will have to play in a restructured electricity industry, if it is to facilitate competition, ensure network reliability, manage transmission congestion, accommodate bilateral contracts, and provide operational support for a spot market. An ISO is an administratively created firm that is charged with the efficient day-to-day operation and control of transmission facilities and assets that are owned by electric-power companies.

An ISO is modeled as a monopolist for the following two reasons. First, a credible technology-based threat to the transmission monopoly does not exist at the moment. Second, free market alternatives to a transmission monopoly are not economically sustainable at present. Both reasons imply that transmission is a source of market power. As a result, a rational electric-power company will not divest itself voluntarily of transmission facilities and assets. Therefore, policymakers throughout the world have ordered the *effective divestiture* of these facilities and assets from the other facilities and assets used to produce electricity and electric power. [1]

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[1] Effective divestiture is the *separation of management control.* In this context, it is the separation of the managers controlling the production of a bottleneck service from the managers controlling the production of nonbottleneck services and one other bottleneck service, which is called distribution. Effective divestiture is a strategy for *eliminating* the threat of anti-competitive behavior by a vertically structured firm that competes in a vertically integrated industry.

Currently, there are two forms of effective divestiture in the United States.[2] Both include an ISO. The first addresses managerial and operational issues that are associated with a geographic area that is currently covered by a conventional tight power pool. The second deals with issues that arise when a high-cost geographic area with a significant power need is not currently covered adequately by a tight pool that contains low-cost generation. Descriptive evidence is reviewed in this report that indicates that the choice of the ISO over other administrative forms for a separated transmission operator, such as a GridCo or a TransCo, has thus far been made only in countries where the property rights over transmission facilities and assets were never in the government's possession.[3]

Whatever administrative form is chosen for the separated transmission operator, it is important that its list of responsibilities be delineated carefully and supported adequately. In this report, ISO functions are divided into three groups. The first group, S_1, contains functions where there is universal agreement that they should be the responsibility of an ISO. The second group, S_2, contains functions that allow an ISO to enhance network reliability. However, there is not universal agreement that these functions should be the responsibility of an ISO. The third groups, S_3, contains functions where there is universal agreement that they do not have to be the responsibility of an ISO.

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[2] The Maine legislature in a departure from effective divestiture has ordered the regulated electric utilities to divest most of their generation assets in an effort to mitigate the vertical market power that these firms have as a result of their ownership and control of transmission assets. See State of Maine, Public Utilities Commission, Re: Public Utilities Commission, Market Power Study, Docket 97-877, *Draft of Vertical Market Power Section*, October 28, 1998, 7 and 7 at fn. 15.

[3] The distinguishing features of a GridCo are that it owns, operates and controls transmission facilities and assets, while it concurrently manages the spot market for electric power. A TransCo fulfills the more limited purpose of owning, operating, and controlling transmission facilities and assets. These alternatives to an ISO are found in countries where the property rights over transmission facilities were initially in the possession of the government and subsequently transferred to private individuals.

The functions contained in S_1 are: (1) scheduling of imports and exports, (2) interconnecting with other transmission grids, (3) coordinating with other ISOs, (4) fulfilling requests for transmission service, (5) disclosing information to transmission users, (6) sharing information with other ISOs, (7) monitoring conformance of transmission users to transmission rules, (8) penalizing nonconforming transmission users, (9) monitoring real-time flows on the transmission grid, (10) identifying transmission constraints, (11) dispatching contractual and noncontractual generation, (12) limiting the rescheduling of generation to maintain reliability, (13) dispatching ancillary services to relieve congestion and ensure system reliability, (14) curtailing specific generation transactions to maintain reliability, (15) determining the feasibility of bilateral contracts and spot-market transactions, and (16) reacting to infeasible contracts.

Functions in S_2 are: (1) providing system security, (2) providing spinning reserves, (3) planning for transmission services, (4) producing ancillary services, and (5) managing a specific type of information feedback loop.

Functions contained in S_3 are: (1) scheduling energy trades around bilateral contracts, (2) brokering energy trades around bilateral contracts, (3) arranging energy trades around bilateral contracts, (4) performing metering and data collection activities, (5) managing the settlements process, (6) collecting levies and taxes, (7) allocating transmission rights, (8) administering funds supporting social goals, and (9) disciplining nonresponsive generators.

The focal point of this report is how to undo the vertical structure of regulated electric-power utilities when there are no chances at present to undo the vertical integration of the electricity industry. Therefore, the ISO functions of greatest analytical interest are those that preserve the vertical structure of the regulated utility. They are found in S_2. Within this group, the two most important functions with respect to the report's focal point are the production of ancillary services and the management of information feedback loops.

The production of ancillary services by an ISO requires that it has a sufficient level of *operational control rights* over some of the generation units used to produce these services. These rights are needed to ensure the availability and dispatch of the generation units that produce the ancillary services. The required level of control is assured when an ISO is allowed to: (1) own some must-run generation, and (2) set the rates, terms, and conditions for the ancillary services.

In addition, ISO ownership of some must-run generation can provide a *safety net* for network reliability. A competitive-bidding process for obtaining ancillary services exposes an ISO to the uncertainties of the ancillary-service market.[4] This threat to transmission reliability can be blunted when an ISO owns some must-run generation. The residual portion of ISO-controlled must-run generation can be brought into service when the ancillary-services market is not running smoothly or cannot react quickly enough to changes in the demand for wholesale and retail services.

The efficient allocation of resources to the production of ancillary services is based on the availability of efficient prices for these services. An ISO is able to set such prices and reveal them to sellers in bilateral trades before they are required to supply the electric power to buyers when it has full access to the information needed to manage a feedback loop that reduces the probability that bilateral trades cannot be completed because they interfere with network reliability. In particular, an ISO's management of this information helps to ensure that prices for ancillary services are set such that the required reliability controls are in place at all times when the iteration

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[4] Suppose, for example, that a generation company participating in the ancillary-services market wins a bid to supply operating reserves, but the associated minimum operating level for the winner's generation cannot be efficiently integrated *ex post* into the electric system by the ISO.

sequence induced by the feedback loop converges rapidly enough to the equilibrium hourly quantities demanded of electric power. In other words, an ISO can leverage its support of bilateral trades in the area of complementing network reliability when it has sufficient information supplied in a timely manner.

The results presented in this report indicate that an independent market for bilateral trades, an independent market for spot transactions, and an ISO with the responsibility of maximally relieving network congestion can coexist peacefully. What is required is that an ISO be allowed to collect the *full range* of quantity-related information from the buyers and sellers in the spot market and traders in the bilateral-contract exchange; then be allowed to produce as well as procure the *full range* of ancillary services necessary for the maximal relief of the transmission congestion associated with the preferred generation dispatch schedules that characterize bilateral trades and spot transactions. Two policy decisions are required to achieve this end. First, an ISO should be allowed to *own* or *lease* some must-run generation units. Second, an ISO should be allowed to collect and disseminate all of the information that is necessary to create an information feedback loop that reduces the likelihood that this ISO will deny bilateral trades in order to meet its responsibility of maximally relieving transmission congestion.

The results of this analysis also indicate that the ISO format laid out in this report may be a first step toward a TransCo, if the ISO's governance structure cannot adequately resolve the tricky liability issues that arise when the ISO controls the operation of the transmission assets, and the economic liabilities associated with this control are born by the stockholders of the regulated utilities. If the ISO's mangers and the regulated utility's managers cannot overcome the resulting moral hazard problems through a set of contracts that is acceptable to regulators, then it would be necessary for regulators to order the regulated utilities to divest themselves of their transmission assets.[5] Such an order would create a TransCo that would be responsible for the operation of the transmission grid, but not responsible for the operation of the spot market. It appears that this structural remedy is consistent with the two groups of ISO responsibilities developed in the report.

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[5] There are some who believe that a TransCo will become the preferred option in the United States after the difficulties of implementing an ISO are fully understood. One of these individuals is Charles Falcone of American Electric Power who argues essentially that there is a "silent majority" for the TransCo. See "Here's Hoecker's plan for Transcos and ISOs: Falcone sees 1999 as Year of the TransCo," *Restructuring Today* (October 16, 1998), 1.

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FOREWORD

The responsibilities of an independent system operator (ISO) have emerged as important elements of the restructuring of the United States' electricity industry. State public utility commissions have a strong interest in these restructuring elements because they affect network reliability and the competitiveness of the retail electricity market.

This report develops three types of responsibilities for an ISO operating in a market with bilateral contracts. It also develops a list of suitable functions for each responsibility. Lastly, it presents a restructuring proposal that supplies an ISO with the tools for the maximal relief of transmission constraints, the effective mitigation of market power, and the efficient assurance of network reliability.

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I would like to recognize the debts of gratitude that I owe to all the commentators on the contents of this report. Each of you helped to make this report a better product. I am most indebted to Mr. Kenneth Costello of the National Regulatory Research Institute, Dr. Grace Hu of the Washington D.C. Public Service Commission, and Dr. Karen Palmer of Resources for the Future. Their reviews were particularly insightful because they forced me to focus on the important issues. Lastly, I owe a huge debt to Ms. Marilyn Reiss of the NRRI's Electric and Gas Division who has patiently prepared and reprepared this report for publication, while simultaneously serving as my most perceptive and diligent editor.

INTRODUCTION

Restructuring a regulated electricity industry into competitive and noncompetitive sectors cannot occur without governmental decisions. The challenge to the government is to solve problems that are neither easily dissected nor easily understood. However, there is hope for government officials entrusted with this task. Each of the problems currently facing them in the electricity industry already has been encountered and solved partially or fully by past regulators of the telecommunications and natural-gas industries.[1] Therefore, those individuals currently occupied with the transformation of the electricity industry can turn to existing regulatory practices in these industries for some hints on how to solve the problems they face in the electricity industry.

The problems that are being encountered during the transformation of the electricity industry fall into four categories. The first category consists of problems associated with determining the appropriate form of continued regulation.[2] Should regulators, for example, order nondiscriminatory and open access to transmission and distribution facilities regardless of the ownership of these facilities? What restrictions should regulators place on the regulated utilities as these firms compete to serve the electricity industry's wholesale and retail customers? Should the regulated utilities be required to provide open and nondiscriminatory access through structurally separated distribution and transmission firms? Should regulators encourage regulated utilities to

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[1] Kenneth W. Costello and Robert J. Graniere, *Deregulation-Restructuring: Evidence for Individual Industries* (Columbus, OH: The National Regulatory Research Institute, 1997).

[2] William G. Shepherd, "Dim Prospects: Effective Competition in Telecommunications, Railroads, and Electricity," *The Antitrust Bulletin* (Spring 1997): 151-175.

divest themselves voluntarily of their transmission and distribution facilities in exchange for less regulation in the wholesale and retail markets? Each of these questions or a close derivative already has been adequately addressed in the natural-gas and telecommunications industries.

The second category of problems has to do with the efficient and fair pricing of competitive and noncompetitive services. Should market-based prices for new products or services draw an unusual amount of regulatory attention because of inaccurate measures of their embedded costs of service and no histories of their market demands? Can wholesale and retail prices designed to meet the competition also promote fairness in the transformed electricity industry? Telecommunications and natural-gas regulators already have made many difficult "calls" as they struggle to find the answers to these two questions. Telecommunications history is particularly telling in this regard. AT&T's divestiture of its local operating companies did not result in immediate and unlimited pricing freedom. Instead, AT&T was given the opportunity to start down a long road to pricing freedom beginning with "optional calling plans" for residential customers.

Optional calling plans were advertised to customers and sold to regulators as alternatives to standard long-distance rates. Each plan had two characteristics that distinguished it from the standard long-distance interstate tariff. Every plan contained a two-part tariff that induced self-selection by residential customers according to their usage levels.[3] The average rate associated with a plan was lower for customers selecting the plan than the average rate that was associated with the standard tariff. These characteristics forced federal regulators into deciding whether tariffs resulting in price declines, on average, for specific customers are anti-competitive. Regulators

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[3] Ronald Rudkin and David Sibley, "Optional Two-Part Tariffs: Toward More Effective Price Discounting," *Public Utilities Fortnightly* (July 1, 1997): 32-37.

working on the transformation of the electricity industry have up until now only dipped their big toes into these cold waters, but they can be assured that they will be fully immersed in such problems after a consensus has been reached on the "stranded-cost" problem.

The third category is comprised of problems associated with ensuring that wholesale and retail customers are not targets for fraudulent and deceptive marketing tactics.[4] If history is any guide to the future, then there may be opportunities for a regulated subsidiary of a regulated utility to purchase the products or services of an unregulated affiliate of that utility at inflated prices because the regulated subsidiary withholds pertinent market information from its affiliate's competitors. A famous example of this deceptive marketing practice is the predivestiture relationship of AT&T's regulated companies with AT&T's unregulated manufacturing subsidiary — Western Electric. The separation of the incumbent utility's assets into facilities supporting both competitive services and noncompetitive services is an activity that also is susceptible to deceptive marketing practices. A regulated utility has a profit motive for assigning the costs of facilities that are used jointly in the production of competitive and noncompetitive services to only the noncompetitive services. Regulators working on the transformation of the electricity industry have not yet experienced the inevitable avalanche of these allegations of anti-competitive behavior by the regulated utility.

Allegations of anti-competitive behavior by the regulated utility will not stop at complaints of inflated regulated prices and improperly assigned costs. There is the plethora of complaints associated with outright fraudulent marketing practices. The transformation of the telecommunications industry offers clear examples in this area. For a relatively long period of time, telecommunications regulators have attempted to

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[4] The National Regulatory Research Institute, *Proceedings of the Second NARUC/NRRI Commissioners Summit* (Columbus, OH: The National Regulatory Research Institute, 1998), 8-9.

deal with the problem of "slamming," which is the unauthorized switching of a customer from one long-distance company to a competing long-distance company. This fraudulent marketing practice is associated in varying degrees with several long-distance competitors. When the companies' marketing practices are challenged by regulatory authorities, the usual defense is either to apologize for the behavior of third-party telemarketing companies and then arrange for a switch back, or to argue that the customers did indeed authorize the changes because they confirmed information such as their address and current long-distance company. Similar problems surely will emerge for an indeterminate period of time in the electricity industry, if aggregators or resellers of electricity gain acceptance in the retail market.

The fourth category of problems deals with promoting the economic efficiency of the transformed industry through regulatory interventions addressing the industrial organization of the industry. Threats of anti-competitive pricing and fraudulent marketing practices push regulatory authorities into decisions that affect the industrial organization of the transformed industry. A regulatory intervention in the natural-gas industry consisted of unbundling regulated services and functions. Regulatory interventions in the telecommunications industry emphasized the dismantling of the vertically structured AT&T in an effort to provide equal access to local-loop facilities to AT&T and its competitors.

State and federal regulators are intervening presently in the industrial organization of the electricity industry, and they are running into similar problems that have been solved by past regulators. Like the natural-gas and telecommunications industries before it, the electricity industry is a vertically integrated industry.[5] The transmission and distribution facilities are currently owned by the regulated utilities.

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[5] Local gas utilities generally provide both distribution and gas-supply services, but not interstate pipeline transmission.

These facilities are essential for the delivery of electricity to retail and/or wholesale customers. Also, similar to the natural-gas and telecommunications industries, the regulated utilities in the electricity industry are vertically structured firms.[6] An open question then in this industry is how to undo the vertical structure of the regulated utilities when there are no chances at present to undo the vertical integration of the industry.[7] This is the focal point of this report. [8]

This report is divided into five main sections. The first section contains some remarks on an intervention for deregulating the distribution market that has been

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[6] This report adopts a substantive economic distinction between vertical integration and vertical structure that is implied by Jean Tirole. See J. Tirole, *The Theory of Industrial Organization* (Cambridge, MA: The MIT Press, 1989), 169-173. Vertical integration symbolizes an economic characteristic of an industry. Specifically, it denotes an industry that is subject to economic exploitation by a monopolist that *controls* either critical raw materials or essential, bottleneck facilities. The causes of vertical integration for the electricity industry are the monopolistic control of transmission or distribution facilities. Vertical structure symbolizes an organizational characteristic of a firm. Specifically, it denotes a firm that has internalized the production of some or all *upstream* products and services. For example, an existing regulated firm providing retail services has internalized the production of distribution, transmission, and generation services.

[7] There may be some question as to how there can be a vertically *integrated* industry without vertically *structured* firms. Perhaps, this central point of industry restructuring will be clarified by showing that vertically structured firms are not *necessary* for the existence of a vertically integrated industry. An industry is vertically integrated whenever a single firm controls the supply of either a raw material or intermediate product or service that is critical to the production process. See Tirole, *The Theory of Industrial Organization*, ch. 4. The aluminum industry was vertically integrated in its early stages of development because Alcoa controlled the South American bauxite deposits, and the telecommunications industry was vertically integrated before and after the AT&T divestiture because a single firm controlled access facilities in its respective geographic markets. Alcoa remained a vertically structured firm *after* it lost its antitrust case. Meanwhile, the Regional Bell Holding Companies have been trying to regain their former status of vertically structured firms beginning the day *after* the AT&T divestiture was completed. Therefore, a vertically structured firm is not a necessary condition for the existence of a vertically integrated industry.

[8] Other focal points characterizing the restructuring of the electricity industry are: (1) determining an incentive-compatible form of regulation, (2) pricing regulated services efficiently and fairly, and (3) ensuring against fraudulent and deceptive marketing tactics.

proposed as a means to unravel the vertical integration of the electricity industry. Its purpose is to present arguments suggesting that the proposal is not likely to succeed.

The second section examines the different models that have been adopted for transmission providers throughout the world. It is essentially a descriptive section highlighting important features of each transmission model. It is important for state regulators to realize that each of these transmission models can be adapted easily to the analysis of unbundled distribution services.

The third section classifies the functions that should be, can be, and may be the responsibility of the characteristic form for a transmission provider in the United States, which is the independent system operator (ISO). The foundation for this section is an amalgamation of the observations and conclusions of experts in transmission services and transmission policy. This section also develops and presents a three-tier representation of an ISO's functions and responsibilities that is built upon this foundation. The method of construction is to refer back continuously for guidance to the experiences and practical concerns of those involved with the formation of ISOs.

The fourth section addresses the standard economic issues associated with the ownership, operation, and control of bottleneck transmission facilities by a vertically structured regulated utility competing in the upstream generation market and the downstream wholesale and retail markets. A descriptive analysis employing deductive reasoning is presented demonstrating why the operation and control of transmission facilities have to be separated from the ownership of these facilities. This reasoning rests on the fact that the right to operate and control bottleneck facilities is a formidable source of market power under the appropriate conditions. This section also contains a policy analysis of why an ISO was chosen in the United States as the standard form for a transmission provider over the GridCos and PoolCo-WireCos found elsewhere in the world. This separate analysis is based on a comparison of the observable differences in the characteristics of the three different formats for a separate and independent transmission provider. Similar to the discussion contained in the second section, the discussion in this section is adapted easily to the analysis of a structurally separate distribution provider.

The fifth section analyzes the interactions between an ISO and bilateral contracts when an ISO facilitates competitive sales to wholesale and retail customers and relieves transmission congestion. It contains a descriptive analysis of how an ISO can maximally relieve transmission congestion subject to the constraint that it cannot run "rough shod" over bilateral contracts in order to perform a least-cost dispatch of the available generation units. This analysis is necessarily deductive because the modified version does not yet exist in the United States or elsewhere.

THE ROBUST VERTICAL INTEGRATION OF THE ELECTRICITY INDUSTRY

Reality is such that the reconfiguration of a regulated industry never emerges fully detailed from the collective mind of the stakeholders. Instead, industry reconfiguration occurs as if a tournament is being run. Winners and losers measure their successes and failures by the characteristics of the new market institutions that displace the old ones. At present, several market innovations are vying for permanent places as institutions in the restructured electricity industry.[9] The ISO is the market innovation that is emphasized in this report. However, it is not possible to adequately discuss those ISO characteristics that are necessary for the support of wholesale and

[9] A market innovation is market behavior that is seeking the status of a market institution. This status is achieved when the market behavior becomes widely accepted and is viewed as habitual among the market participants. For example, the corporation is a market institution when it is characterized by centralized decisionmaking within a hierarchical organization. It is a market innovation when it is characterized by decentralized decisionmaking within a hierarchical organization. See Roy Radner, "Hierarchy: The Economics of Managing," *The Journal of Economic Literature* XXX (September 1992): 1382-1415.

retail competition without first analyzing a free-entry proposal meant to unravel the vertical integration of the electricity industry.

Free-Entry Into Transmission and Distribution Markets

A six-point proposal for introducing wholesale and retail competition into the electricity industry dismisses open transmission access as anti-competitive and replaces it with a set of legally sanctioned principles in the tradition of free markets that govern the use, pricing, and ownership of existing and new mediums for transmitting electric power and distributing electricity.[10] First, transmission and distribution *rights of way* are treated as quasi-public goods. Typically, use restrictions and multipart tariffs are the methods of choice for apportioning an economic good of this type.[11] Second, each generator has the right to sell electric power voluntarily to whomever is interested in buying that power. But third, each generator's right to sell is not tied to a law or regulatory rule that requires the owners of transmission and distribution facilities to offer transmission-access or distribution-access services at tariffed rates. Instead, the fourth point is that the transmission and distribution owners are free to set price levels for these services without regulatory oversight. However, fifth, this particular form of pricing freedom is not free from regulatory oversight because the pricing of transmission and distribution services cannot block entry into competitive markets that rely on access to transmission and distribution facilities for their smooth operation. In other words, transmission and distribution pricing cannot be used to hinder entry into generation, wholesale, and retail markets. Lastly, the transmission and distribution owners do not

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[10] Clyde Wayne Crews, Jr., "Electricity Reform: The Free Market Alternative to Open Access," *The Electricity Journal* 10 (December 1997): 32-43.

[11] Douglas N. Jones et al., *Regional Regulation of Public Utilities: Opportunities and Obstacles* (Columbus, OH: The National Regulatory Research Institute, 1992).

have *de jure* exclusive franchises with respect to the production and supply of transmission or distribution services.

Support for Free Entry

The support for the preceding six market rules is a belief that threats of entry into the transmission and distribution markets are sufficiently robust to ensure a competitive electricity industry. But unfortunately, this belief is a specialized economic proposition whose validity is determined by the specifics of the economic situation. In particular, threats of entry are poignant forces for competition only when entry can occur rapidly and exit can occur costlessly because costs are not "sunk."[12] Obviously, this requirement is not a high-probability event given the existing transmission and distribution technologies. Furthermore, these facilities are single-use assets, which effectively make credible threats of entry into the transmission or distribution markets even less likely.

Potential Mitigation of Market Power

Still, it is possible that actual entry into transmission and distribution markets can mitigate the market power of current owners of transmission and distribution facilities. The critical factor is the scale of market entry.[13] A case study involving this factor is United Telecommunications, Inc.'s entry into the long-distance market. United

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[12] William Baumol, John Panzar, and Robert Willig, *Contestable Markets and the Theory of Industry Structure* (New York: Harcourt Brace Jovanovich, 1982).

[13] William G. Shepherd, "'Contestability' versus Competition," *American Economic Review* 74 (September 1984): 572-587.

Telecom, as it was then known, was a holding company managing regulated local operating companies scattered across the United States. This firm had relatively deep pockets as compared to most of the firms choosing to enter the long-distance market. United's entry strategy was to leap frog into third place in the long-distance market by building a more cost-efficient, nationwide, backbone switching network, using fiber-optic transmission and digital-switching technologies. A structurally separated subsidiary, United Telecommunications Communications, Inc., was formed to accomplish this objective.

United Telecom found it expensive to implement this strategy. In 1984, the estimated cost of building United's vision of a long-distance network was approximately 2 billion dollars. While completing its backbone network, United's start-up company acquired a large Texas-based telecommunications reseller and merged with GTE Sprint. The expanded company was known as US Sprint, and it still was only the third largest long-distance competitor behind MCI and AT&T. The moral of this story is that large-scale entry and substantial investments in cost-saving technology appear to be necessary to gain and hold a noticeable share of the national long-distance market. However, technological change in the areas of electric-power transmission and electricity distribution have not been nearly as impressive in terms of cost savings as those in telecommunications. Therefore, it appears that effective entry into either of these markets is apt to be more costly in terms of miles of transmission and distribution facilities than United's entry into the long-distance market approximately fifteen years ago.

Furthermore, it is not likely that retailers, aggregators, or end-user groups will possess or can raise financial resources that are deep enough to pose credible threats of wide-scale entry into the local or regional markets for transmitting or distributing electric power. The deployment of distribution facilities is more costly in densely populated areas than installing local-exchange facilities because electrical distribution must be more adequately protected from incidental contact for obvious safety reasons. In the less densely populated areas, it also would appear that it is more costly to deploy these facilities because the associated construction costs appear to be more sensitive to distance. Meanwhile, line losses associated with the transmission of electric power represent much larger economic and engineering problems than the fading of digital signals that is associated with the transmission of data and voice messages over relatively long distances. Furthermore, it is more difficult to plan and build high-voltage transmission facilities than it is to plan and build the transmission facilities for long-distance communications. Along with the passage rights that have to be negotiated over tribal burial grounds, economic deals that have to be negotiated for the use of rights of way involving subway tunnels and bridges, and the socio-political negotiations involving bike paths and other social amenities, there are the health issues that may be associated with the deployment of additional high-voltage transmission lines.[14] In short, retailers, aggregators, and end-user consortia will find it difficult to raise the financial resources necessary to be successful alternative distribution or transmission companies, even if they are granted parallel rights of way with telecommunications or electric-power firms, or railroad companies.

Market Entry Options

With alternative distribution and transmission companies being a long shot, partnerships with real-estate developers and alliances with existing companies that already have rights of way may be ways to hedge a bet of successful competitive entry

[14] Mohammad Harunuzzaman, "The EMF Issue: How Consumers, Utilities, and Regulators are Responding to a Growing Health Concern," *NRRI Quarterly Bulletin* 12 (March 1991): 47-56; idem, "Overview of Scientific Research on Electromagnetic Fields and Human Health," *NRRI Quarterly Bulletin* 11 (September 1990): 247-267.

into either the transmission or distribution markets.[15] Partnering with real-estate developers for the contracts to build and operate alternative distribution companies is a textbook form of fringe competition for new customers.[16] While sharing rights of way with cable companies, phone companies, gas companies, railroads, and water companies cannot be dismissed out of hand, the transaction costs associated with forming the alliances and initiating and finalizing contracts are likely to be significant especially if rights of way are scarce. Therefore, this particular option does not appear to be particularly conducive to rapid competitive entry into either of the markets. Finally, it will be difficult to design auctions for rights of way on highways and railroad lines for the purpose of adding high-voltage transmission lines. The auction design will have to accommodate private and social valuations during the bidding process because the private valuations of these rights of way are not likely to be sufficiently large to compensate for the health issues associated with transmission services and the protection issues associated with distribution services. In short, it will not be a trivial problem for independent power producers to get their power to their customers at a reasonable cost in the absence of mandatory open access to existing transmission and distribution facilities at regulated prices.

The last set of options for retailers, aggregators, and end-user consortia, who desire access to alternative transmission and distribution facilities, is to cooperate with the current owners of transmission and distribution facilities.[17] They could agree to pay for upgrades and extensions to the existing transmission and distribution networks in exchange for access to the entirety of these networks at a negotiated price. They could

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[15] Crews, "Free Market Alternative," 34-35.

[16] Unfortunately, this competitive format is not particularly well-suited for bringing down end-user prices because one of its most visible characteristics is price leadership by the dominant firm.

[17] Crews, "Free Market Alternative," 36.

build their own transmission capacity on a limited scale and offer some or all of it to the incumbent utilities in exchange for access to the entire transmission or distribution system. They could also agree to cover the labor costs that the incumbent utilities incur to upgrade or extend their transmission and distribution facilities in exchange for limited access to these networks. Although each of these options rests on firm conceptual ground, their practical chances of success are affected by strategic issues and contracting difficulties.

More than simply access to the entirety of the regulated utilities' transmission and distribution networks is required for the successful implementation of the first option. Long-term pricing issues have to be resolved contractually, and also contractual solutions have to be found for the loop-flow problems associated with electric power. The second option could work well in the real world, but its applicability is limited. On one hand, the new entrants have to be dealing with financially strapped incumbents. On the other hand, the rights of way owned by the new entrants have to be critical to the regulated utilities' operations. However, it is extremely unlikely that either of these situations will arise in the initial stages of competitive entry into transmission and distribution markets. The covering of the regulated utilities' costs by new entrants is most suitable for geographic areas where these utilities do not want to upgrade or extend their transmission and distribution facilities, while the new entrants want these things to happen. But obviously, such competitive scenarios cannot characterize the bulk of competitive-entry opportunities for new entrants into transmission and distribution markets. Therefore, bargaining with incumbent utilities for access to their transmission and distribution facilities does not appear to be a strong form of competitive entry.

Deficiencies of the Free-Entry Proposal

Surely, it has not escaped notice that this particular free-market proposal has just been dismissed. But, it is important to place the dismissal in the proper context. The proposal has been found to be deficient because of the economic circumstances characterizing the electricity industry. A free market works best when buyers and sellers cannot engage in strategic behavior meant to increase profits through higher prices.[18] With respect to this proposal, the problem is that the economics of the electricity industry provide ample openings for such behavior. That is, the dominant technologies for transmitting and distributing electric power are associated with sunk costs of a magnitude that weaken the pro-competitive influence of threatened market entry and mitigate most of the forces working in favor of actual entry. Therefore, competitive markets producing ordinary (economic) profit for transmission and distribution services are not expected to emerge even if administratively imposed entry restrictions were lifted, and moreover, competitive transmission and distribution markets could not support the handsome extraordinary (economic) profits that are needed to foster entrepreneurial activity and spur partnerships in electric-power delivery.[19]

It does not appear then that a credible threat to existing transmission and distribution providers will arise even if laws ensuring exclusive franchises are removed from the books. What this means is that the regulated utilities are in the position to earn extraordinary economic profits, if they are given pricing freedom in exchange for

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[18] R.J. Michaels, "Markets of the Future, Utilities of the Past," *The Electricity Journal* 9 (October 1996): 59.

[19] It is the opportunity to earn extraordinary economic profits that will overcome the risks associated with entry into these markets. However, the sunk costs associated with deploying transmission and distribution technologies imply that such opportunities exist only for a limited number of new transmission and distribution suppliers.

losing the legal rights to be the sole providers of transmission and distribution services within a prespecified geographic territory. Moreover, this exchange could place them in the position to withhold transmission and distribution facilities strategically, if they also are permitted to offer transmission and distribution services voluntarily as the *quid pro quo* for the mere possibility of new entrants into the transmission and distribution markets. Finally, there would be little reason, or for that matter opportunity, for the regulated utilities to cooperate or reciprocate with new entrants seeking to provide alternative transmission and distribution services. Therefore, the circumstances currently describing the production of transmission and distribution services indicate that ending exclusive franchises is not a substitute for mandated open access to transmission and distribution facilities. Consequently, the remainder of this report is dedicated to examining the issues associated with establishing an ISO as the gatekeeper for a competitive electricity industry.[20]

MODELS OF TRANSMISSION PROVIDERS

Perhaps, it is not surprising to anyone that the drivers of efforts to restructure the vertically integrated electricity industry are not uniform throughout the world. Fortunately, this variation is useful for classifying the different approaches toward

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[20] An important determinant of the need for an ISO is the belief that the vertical integration of the electricity industry is antithetical to the competitive processes emerging in various sectors of the industry. Vertical integration most often is associated with market power and essential bottleneck facilities, and as a result, restructuring of a vertically integrated industry involves more than simply introducing the seeds of competition and letting the vegetation grow where it may. Instead, the political economy of restructuring this type of industry typically requires that the benefits of competition give way in the early stage of competitive development to the protection of consumer *and* competitor interests. See R.J. Graniere, "Role of Political Costs in the Restructuring of the Electricity Industry," Working Paper, The National Regulatory Research Institute, Columbus, Ohio, 1998, 12-17.

dismantling the vertically structured regulated utilities. For example, it is apparent after reviewing several efforts around the world to restructure the electricity industry that they can be divided into two disjoint sets, where both sets are defined by their initial conditions. One set contains primarily the European efforts involving the privatization of a governmentally owned electricity industry, and the other set contains predominately the North American efforts to reconfigure investor-owned utilities within an already privatized industry. The European and North American efforts are disjoint sets because each effort is associated with a fundamentally different *initial* perspective on the nature of transmission facilities in particular and electricity-producing facilities in general.

The differences between the initial European and North American perspectives are best understood by discussing the fundamental differences between private property and common property. Both types of property are created by economic activity in either less developed or more developed societies.[21] In general, usage rights over private property are delineated more clearly than usage rights over common property.

Who has access to and use of private property is clearly defined in all societies. In addition, the terms and conditions for access to and the usage of private property are well-defined in all societies. The reason is that a private owner with the power of exclusion makes these decisions. Generally, a private owner dedicates his or her property to its highest valued use in his or her eyes subject to the society's laws. For example, private property cannot be used to capture illegal gains. In fact, illegal use of private property makes that property subject to confiscation by federal law enforcement agencies and some state and local law enforcement agencies. Another example of limits on the use of private property is that private property cannot be used in a manner that threatens the health of others.

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[21] H. Peyton Young, *Equity: In Theory and Practice* (Princeton: Princeton University Press, 1994).

The laws and economic incentives are not so clear cut when it comes to access to and the use of common property. By definition, everyone has an equity claim on this type of property.[22] Often times, there is no easy way to deny access to and use of common property. Consequently, the uses to which common property is put are usually determined by customs and norms with an enforcement authority monitoring and correcting communal behavior. This means that the division of the gain or loss from the use of common property typically is determined by power, prestige, precedent, and need. In short, common property is supposed to be managed to the benefit of everyone in the society.

Private property and common property have norms of ownership that complement access and usage.[23] The norm for private property is that it is operated and controlled by individuals, groups of individuals, and corporations or their agents. The norm for common property is that it is operated and controlled by the government or its agents. These norms provide clear pointers to how transmission facilities and other electricity-producing facilities were perceived prior to the efforts undertaken to restructure electricity industries in Europe and North America. These facilities were perceived primarily as common property in Europe, while they were perceived primarily as private property in North America.

It would not be fair to say however that transmission and other electricity-producing facilities were exclusively private property in North America and common property in Europe. Potential users of these facilities were *excluded* in Europe by referencing specific regulatory rules, while potential users of these facilities were *included* in North America on the basis of regulatory rules. This means that

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[22] Ibid., 1-2

[23] The two norms are supported by highly visible and continuously repeated events in both less developed or more developed societies.

transmission and other electricity-producing facilities are hybrids, neither fish nor fowl, neither private property nor common property.

The essence then of privatization in Europe is that a national government wants to endow transmission and other electricity-producing facilities with more of the characteristics of private property. It has chosen to do this by selling off its rights over access to and usage of some of these facilities to private investors. It is able to do this by using the following three-stage procedure. First on its motion, it divests its electricity industry into several parts because this industry is governmentally owned. Second, it selects those parts of the industry that will remain governmentally owned. Third, it sells the residual parts to private investors. This procedure reduces the complaints that the government will receive as a result of its efforts to privatize the industry.

The complaint level is expected to be low from those parts of the electricity industry that are *not* being privatized. In the main, complaints will come from stakeholders in the parts being privatized. In particular, those in charge of privatizing the industry will experience resistance from some of the firm's employees and most of the unions, if any. Also, they may have to contend with the discontent of some ministry employees and selected members of government. However, by and large there is not apt to be a massive conflict between private and public interests, unless union membership and influence are unusually strong in the country.

A North American government cannot restructure an electricity industry using the three-stage procedure that is available to a European government. The primary reason why this is so is because the entire industry already is privatized. That is, the different companies within the industry already are owned by private investors. This means that a divestiture order by a North American government is interpersonal. In other words, person 1 — the government — is ordering person 2 — a privately owned company — to divest some or all of its facilities and assets. Obviously then, those in charge of restructuring a North American electricity industry have more to contend with from stakeholders who resist the sale of these assets and the disintegration of their firm. In summary then, the nature of the conflict in North America is much different from the nature of the conflict in Europe when the event is the restructuring of an electricity industry.

The essence of this difference is that reformers of an already privatized industry have to recognize the legitimacy of the existing property rights to the existing assets that pertain to access to and usage of the associated facilities and assets. That is, reformers cannot act *as if* the existing owners want to relinquish their rights over access to and usage of their assets. Instead, they have to act in a manner that minimally disrupts these existing property rights.[24] A comparison is presented in this section of the differences in responsibilities between models of the ISO used in the United States and other models of transmission providers used throughout the world.

Electric Industry Restructuring — England and Wales

Internationally, the electric-power industry has been restructured in England-Wales and parts of Canada and Australia (see Table 1). Each of these restructurings has associated with it a different perspective on the proper roles and responsibilities of a transmission provider. Industry reformers in England and Wales have opted to configure their transmission market as a monopoly with a regulated firm that owns *and* operates transmission facilities. In addition to operating the transmission system, the National Grid Company for England and Wales is responsible for scheduling and dispatching generators, scheduling and dispatching demand-side management options, purchasing and dispatching ancillary services, overseeing the pool-settlement process,

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[24] F. Woolf, "The Unbundling and Rebundling of Transmission and Market Related Functions," *The Electricity Journal* 9 (December 1996): 45.

TABLE 1: CHARACTERIZATION OF TRANSMISSION MODELS IN THE BRITISH COMMONWEALTH

Models	Company	Transmission Owner	Power Pool	Power Exchange	Absentee Landlord	Figurehead Monarch*
England and Wales	National Grid Company	Yes	Mandatory	No	No	No
Australia	Victoria PowerNet	Yes	N/A	N/A	Yes	Yes
	Victoria Power Exchange	No	N/A	Yes	N/A	N/A
	Victoria Power Pool	No	Mandatory	N/A	N/A	N/A
Canada	Grid Company of Alberta	Yes	N/A	No	No	No
	Power Pool of Alberta	No	Mandatory	Yes	N/A	N/A

Notes: * A figurehead monarch is an official transmission provider that has no say in the expansion or enhancement of the transmission system for reliability purposes.

N/A means "Not Applicable."

Source: Author's construct.

and handling the transfer of funds for the pool of generators.[25] Therefore, the National Grid Company, which is designated as the exemplar for the GridCo, is a *full-service* transmission provider.[26] But, it should be noted that the National Grid Company operates in a transactional environment unlike that found in any of the other countries undergoing a significant restructuring of their electricity industries. It also is the transmission administrator of a mandatory power pool that includes all competitive generators in England and Wales. As a result, it is in the position to establish the spot price for electric power through the economic dispatch of all available generators without regard to whether a dispatched generator has submitted a winning bid to supply electricity to particular end users.

Electric Industry Restructuring — Australia

The roles and responsibilities of the transmission provider and the transmission owner in Victoria, Australia are slightly different from those assumed by the National Grid Company for England and Wales. The province of Victoria has restructured its electricity industry by creating the privately owned but monopolistic Victorian Power Exchange and the monopolistic PowerNet Victoria. The Victorian Power Exchange is responsible for the operation of the transmission system, administration of the power pool, and creation of the spot market for electricity. But, it does not own any transmission assets. Instead, transmission facilities are owned by PowerNet Victoria, who conversely cannot manage and operate these facilities. As a result, the GridCo is

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[25] W.H. Dunn and M.A. Rossi, "Practical Aspects of Electricity Restructuring," *The Electricity Journal* 9 (October 1996): 46.

[26] Some industry observers believe that a GridCo is a necessary condition for equilibrium in the transmission market. See Woolf, "Unbundling and Rebundling of Transmission," 49-51.

not the model that these Australians used to restructure their electricity industry. The Victorian Power Exchange is rather a PoolCo that administers a mandatory power pool known as the Victorian Power Pool, and PowerNet Victoria simply is an absentee transmission owner who has a contractual relationship with a PoolCo.

Because the Victorian Power Exchange does not own transmission facilities, it has to sign transmission contracts with PowerNet Victoria. These contracts deal only with the leasing of transmission assets to the Victorian Power Exchange, which uses these assets to produce network (ancillary) services. The costs of the leases are passed on to the participants of the Victorian Power Pool. The members of the pool must sign contracts with the Victorian Power Exchange for network (ancillary) services produced using the transmission lines that the exchange has leased from PowerNet Victoria for the purpose of operating the transmission system effectively.[27] However, contracts with the exchange are not the only recourse for transmission users in Victoria. They also can sign physical connection (direct-access) agreements with PowerNet Victoria that cover the costs of the site-specific transmission facilities required to connect these customers to the remainder of PowerNet Victoria's transmission system. However, these direct-access customers also have to sign supplementary contracts with the exchange for network (ancillary) services produced using non-site-specific transmission facilities.[28]

Electric Industry Restructuring — Canada

The restructuring of the electricity industry in Alberta, Canada has followed a path different from those taken in other countries of the British Commonwealth.

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[27] Dunn and Rossi, "Practical Restructuring," 47.

[28] Ibid.

Privatization was not an issue in Alberta because the industry already was in the hands of private investors. However, the provincial government believed that a monopolistic transmission company and a mandatory power pool were necessary components of a transformed industry. The mandatory power pool is called the Power Pool of Alberta. It is an independent company that is responsible for power-pool administration and system-control functions. Its administrative responsibilities include, but are not limited to, handling the power-pool settlements and processing and providing information on the spot market for electric power, while the system-control responsibilities include, but are not limited to, scheduling and dispatching generators. The company is called the Grid Company of Alberta, and it is a joint venture of the four transmission-owning companies in Alberta. It is responsible for providing the transmission services, setting the standards for ancillary services, and procuring the ancillary services for the power pool.[29] Therefore, the Grid Company of Alberta has fewer duties than those of the National Grid Company for England and Wales, but it has considerably more duties than what is required of PowerNet Victoria in Australia. Still, it would be speculative to say that the fewer duties of the Grid Company of Alberta translate directly into less responsibility. Unlike the National Grid Company which also is the power pool for England and Wales, the Grid Company of Alberta has to inform the Power Pool of Alberta of the prices and terms of the ancillary-services contracts so that the Power Pool of Alberta can dispatch them efficiently. Consequently, the Grid Company of Alberta has to coordinate its activities with an independent power pool, which is not a requirement for the National Grid Company for England and Wales.

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[29] Ibid.

Electric Industry Restructuring — International Summary

In summary, the National Grid Company for England and Wales does not have to deal with an independent power pool because it is the power pool. The Grid Company of Alberta has to coordinate its behavior with the behavior of the mandatory power pool. Alternatively, the Victorian Power Exchange is a PoolCo because it administers the mandatory Victorian Power Pool. However, unlike the National Grid Company for England and Wales or the Grid Company of Alberta, the Victorian Power Exchange does not own the transmission facilities and assets that it uses to produce transmission services for the participants in the mandatory power pool. Consequently, the approach taken in Australia could result in the inefficient expansion and reenforcement of the transmission network. Fortunately, this inefficiency was anticipated by Australian policymakers. The Victorian Power Exchange is empowered with the authority to order new investment in transmission even though they are not the owners.[30] In effect, PowerNet Victoria has many of the attributes of a figurehead monarch.[31]

It is undecided currently whether any figurehead monarchs will exist in the United States' transmission models. Transmission owners in the United States almost assuredly will possess property rights over their physical facilities and, more than likely, these property rights will include the authority to propose or oppose new investments in transmission facilities. The public-policy issue is whether they will be allowed to exercise their support or denial with or without interference from a company responsible

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[30] Ibid.

[31] A figurehead monarch is an official transmission provider that has no say in the expansion or enhancement of the transmission system for reliability purposes.

for the day-to-day operation of the transmission network. Typically, transmission owners have a singular responsibility when it comes to investing in their networks. They do the planning necessary to avoid situations where their networks are insufficiently reenforced to serve the expected demand for electric power without violating their reliability criteria. Furthermore, they also have a singular responsibility in operating their networks. They must react in real time to solve the problems that arise when the most economical dispatch of the available generation violates their networks' reliability limits.[32] However, the various configurations of the ISOs in the United States do not allow the transmission owners (who are not ISOs) to accept the second responsibility. In fact, the owners are expressly precluded from taking any actions in real time to relieve operating constraints: they are not allowed by regulatory rule to engage in any activities related to the day-to-day operation of their transmission networks. Therefore, the uncertainty afflicting transmission owners in the United States is whether they will be allowed to do the planning that is necessary to minimize operating constraints in the future.

Electric Industry Restructuring — California

California's transmission model is a component of an overriding public policy meant to control the market power of any individual regulated utility or group of regulated utilities.[33] To achieve this objective, California's policymakers have chosen to modify the European approaches to restructuring this industry. Similar to actions

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[32] D. Baldassari, "Building a Foundation of Reliability on the Regional Transmission Highway," (mimeo), 2.

[33] A. Henney, "Contrasts in Restructuring Wholesale Markets: England/Wales, California, and the PJM," *The Electricity Journal* 11 (September 1998): 24-42, 31-32.

taken in Europe, the California policymakers decided to separate the ownership of transmission facilities from the day-to-day control and operation of the transmission network. However, unlike the approaches taken in Europe, they have decided to allow their regulated utilities to retain their ownership of transmission facilities. This departure from the European approach is a rational response to the transaction costs that would accompany a state mandate requiring a vertically structured electric-power utility to involuntarily divest itself of its transmission facilities and related assets.

In California, an ISO does not own the transmission facilities and related assets that it is responsible for operating and controlling on a day-to-day basis.[34] One of the California ISO's main responsibilities is to relieve transmission congestion, if at all possible to do so. However, it cannot achieve this objective by "clearing the market" through the least-cost redispatching of the available generation.[35] Such a restraint is not part of any of the restructuring initiatives in Europe.

Even though California's regulated utilities retain ownership of their respective transmission facilities as is the case in Alberta, Canada, they are not required to create a new firm such as the Grid Company of Alberta to ensure the coordination of the expansion and reenforcement of the transmission network and the absence of collusion. Instead, California's policymakers have created a Power Exchange for the express purpose of separating the spot and bilateral-trade markets for electric power, thereby providing a structural remedy for the mitigation of horizontal market power.[36]

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[34] It is important to note that the ISO, itself, is not owned by the transmission-owing regulated utilities. It also is important to note that the ISO is not managed by personnel on rotation or leave from the regulated utilities. These restraints have been placed on the ISO in order to avoid self-dealing arrangements and discriminatory access to California's transmission system.

[35] S. Stoft, "California's ISO: Why Not Clear the Market," *The Electricity Journal* 9 (December 1996): 39.

[36] The power exchange in California is responsible for only the operation of an hourly spot market for bulk power.

In fact, California's division of the generation market into a Power Exchange and a bilateral-contract exchange has resulted in the strong separation of the bilateral-trade market from the ISO. Parties to bilateral trades can provide their own ancillary services, and they do not have to submit their contract prices to the ISO.[37]

The freedom granted to the bilateral traders in California and the restraints placed on California's ISO come at the expense of the least-cost dispatch of the available generation and the security of the electricity market.[38] It is important to note that this freedom and these restraints are reasonable in the context of minimizing any factors that can interfere with bilateral trades of electric power. Traders in the bilateral-contract exchange do not have to submit binding prices to the ISO because the availability of these contractual prices serves no purpose. The ISO is not an economic dispatcher in California, and consequently, there is no cost-related need to empower it to alter the configuration of the bilateral trades of electric power created through the contractual process. In fact, the ISO is empowered to alter this configuration only when the preferred generation dispatch schedules for spot transactions and bilateral trades result in congestion that it cannot relieve through ancillary services, and even these interventions by the ISO are minimized in California.[39] The Power Exchange, which coordinates the spot market for electric power, is required to submit a preferred generation dispatch schedule that already has accommodated *a priori* known transmission constraints. Scheduling coordinators, other than the Power Exchange, must submit preferred schedules that already have balanced generation, load, and losses, but they cannot provide the ISO with information pertaining to the costs and

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[37] Stoft, "California's ISO," 38.

[38] A subsequent section will devote more time to this important trait of the California approach to restructuring the electricity industry.

[39] Stoft, "California's ISO," 39.

availability of generators that fall outside their preferred dispatch schedules. As a result, the ISO is not aware of any electric power that it can use for congestion management with the associated effect that too many transmission lines are left operating at their security limits.[40]

California's approach to restructuring the electricity industry is unique in comparison to the industry restructuring efforts outside of the United States. Close coordination among the market institutions in California is not anticipated as in the case of Victoria. The California utilities retain *direct ownership* of their transmission facilities: they did not have to form a joint venture company and transfer their transmission assets to it; as the utilities in Alberta did. The configuration of voluntary bilateral trades is heavily protected from alteration in California, while the efforts to restructure the electricity industry occurring outside of the United States leave the configuration of bilateral trades virtually unprotected. Finally, the restraints on the generation scheduling activities of the Power Exchange in California are significantly stronger than the restraints on similar activities by the power exchange in Victoria and the GridCos in England and Wales and Canada. Clearly, policymakers in California are concerned much more about potential abuses of market power than are the policymakers in Alberta, England and Wales, and Victoria. This concern is not unfounded. California's policymakers learned from their intensive study of the European approaches that

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[40] Ibid., 40. California's approach to restructuring its electricity industry exhibits a general trait of restructuring efforts that have been initiated in Europe, Canada, Australia, and elsewhere in the United States. The trait is that the "first-phase" of an industry restructuring effort always has unintended consequences that are corrected as they become apparent. The above result already is being addressed by the Federal Energy Regulatory Commission (FERC) with the assistance of California's policymakers. Specifically, the ISO serving California can now accept voluntarily supplied information from all generators and their customers in order to relieve transmission congestion and provide ancillary services. See S. Stoft, "Transmission Pricing Zones: Simple or Complex," *The Electricity Journal* 10 (January/February, 1997): 24-31.

separation of transmission and generation facilities does not rule out market-power abuses by generation companies.[41]

Electric Industry Restructuring — PJM Region

On the other side of the United States, the PJM Power Pool also is dealing with the restructuring of the electricity industry. Its approach thus far has been substantially different from the approach taken in California. Members of the PJM Power Pool do not schedule spot-market transactions through a power exchange that is separate from the ISO. Instead, both spot transactions and bilateral trades are handled by the PJM ISO.[42] Whereas the restraints on California's ISO prevent it from operating as the least-cost dispatcher of generation, a primary function of the PJM ISO is minimizing the cost of dispatched electric power.[43] Although the ISO in California is required to relieve congestion by minimally altering the configuration of bilateral trades, the PJM ISO is authorized to maximally relieve transmission congestion without regard to the initial (submitted) configuration of bilateral trades.[44] Whereas the California power exchange is not allowed to see the preferred dispatch schedules submitted by the scheduling coordinators for bilateral trades, and the ISO in California is not allowed to arrange voluntary bilateral trades, the PJM ISO does see all of the preferred dispatch schedules and is allowed to arrange beneficial trades on the basis of its superior price-quantity

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[41] Henney, "Contrasts in Restructuring Wholesale Markets," 24-25.

[42] W.W. Hogan, "Getting the Prices Right in PJM: Analysis and Summary: April through August," (mimeo) John F. Kennedy School of Government, Harvard University, Cambridge, 1.

[43] J.D. Lambert, "ISOs as Market Regulators: The Emerging Debate," *Public Utilities Fortnightly* (April 15, 1998): 52.

[44] Hogan, "Getting the Prices Right in PJM," 1.

information.[45] In fact, the only similarity between the two approaches is that the regulated utilities are allowed to retain their ownership of transmission and some generation with the remaining generation being candidates for divestiture.

PJM's ISO classification lies somewhere between a conventional GridCo and a conventional PoolCo. PJM's ISO cannot be a GridCo or a TransCo because it does not own the transmission facilities that it uses to produce transmission services. PJM's ISO cannot be a PoolCo because it does not lease transmission facilities from the transmission owners after the owners have transferred control over these facilities to a "wires company."[46] But, there is a significant similarity between the PJM ISO, a GridCo, and a PoolCo. Each market innovation has been designed to introduce competition in the electricity industry without unduly upsetting the conventional ways of doing business with respect to the delivery of electricity.

Electric Industry Restructuring — Other Regions in the United States

Two other ISOs are up and running in the United States. The first is the ISO providing service for the New England Power Pool (NEPOOL). The second is the ISO that provides transmission services to a portion of the Midwest region. The functions and responsibilities of each of these ISOs fall within the boundaries set by the ISOs serving California and the PJM region.

The ISO providing transmission and others services to NEPOOL has a structure that parallels the structure of the PJM ISO. It is a least-cost dispatcher for the region,

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[45] Ibid.

[46] Woolf, "Unbundling and Rebundling of Transmission," 46.

and the suppliers to this ISO function as a tight power pool. In December of 1998, the FERC approved NEPOOL's proposed restructuring of its ISO, which included market rules for mitigating horizontal market power and a request that market-based rates be applied to electric power sold independently of bilateral contracts.[47] Consequently, NEPOOL now has the regulatory authority to manage a bid-based spot market in addition to offering regulated transmission services.[48]

The Midwest ISO (MISO) has a more limited role than either the PJM or NEPOOL ISOs. It primary function is to provide regulated transmission services. Two reasons account for this state of affairs. First, regulated utilities in the Midwest tend to be self-reliant in the sense that they are prone to self-generate almost all of the electric power needed to serve their customers.[49] This implies that the spot market in the Midwest is a "thin market."[50] Second, the margin of unused capacity is narrow in the Midwest. That is, regulated utilities in the Midwest have relatively little electric power to sell into a spot market. Together, these reasons ensure that very few opportunities exist for buyers and sellers in a spot market managed by MISO. They also ensure that MISO will be profitable only if its transmission tariffs are set sufficiently high.

However, there are two new ISO-related developments that fall outside of the boundaries set by the California and PJM ISOs. The first is occurring in Northern Maine, which is a relatively small geographic area that is electronically isolated from

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[47] FERC Docket Nos. OA97-237-000 et al., December 17, 1998, 85 FERC sec. 61.379.

[48] News Digest: Transmission and ISOs, *Public Utilities Fortnightly*, 37 (February 1, 1999): 14.

[49] B.W. Radford, "MAPP, MISO & PJM: Three Regions Fight Over Wires, Prices and Profits," *Public Utilities Fortnightly* 37 (February, 1, 1999): 25-31.

[50] The definition of a "thin market" is a market where there is very low demand for the offered service.

NEPOOL.[51] This territory is believed to be too small to support an ISO in the tradition of either PJM or NEPOOL. The particular concern is that it would be too costly. The proposed alternative is an Independent System Administrator (ISA). This organization would *not* operate and control transmission facilities and related assets that have been transferred to it by the transmission-owning utilities in Northern Maine. Operation and control of these facilities and assets would remain with the utilities. Instead, the ISA would perform a mixture of four analytical and administrative functions.

First, the ISA is the day-ahead scheduler of transmission services. This means that the ISA coordinates the delivery of electric power to Northern Maine. Second, the ISA submits its schedule to the transmission-owning utilities, who are obligated to follow it exactly as long as there is not a transmission contingency requiring real-time adjustments. This means that the ISA is not directly involved in the physical act of delivery. Third, the ISA secures ancillary services at reasonable prices. This implies that the ISA has official responsibility for the reliability of the transmission grid serving Northern Maine. Fourth, the ISA monitors the actions of the transmission-owning utilities when its employees are on-duty, while it reviews the actions taken by the transmission-owning utilities when the ISA's employees are not on-duty. This means that ISA does not perform its functions twenty-four hours a day. Clearly, the ISA's role is much more limited than any of the other roles of the ISOs providing services in the United States.

The second new development is occurring in the Upper Midwest states, which is the geographic area covered by the Mid-Continent Area Power Pool (MAPP). MAPP's dominant electrical characteristics are a relatively weak transmission grid and a "super-bottleneck" transmission facility connecting MAPP to the Mid-America Interconnected

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[51] In fact, it is within the control area of the New Brunswick Power Company, which is a Canadian electric-power utility.

Network (MAIN). This facility is known as the Twin Cities Export Constraint (TCEC).[52] Northern States Power Company (NSPC) — a MAPP utility — controls TCEC. This means that the less expensive electric power generated by MAPP utilities has to pass through NSPC's transmission facilities before it can by imported by the utilities located within the MAIN territory.

NSPC appears to be dissatisfied with the expected economic return on its transmission facilities, if it joins the proposed ISO for MAPP.[53] As an alternative to ISO membership, it has announced plans to join with Alliant Energy (AE) to jointly develop a for-profit transmission company serving the Upper Midwest states.[54] This joint venture may be called a quasiTransCo because neither NSPC nor AE intends to divest their generation companies and marketing enterprises.[55]

The formation of a quasiTransCo creates three issues for a restructured electricity industry. First, it lays the foundation for a Swiss cheese ISO.[56] This addition to the restructuring landscape could complicate the administration of transmission facilities operated and controlled by an ISO. If a quasiTransCo is interconnected with an ISO, then Kirchhoff's Laws ensure that electric power entering and exiting

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[52] The Twin Cities Export Constraint is a super-bottleneck facility because it is the only transmission line that connects MAPP and MAIN.

[53] B.W. Radford, "MAPP, MISO & PJM," 27.

[54] AE currently is a member of MISO. If NSPC's and AE's joint venture is approved by the FERC, then AE intends to leave MISO.

[55] Recall the standard definition for a TransCo is a stand-alone company that owns, operates, and controls transmission facilities and related assets. A TransCo does not own, operate, and control generation companies, and it does not own, operate, and control marketing enterprises.

[56] A Swiss cheese ISO serves a geographic area with holes in it. In this instance, the holes would be in the MAPP and MISO territories.

transmission nodes controlled by the ISO will traverse transmission facilities operated and controlled by the quasiTransCo. The quasiTransCo will have to be compensated in some fashion for the use of its facilities.

Second, the formation of a quasiTransCo simply recreates on a smaller scale the economic problem meant to be solved by an ISO. Consider that a quasiTransCo, at best, is a joint venture involving at least one vertically structured utility. This means that the management of a quasiTransCo, at least in part, reports to the management of a utility that also has fiduciary responsibilities in the areas of generation and retail services. This fact reintroduces at full strength all of the incentives and opportunities for anti-competitive behavior by a vertically structured utility facing competition in upstream and downstream markets.

Third, the formation of a quasiTransCo focuses attention on the theoretician's *individual rationality constraint*. In the context of ISOs and quasiTransCos, this constraint requires that a utility or a subgroup of utilities will not join an ISO if either believes it can do better economically by going it alone. This means that being a "team player" is not rational behavior when the constraint is binding. In other words, collaboration with other utilities comes at too high a cost for such a utility or subgroup of utilities.

FUNCTIONS AND RESPONSIBILITIES OF AN ISO

Previously, two reasons were given as to why a GridCo, a PoolCo, or an ISO is necessary for the effective restructuring of the electricity industry. They are worth noting again. First, there is a need to protect against self-dealing among any affiliated generation and transmission companies. By construction, GridCos or PoolCos rule out self-dealing because the owners of GridCos or PoolCos are not allowed to own generation facilities. However, the construction of an ISO does not rule out the possibility of adverse economic consequences as a result of self-dealing because the owners of the transmission facilities — the utility's stockholders — also are allowed to own generation facilities. Thus, it is very important that regulators closely monitor the transactions between an ISO and generation companies with ownership ties to it. Second, there is a need to provide adequate insurance against fears of discrimination in the supply and delivery of transmission access to unaffiliated generators and wholesale and retail customers purchasing services from unaffiliated generators when transmission is provided by an ISO. That is, unaffiliated generators must be able to deliver their electric power as easily, as quickly, and as reliably as the affiliated generators. Meanwhile, electricity must be readily available to wholesalers who have chosen either direct access to unaffiliated generators or to retailers who themselves rely on the delivery of electric power purchased from unaffiliated generators. It is well known to those familiar with the history of the telecommunications industry that the efforts necessary to meet these three requirements are not trivial. So, the pertinent question is: What functions does an ISO have to perform and what responsibilities does it have to fulfill to ensure the absence of self-dealing and the efficient and fair delivery of electric power?

One approach to answering the preceding question is to partition ISO functions and responsibilities into three sets. The first set, S_1, contains functions and responsibilities satisfying either or both of the following two conditions. Either an ISO is the only entity that can perform the function efficiently, or the creation of an ISO is the only rational choice for fulfilling the responsibility. An immediate implication of these conditions is that the elements in S_1 represent the minimal set of operations and controls for an ISO that is charged with serving the needs of competitive generation, wholesale, and retail markets. The second set, S_2, contains functions and responsibilities satisfying the condition that network reliability is enhanced when the function is performed or the responsibility is fulfilled by an ISO. An implication of this condition is that S_2 contains transmission-related functions and responsibilities that could be performed and fulfilled less efficiently by companies other than an ISO. This means that disagreements over whether a function or responsibility should be contained in S_1 or S_2 are caused exclusively by differences of opinion among the stakeholders with respect to the appropriate role of an ISO in the restructured electricity industry. The third set, S_3, contains functions and responsibilities satisfying the condition that network reliability is not enhanced when the function is performed or the responsibility is fulfilled by an ISO.

Table 2 is a classified list of the functions and responsibilities contained in S_1. It has been constructed using two restrictions that increase the probability of completing a bilateral trade. On the one hand, the ISO is limited to the physical dispatch of the available generation.[57] On the other hand, its supporting role with respect to setting the spot price for electric power is restricted to its management of transmission constraints and bottlenecks.[58] Consequently, the ISO does not participate directly in the bilateral trades or spot transactions between buyers and sellers of electric power. Instead, it limits its involvement to ensuring the delivery of electric power and pricing the transmission and ancillary services that ensure these deliveries.

Functions and Responsibilities Contained in S_1

The classified S_1 list is divided into management, administration, enforcement, operation, and correction categories. *Management* includes all of an ISO's efforts

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[57] Dunn and Rossi, "Practical Restructuring," 47.

[58] Woolf, "Unbundling and Rebundling Transmission," 48.

TABLE 2: S_1 RESPONSIBILITIES FOR AN ISO

Management	Administration	Enforcement	Operation	Correction
Scheduling of Imports	Fulfilling requests for transmission service	Monitoring conformance of transmission users with procedures, codes, protocols	Monitoring real-time power flows on grid	Limited rescheduling to maintain reliability
Scheduling of Exports	Information disclosure to transmission users	Penalizing non-conformers	Identification of transmission constraints	Dispatching ancillary services to relieve congestion
Interconnection with other Grids	Information sharing with other ISOs		General dispatch of generation	Curtailing generation transactions to maintain reliability
Coordination with other ISOs			General dispatch of ancillary services Maintenance of reliability	Reacting to infeasible bilateral contracts

Source: Author's construct.

directed toward scheduling imports and exports, interconnecting with other grids operated by other ISOs, and coordinating with other ISOs on a regional level.[59] *Administration* deals with staying ahead of requests for transmission services, maintaining a good reputation with transmission users through information disclosure, and transferring information unselfishly to other ISOs to assist them with the importing and exporting of electric power.[60] *Enforcement* consists of monitoring conformance with transmission codes, protocols and procedures, and of penalizing nonconforming transmission users.[61] *Operation* involves monitoring real-time power flows on the transmission grid to determine when constraints exist, dispatching the available generation, dispatching ancillary services, maintaining system reliability, and allocating the available transmission capacity to reflect the scheduling of generation and the commitment of generation units.[62] *Correction* is restricted to limited rescheduling of available generation to maintain system reliability, dispatching ancillary services to relieve transmission congestion, curtailing generation transactions in real time to maintain system reliability, and deciding on a course of action if bilateral trades for generation of varying duration and firmness cannot be implemented physically.[63]

Voltage control is an explicit example of an S_1 function for an ISO. It occurs through injection of reactive power into the transmission network at major load and

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[59] Ibid., 45.

[60] R.P. Felak, "Implementing RTGs and ISOs: Not Just a Technicality," *The Electricity Journal* (June 1996): 28.

[61] Woolf, "Unbundling and Rebundling Transmission," 46.

[62] Ibid., 46-47; Baldassari, "Foundation of Reliability," 3.

[63] M. Ilic′ and L. Hyman, "Getting it Right the First Time: The Value of Transmission and High Technologies," *The Electricity Journal* (November 1996): 13, 15; Woolf, "Unbundling and Rebundling Transmission," 45.

generation nodes to compensate for reactive transmission losses.[64] Although voltage control is required regardless of whether the transmission network is heavily or lightly loaded, the magnitudes of reactive power rise with the electric power loads placed on transmission lines. Reactive power injections can be provided by generation resources when the transmission network is small and the electric system is an isolated system. Under these conditions, it is possible to correlate the transmission topology with the siting of the generators providing the injection; however, shunt capacitors, stat Var compensators, or new electronic devices are required for the large interconnected transmission networks.[65]

Instructively, an ISO's S_1 functions are clustered in activities pertaining to the coordination of the electricity system that must occur within the two-to-ten-second and the thirty-second-to-ten-minute time frames. Within the first window, an ISO's responses to the normal operation of the electricity system are viewed as natural and essential because it is reacting to how generators have responded to changes in demand.[66] Within the second window, generation resources under contract to an ISO are used to correct the actual mismatch of generation and demand.[67] Examples of regulating generation that automatically provide predefined amounts of energy within a ten-minute period are default regulation, fringe control, and transmission-loss compensation.

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[64] Reactive transmission losses, which are due to the loading of the transmission lines, are a function of the square of the current. Because these losses increase with the loading of the transmission lines, the amount of reactive power required to support a transmission network's voltage level increases quadratically with the loading of the network.

[65] L.H. Fink, "Ancillary Transmission Services," *The Electricity Journal* (June 1996): 22.

[66] M. Ilic′ et al., "A Framework for Operations in the Competitive Open Access Environment," *The Electricity Journal* (April 1996): 63.

[67] Ibid.

The elimination or mitigation of operating constraints is achieved by procuring or "calling up" electric energy that is used to ensure the smooth functioning of the transmission network. For example, the explicit substitution of higher cost generation for lower cost generation by an ISO maintains transmission reliability by balancing the flow of electric power on the grid in real time.[68] However, it is not a trivial task for an ISO to balance load flows for the purpose of maintaining transmission reliability. On the one hand, a generation dispatch is conducted by an ISO or other system manager within a very wide bandwidth.[69] On the other hand, a generation dispatch uses different generating units with varying response rates.[70] Consequently, if an ISO or other system manager finds it necessary to intervene in the dispatch of generation units in order to balance load flows, thereby deviating from the preferred dispatch, then it has to be sensitive to the effects of bandwidth and multiple response rates. To further complicate matters, an ISO or other system manager has to know which changes in electric load on the system *cannot be controlled and filter them out* before it can effectively deal with load changes that it can balance through the redispatching of generation units.[71]

When an ISO controls load flows in the above context, it is involved in the S_1 function of default regulation. Explicit intervention by the ISO is the last line of protection against the degradation of transmission reliability. But, there are two other control functions that are as important as default regulation. The first is fringe control, which is achieved through the deployment of fringe load. Operationally, fringe control is

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[68] Baldassari, "Foundation of Reliability," 1.

[69] Fink, "Ancillary Transmission Services," 19.

[70] Ibid.

[71] Ibid.

the network responses necessary to regulate frequency, which is the second additional control function. Frequency regulation, in turn, is required because generating units cannot respond instantaneously to rapid changes in electric load that are the consequences of the demand characteristics of wholesale and retail customers.[72] If this aspect of generation dispatch is not accounted for, then there would be a continuous fluctuating imbalance between generation dispatch and electric load. By adversely affecting transmission reliability, this imbalance might result in the violation of reliability standards.[73] Therefore, fringe control and frequency regulation are S_1 functions for an ISO.

Another need for generation that an ISO will have to deal with in the context of S_1 functions is compensation for transmission loss. Unavoidably, energy loss is associated with the transmission of electric power from the entry node to the exit node of a transmission network. This physical phenomenon becomes more intense with increases in distance and electric load, but it is the transmission loss due to heavily loaded transmission lines that is the most important in the context of reliability. The reason is that compensation for these losses is achieved by loading even more electric power on the already heavily loaded transmission lines. It has been argued forcefully that an ISO necessarily must assume this responsibility because it is too difficult for anyone other than an ISO to calculate the losses.[74] If this argument becomes public

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[72] Frequency regulation increases the cost of a real-world economic dispatch because such effective regulation requires the parallel operation of multiple generation units so that their additive rates of response are adequate to follow customer-imposed load fluctuations. See ibid., 20-21.

[73] If reliability standards are to be maintained in the face of fluctuating energy, then the standard bandwidth for transmitting electric power would have to increase because the bandwidth required to transmit fluctuating energy is twice the bandwidth required to transmit nonfluctuating energy. See ibid., 21.

[74] Ibid., 21.

policy, then an ISO would have to obtain energy under contract directly from generators for the express purpose of loss compensation.

The discussion of an ISO's S_1 functions indicates that regulating generation is a complement to economic generation. It has been suggested that different firms and units will supply economic generation and regulating generation in a competitive generation market; and furthermore, this separation will cause additional complications for an ISO.[75] As noted in the context of these suggestions, if the ISO's contracts for regulating generation do not allow it to order the regulating generators to reduce their output when the network's lower regulating limit is violated, then an ISO would have to look elsewhere for the generation reduction. But despite this complication, it would appear that an ISO is a reasonable candidate for supplying regulating generation because it has ready access to all the information required for real-time operation of the transmission grid.[76]

In any event, the S_1 functions identified above represent an ISO's responses to the actual state of the transmission network under normal and abnormal circumstances. They are performed using resources that assist in establishing the reliable operation of an electric-power system.[77] In essence then, S_1 functions eliminate or mitigate operating constraints that compromise network reliability. Operating constraints, however, can occur at any point in time. Consequently, at any time of the day, the transmission network would not be able to deliver generation "at least cost" without violating the reliability standards adopted for the transmission grid, if these S_1 functions were not performed.[78]

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[75] Ibid., 20.

[76] Baldassari, "Foundation of Reliability," 2.

[77] Ilic′ et al., "A Framework for Operations," 68.

[78] Baldassari, "Foundation of Reliability," 1.

Functions and Responsibilities Contained in S_2

Disagreements over the appropriate functions and responsibilities of an ISO arise when moving outside the context of ensuring the coordination of the electricity system and after entering the context of enhancing the electricity system's security. Therefore, there is virtually universal agreement that an ISO will be responsible for solving the short-term and real-time problems associated with managing the electricity system such as regulating frequency, controlling congestion, and responding to disturbances to the electricity system.[79] Differences of opinion emerge among stakeholders when they consider an ISO's roles in the excess-of-thirty-minutes time frame.

Economic dispatch is a transmission-related function performed within this time frame.[80] A successful economic dispatch, in part, is dependent on the *correct* anticipation of future conditions pertaining to the electrical characteristics of the expected daily trend in load. The other part is that the generating units providing the best match of expected cost characteristics to anticipated electrical characteristics are brought "on line." An economic dispatch, therefore, is not required when no one wants to coordinate the cost characteristics of the available generation resources with the electrical characteristics of the transmission network. However, the failure to pursue an economic dispatch does not mean that concerns about network reliability fall by the wayside. Network reliability can be ensured without an economic dispatch, but this assurance is realized at a higher economic cost as compared to the economic cost

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[79] Ilic' et al., "A Framework for Operations," 63.

[80] Economic dispatch is a cost management function that occurs within the thirty-minute-to-two-hour time period. See Ibid.

arising under an economic dispatch. Hence, enhancing network reliability is not the purpose of an economic dispatch. Consequently, economic dispatch is not an S_2 function under the definitions developed for this report.[81] Recall that the defining attribute of an S_2 function is that it enhances network reliability, if it is performed by the ISO.

Are there any transmission-related functions occurring within the excess-of-thirty-minutes time frame that are S_2 functions using the definitions developed for this report? Providing for system security is a function that enhances network reliability when it is performed by an ISO. System security is the resiliency of an electricity system in relation to well-defined and potentially significant disturbances threatening the maintenance of network reliability.[82]

ISO-provided system security enhances network reliability for the following reasons. In order to achieve system security, the ISO obtains generation either under contract or through operational control rights that provides an adequate reserve margin ensuring the ongoing normal operation of the system. However, what is believed to be an adequate reserve margin can be absorbed unexpectedly. When this occurs for whatever reason, the ISO providing security could directly curtail the access of wholesale and retail customers to the transmission network. Alternatively, it could use a sliding-scale transmission tariff that increases the costs to all wholesale and retail customers as the reserve margin decreases.[83]

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[81] Similar arguments indicate that developing unit-commitment programs is not a S_2 function. These programs are designed to project for dispatchers those generation units that should be operating in the future because it can take from one to ten hours to restart a generating unit. That is, these programs are designed to facilitate an economic dispatch. See Ibid.

[82] Its analytical representation is a joint probability distribution of random electrical disturbances and the contingent (resulting) violation of critical operating constraints. See Fink, "Ancillary Transmission Services," 24.

[83] Ibid.

ISO-provided spinning reserves is another function that is contained in S_2.[84] Spinning reserves are the generation resources providing protection against the contingency of losing a major generating unit. These resources can be obtained by an ISO either under contract, through operational control rights, or through ownership of the generation units. "Pros and cons" are associated with an ISO performing this function.[85] The "pro" of most interest with respect to enhancing network reliability is that a generation company providing spinning reserves under contract to an ISO might not be able to respond quickly enough to a sudden loss of generation because it is likely to have confined this generation service to a few units.[86] On the negative side however, involving an ISO in the system-wide provision of spinning reserves reduces the incentives for customers to purchase their electric power from generation companies with proven track records.

Planning for transmission services is another S_2 function. Several commentators believe that an ISO should have this planning responsibility.[87] Their common belief is that an ISO has the best knowledge of where facilities expansion or reenforcement is needed to avoid violating the reliability planning criteria.[88] The ISO's superior

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[84] The spinning reserve requirement could be spread across the native and nonnative suppliers in the electricity system, and an ISO would naturally use its transmission tariffs to recover the costs that it incurs to fulfill its spinning reserves responsibility.

[85] Fink, "Ancillary Transmission Services," 23.

[86] A "pro" related to an ISO's provisioning of spinning reserves, but unrelated to enhancing network reliability, is that the total level of spinning reserves would be excessively high if each generation company in the electricity system had to provide enough spinning reserves to cover the unexpected loss of its largest generation unit.

[87] For example, see Ilic′ and Hyman, "Getting it Right the First Time," 13-14.

[88] The reliability-planning criteria are derived from the transmission network's historical operational characteristics and the desired future operational characteristics for this network. The objectives of the planning effort are to determine: (1) where additions to the transmission network are needed, and (2) how to redispatch generation, if possible, to relieve transmission constraints without building new voltage lines. See Felak, "Implementing RTGs and ISOs," 27-28.

knowledge is obtained from various sources. They argue that an ISO is in the perfect position to draw inferences about future transmission needs from the current requests for transmission services by generators and their customers. Furthermore, they note that an ISO is most familiar with the real-time operation of the transmission network; this is important for planning purposes because the nonfungible nature of transmission facilities makes it difficult to build "latent flexibility" into the network.[89] Lastly, they indicate that the expansion of a portion of the transmission network creates effects that ripple through the entire network. Therefore, they conclude that whoever is responsible for expanding this network must have the incentive to make investment choices that minimize costs to *all* users. An ISO has the incentive to act in this manner because it should not be inappropriately influenced by the fact that its owners also own generating units.

However, placing the transmission planning responsibility in the hands of an ISO is not without its problems. Transmission planning occurs within the context of anticipated customer load patterns and the delivery obligations of the electricity providers. Therefore, an ISO engaged in transmission planning would need information pertaining to projected consumer demand and generator locations, and it would have to accumulate and process information on land exploration and title claims, which are activities associated with the permitting and siting of new generation and transmission facilities.[90] Therefore, as Woolf concludes, an immediate problem for an ISO with planning responsibility is obtaining this competitively sensitive information from electricity retailers and electric-power generators.

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[89] A particular transmission line, once deployed in the network topology, cannot send its transmission capacity elsewhere. See ibid., 27.

[90] Woolf, "Unbundling and Rebundling of Transmission," 49-50.

Ideally, all stakeholders participating in the production, delivery, and use of electricity would truthfully provide information into the transmission-planning process. This information, in turn, would drive the transmission-expansion process, which consists of adding generators or improving and reenforcing the existing system. However, even if this information is imparted truthfully, its accuracy depends on precise and dependable load forecasting, which is far from assured in an industry undergoing transformation.[91] Further complicating the planning process is that the lead time for new generators is less than the lead time for new transmission facilities; consequently, the generators would not be predisposed to sharing their competitively sensitive information with an ISO.[92] Unfortunately, Kirchhoff's Laws preclude an ISO from countering the generators' competitive self interests by building route flexibility into the transmission network.[93]

Functions and Responsibilities Contained in S_3

Transmission planning, reserve-margin maintenance, and assurance of adequate spinning reserves are functions on the cusp of activities supporting S_1 functions. It already has been argued that unit commitment and economic dispatch are neither S_1 nor S_2 functions. Therefore, both of these functions are contained in S_3 using the definitions developed for this report. Surely, there are other economics-related functions that are contained in S_3.

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[91] Baldassari, "Foundation of Reliability," 3.

[92] Ibid.

[93] Felak, "Implementing RTGs and ISOs," 27.

An ISO could schedule, broker, and arrange energy trades *around* bilateral contracts, and then it could economically dispatch all of the generation units involved in this activity.[94] Whenever an ISO manages these aspects of energy delivery, it naturally establishes a quasispot market for electric power.[95] Moreover, an ISO should be able to perform this function particularly effectively because these particular quasispot prices, in part, are determined by transmission constraints and bottlenecks.[96] However, an ISO operating in this manner would not be a "market maker" for the spot transactions, even if it published these prices. The reason is that the ISO does not reschedule bilateral contracts to achieve an economic dispatch. Instead, its role is limited to that of a facilitator who acts neutrally as it sets quasispot prices according to preestablished rules.[97]

Additionally, an ISO could perform other functions that do not enhance network reliability. It could be involved in metering and data collection, settlements, administration, billing, collection of levies and taxes, administration of social-goal funds, allocation of transmission rights, and the discipline of nonresponsive generators to dispatch instructions.[98]

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[94] An ISO cannot alleviate the problem of must-run generation, where a generating unit in an ISO's territory is the only unit capable of relieving a constraint or providing an ancillary service. See Dunn and Rossi, "Practical Restructuring," 49.

[95] In principle, there is a continuum of spot prices for electric power. If transmission congestion is not an issue, then a single spot price results when an ISO is empowered to economically dispatch all of the available generation. If transmission congestion is a problem, then there may be a different spot price at each node in the transmission network or at groups of nodes in the network. Similar situations would arise at the distribution level, if wholesale and retail competition create distribution congestion.

[96] Woolf, "Unbundling and Rebundling of Transmission," 47-48.

[97] Dunn and Rossi, "Practical Restructuring," 48.

[98] Woolf, "Unbundling and Rebundling of Transmission," 45-46; Dunn and Rossi, "Practical Restructuring," 52.

ISO OWNERSHIP AND OWNERSHIP RIGHTS

Whatever the functions and responsibilities ultimately shouldered by an ISO, a constant feature accompanying its creation is that an ISO sells bottleneck and essential transmission services to its customers. These services will be supplied monopolistically for the foreseeable future. The reasons are the present technological and political circumstances characterizing the electricity industry. However, as established in the previous section, not all of the transmission-related services must be supplied by a monopolistic ISO. It has been argued why an ISO could be the sole supplier of the ancillary services required to maintain the physical equilibrium between the generators' electric loads and the consumers' demand for electric power; the discussion thus far also has indicated, however, that an ISO could easily be one of the competitors in the market for these services.

So, what if two market experiments were run to determine whether an ISO is a natural monopolist?[99] Suppose the first experiment yields the result that the combined transmission- and ancillary-services market is a natural monopoly. Suppose further that the second experiment yields the result that only the transmission-services market is a natural monopoly. Both results ensure the vertical integration of the electricity industry. Consequently, either result ensures that an ISO is a significant strategic force in a restructured electricity industry.

An ISO can act strategically for the benefit of its owners in several ways when it is a natural monopolist. If it is in its owners' self-interest to do so, an ISO can

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[99] An ISO is a natural monopolist when it is the least-cost supplier of the total package of pertinent services. See W.W. Sharkey, *The Theory of Natural Monopoly* (New York: Cambridge University Press, 1982).

expropriate all of the above-normal profits in the electricity industry by setting nonlinear (e.g, two-part) prices for its transmission and ancillary services.[100] If for either internal or external reasons outright profit maximization is not a feasible objective for an ISO, it can act anti-competitively by denying transmission access to its owners' competitors in the generation market. If the denial of access is a nonsustainable strategy because of new technological advances or the eventual intervention by regulators, then an ISO can act in the best interest of its owners by providing inferior transmission access and ancillary services to nonaffiliated generation companies, where inferiority is determined relative to the type of transmission access and ancillary services that it offers the affiliated generators. Lastly, whatever its particular internal and external situations, it can assist affiliated generators indirectly by pricing its transmission and ancillary services anti-competitively. Consequently, ISO ownership and the rights of ISO ownership immediately become public-policy issues.

Public-Policy Decisions Pertaining to ISO Ownership and Rights

The public-policy decisions pertaining to the ownership of an ISO and the rights of this ownership were made quickly and decisively in the United States. With respect to the rights of ownership, the first decision was that an ISO's owners would be the current owners of transmission facilities and assets, unless the current owners voluntarily opted to sell their facilities and assets to nonaffiliated buyers. The second decision was that the owners could own generation and retailing facilities and assets, while they continued to own transmission facilities and assets. Together, these decisions created incentives for an ISO's owners to want the ISO to behave

[100] J. Spengler, "Vertical Integration and Anti-trust Policy," *Journal of Political Economy* 58 (1950): 347-352.

strategically; these incentives, in turn, forced public policymakers into finding a way to stop the owners from acting on their incentives. Therefore, the third decision was that the owners would not be permitted to control or oversee an ISO's day-to-day operations. This last decision had an immediate effect on the course of the transformation of the electricity industry in the United States; namely, no GridCo, PoolCo-WireCo, or TransCo would be formed in this country in the immediate future.[101]

Interestingly, this particular set of policy decisions represents a least-resistance solution to a sensitive transactional problem. Because transmission facilities and related assets are privately owned in the United States, the transaction costs associated with establishing a GridCo, PoolCo-WireCo, or TransCo would be enormous. Some form of governmental mandate would have to be issued that required the current owners of transmission facilities and assets to divest themselves of these potentially highly profitable economic resources.[102] If gears were set in motion to issue this mandate, then undoubtedly a monumental legal battle would have ensued. After all, the current owners of these facilities and assets are not accused formally of the anti-competitive use of their bottleneck transmission facilities.

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[101] Recall NSPC and AE recently have announced plans to form a for-profit, independent company that would own, operate, and control transmission facilities and assets. This is not the classic TransCo design. NSPC and AE are not selling their transmission facilities and assets to third parties. FERC has not yet voted on the NSPC-AE proposal. Before FERC votes, it will have to resolve the regulatory issue of whether it can adequately regulate a quasiTransCo under the market conditions characterizing the NSPC-AE joint venture. In addition, FERC has to address the opposition of many of the regulated utilities who contend that a quasiTransCo subverts ISO proposals. See Radford, "MAPP, MISO & PJM," 24-31.

[102] The transaction cost associated with the creation of a PoolCo by regulated utilities in the United State also would be significant. The government would have to mandate the creation of a WireCo, which is a separate and independent company that owns transmission facilities and assets and does nothing else. Recall, a PoolCo is a power exchange with a contractual relationship with the WireCo. Meanwhile, a GridCo is a PoolCo that is allowed to operate and control the transmission system. A TransCo is not a PoolCo because it does not manage the spot market for electric power.

In addition to being the least-resistance solution to a restructuring problem, these three decisions also represent a least-disturbance foundation for the introduction of competition into the United States' electricity industry.[103] The Important features of the ISO format are quelling fears of anti-competitive self-dealing by a vertically structured supplier of electricity and providing protection against anti-competitive discrimination in the availability and use of transmission facilities and related assets. The ISO format, however, also has to be consistent with ownership of transmission and generation facilities residing in the same firm. In the course of bowing to this consistency condition, policymakers could infer easily that they would be exposing themselves to warranted criticism if they permitted the ISO's activities to be overseen by the ISO's owners. Consequently in the United States, the initial condition of private ownership of the majority of the electricity industry's facilities and assets created the real need to separate transmission ownership from the operation of the transmission system.

Does the United States' ISO format for transmission and ancillary services create a risk or uncertainty that would not exist under a GridCo, PoolCo-WireCo, or TransCo? Clearly, it does. The commercial motives of any transmission owner, regardless of the organization of the transmission company, establish definitively the risk of the transmission company acting anti-competitively when it simultaneously owns generation facilities and related assets. Furthermore, a significant source of uncertainty is created by the ISO format adopted in the United States because an ISO's customers may not know who to blame when something goes wrong with the transmission network.[104] Should the transmission owners shoulder the blame because they are responsible ultimately for transmission planning? Should the ISO's management accept the blame because they are responsible for the maintenance of the transmission network? It

[103] Woolf, "Unbundling and Rebundling of Transmission," 45.

[104] Ibid., 51.

would appear that blame cannot be assessed under the ISO format until after a detailed investigation of the cause of the transmission failure. Such uncertainty may be a source of additional transaction costs that would not be associated with the adoption of a GridCo or TransCo. However, it is a problem with the PoolCo-WireCo configuration.

It has been asked: Is the ISO format in the United States a step toward a GridCo or TransCo format for the United States?[105] The analysis presented in this section indicates that it is not. The direct creation of a GridCo or TransCo in the United States requires the divestiture of privately owned transmission facilities. However, this particular divestiture is not likely to occur either voluntarily or involuntarily in the United States.

The typical situation with respect to voluntary divestitures is that a company's executives decide to divest themselves of specific economic resources when this decision is consistent with their economic self-interests. Clearly, it is not in the economic self-interest of the regulated utilities in the United States' electricity industry to divest themselves voluntarily of their transmission facilities. These investments are a potential source of market power because they cannot be easily duplicated by new entrants into the transmission market.

With respect to involuntary divestiture, the usual case is that the pertinent judicial authority will order divestiture as a remedy for preventing the continuation of anti-competitive behavior on the part of an incumbent. But presently, no formal cases can be found in the United States' judicial system against regulated utilities that support the use of this remedy. Consequently, the conditions presently existing in the United States' electricity industry are not consistent with a conclusion that the creation of an ISO is a step toward the eventual creation of a GridCo or TransCo.

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[105] Ibid., 48.

It is true, however, that the conditions necessary for the emergence of a GridCo or TransCo would exist in the United States, if all of the pertinent regulated utilities in the relevant geographic area voluntarily divested themselves of their generation, wholesaling, and retailing facilities, and assets.[106] Because the regulated utilities would now own only transmission facilities and assets, they would be candidates for organization as a WireCo with a contractual relationship with a PoolCo, a GridCo, or a TransCo.

If the transmission owners are free to select their preferred form of organization, then they would be unlikely to choose the WireCo option. This choice would cause them to enter into principal-agent relationships with a PoolCo because they would have to provide the PoolCo's managers with incentives that induce them to maximize their profits. The design of the appropriate incentive schemes can be quite difficult, and the schemes themselves can be quite complicated. Therefore, it is more likely that they would opt for organization as a GridCo or TransCo. But at present, there are no known instances of regulated utilities in the United States' electricity industry that are willing to give up their generation, wholesaling, and retailing activities in exchange for the opportunity to be a regulated GridCo or TransCo.

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[106] The term "wholesale facilities" has been introduced to emphasize the fact that the sale of wholesale electric-power services is logically no different from the sale of generation, transmission, or distribution services. Wholesale services are produced by wholesalers, and these firms use various forms of capital to produce their services. For example, they have purchased or leased computers and computer programs for the purposes of monitoring, tracking, pricing, and billing wholesale services. These computers and the personnel who run them are housed in buildings that are either owned or leased by the wholesalers. The term "wholesale facilities" refers to these forms of capital.

BILATERAL CONTRACTS AND AN ISO

The transformation of the United States' electricity industry is occurring squarely within the context of consumer sovereignty, which is captured in the construction of what can be called a type-A proposal (see Table 3). This proposal creates an economic environment that allows various consumers to choose easily and rationally from a set of electricity or electric-power providers. The choices available to them are constructed to span a wide range of "on-demand" or contractual relationships between buyers and sellers. Wholesale customers have the opportunity to purchase electric power in a spot market at market-clearing prices. Retail customers will be able to purchase electricity at market-based prices after they subscribe to use the electricity services of specific competitive suppliers. Lastly, some if not all of the retail and wholesale customers will be able to purchase their respective services on a contractual basis. It is the accommodation of these bilateral contracts that confounds an ISO's behavior.

Coexistence of Bilateral Contracts and an ISO-Type-A Proposal

From the beginning of the public-policy debate on the transformation of the United States' electricity industry, a question arises as to the extent an ISO and bilateral contracts can coexist in the context of type-A restructuring proposals. The source of the question is the observation that bilateral contracts for electric services, under such restructuring proposals, are negotiated without the direct or indirect participation of an ISO. These contracts then are presented as fiats of consciousness to an ISO who among other things is responsible for ensuring the integrity and reliability of the

TABLE 3: SUMMARY OF KEY ASPECTS OF TYPE-A PROPOSAL
Characteristics: (1) Bilateral-trade contracts negotiated without the direct or indirect participation of an ISO. (2) ISO assures integrity and reliability of the electricity system while ensuring minimal interference with the bidding in the power exchange and the negotiation in the bilateral-contract exchange. (3) Physical transmission realities require that an ISO must recognize all possible transmission constraints. (4) ISO receives summaries of subsets of information relating to the operation of the bilateral and power exchanges.
Market Design: (1) Competitive generation (2) Wholesale spot market (i.e., power exchange) (3) Wholesale bilateral trades (i.e., bilateral exchange) (4) Retail bilateral trades (i.e., bilateral exchange) (5) Monopolistic transmission (i.e., an ISO) (6) Distribution (7) Retail-spot (i.e., regulated retail sales) markets
Market Rules: (1) Preferred generation dispatch schedules are prepared independently of each other and an ISO. (2) Economic transactions in the bilateral and power exchanges do not have to account for transmission constraints that are common knowledge. (3) ISO cannot clear the generation market. (4) ISO avoids transmission congestion using only those methods that leave the maximum number of transmission lines at their security limits.
Market Behavior: (1) Buyers and sellers in the bilateral exchange do not have to recognize all relevant transmission constraints. (2) Feasibility of preferred generation dispatch schedules for bilateral trades is determined from the insulated perspectives of buyers and sellers.

TABLE 3: SUMMARY OF KEY ASPECTS OF TYPE-A PROPOSAL — *CONTINUED*
Expected Market Outcomes: (1) Market rules prevent coordination of the power and bilateral-trade exchanges. (2) Market rules prevent the achievement of a fully optimized electric system. (3) Market rules prevent information relevant to the electricity system's optimization from being reported to the ISO. (4) Market rules place a higher priority on protecting the negotiations in the bilateral exchange and the bids in the power exchange than on managing production costs. (5) Preferred generation dispatch schedules are not tied reasonably tightly to the management of the grid. (6) Preferred dispatch schedules are prepared without full information on transmission constraints. (7) Some transmission lines are inefficiently unused. (8) Some generation units are unnecessarily dispatched out of merit order. (9) Some transmission lines are inefficiently at their security limits. (10) Excess of transmission lines left at their security limits unnecessarily decreases reliability of the electricity system. (11) ISO cannot replicate the operational efficiencies of a fully optimized electric system because it is not empowered to re-dispatch preferred dispatch schedules to achieve least-cost dispatch.

electricity system through its operation of the transmission network. However, the physical realities of the transmission network may prevent an ISO from doing what is necessary to fulfill the terms and conditions of some of these contracts. For example, the possibility exists for transmission constraints recognized by an ISO but not the parties to the bilateral contracts. When this possibility becomes a reality, it alters the negotiated relationships between buyers and sellers that are reflected in the contracts.

The potentially disruptive influences of any disconnections between bilateral contracts and the physical realities of the transmission network come to the forefront under type-A proposals: these proposals rest upon a very restrictive definition of the least possible interference from an ISO. As an example of the least possible interference phenomenon, consider the following free-market design meant to guide competition. The design contains a power exchange, a bilateral-contract exchange, and an ISO that is responsible for the maintenance of system security and reliability.[107] There are two types of participants in the power exchange. The first type is generators with available electric power that is not under contract to anyone. The second type is customers that find it beneficial to meet their electric-service needs outside the bounds of bilateral contracts. The public-policy aspect of the power exchange is the adoption of bidding protocols by buyers and sellers that minimize the total cost to buyers.[108]

A type-A (consumer sovereignty) proposal can be implemented with four rules that prevent any effective coordination of the power and bilateral-contract exchanges. The first rule is that the feasible dispatch schedules for the power exchange and the bilateral-contract exchange are prepared independently by the managers of the two exchanges. That is, activities in either exchange do not impinge on activities in the other exchange. The second rule is that the exchange managers do not have to account for transmission constraints, even those that are common knowledge to them, as they prepare their dispatch schedules. The third rule is that an ISO manager cannot take any action to clear the actual market, which consists of the power exchange and

[107] This design contains the essential features of California's approach to introducing retail competition into the electricity industry. See Ilic′ et al., "A Framework for Operations," 61.

[108] Stoft, "California's ISO," 41.

the bilateral-contract exchange.[109] The fourth rule is that an ISO is empowered to avoid congestion on the transmission network by using only those methods that leave the maximum number of transmission lines at their security limits after the congestion is relieved. This interpretation of acceptable methods for relieving congestion has costs in terms of lost bilateral trades and system security.[110]

Under these rules, the separate managers for the power and bilateral-contract exchanges present an ISO manager with feasible dispatches of the generators available to them, where feasibility is determined from their individual perspectives. The ISO manager then combines these separate and independent preferred dispatch schedules to create an actual dispatch that takes into account transmission constraints and other reliability-related factors. The actual dispatch falls into one of two categories. It can accommodate fully the dispatch schedules independently supplied by the two exchanges, or it cannot accommodate these separate dispatch schedules fully.

In the first case, an ISO manager is able to meet its S_1 responsibilities without materially affecting either exchange's dispatch schedule. In the second case, an ISO manager is not so fortunate, and more importantly, little can be done about such situations *ex post* since an ISO manager under the third rule is unable to clear the market.[111] That is, an ISO manager is not permitted to execute all available profitable

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[109] It has been argued forcefully that an ISO should be allowed to clear the combined market consisting of the power and bilateral-contract exchanges. The procedure would have the managers of the two exchanges submitting all of their bids to the ISO, and subsequently, the ISO manager would minimize costs using all of the submitted bids. See ibid., 39.

[110] Ibid., 42.

[111] In principle, there is at least one *ex ante design action* that makes it less likely for an ISO manager to not meet its S_1 responsibilities. In theory, the size of an ISO is a "free" design parameter, which means that it is possible to determine an ISO's optimal coverage area. The general relationship between technological efficiency and coverage area has two dimensions. The first is the overall size of an ISO's coverage area, and the second is the size of the control areas within an ISO's coverage area. The efficiency-enhancing directions of these dimensions are: (1) the technological efficiency of an ISO (continued...)

trades in the context of the actual transmission constraints and other reliability-related factors. Additionally under the fourth rule, it has to relieve any congestion in a manner that minimally interferes with the bidding in the power exchange and the negotiation in the bilateral-contract exchange. Some transmission lines, as a result, may remain relatively unused even though they should be used more, while other transmission lines may remain at their security limits when it is not necessary to expose the transmission network to this danger.[112] The under-loaded transmission lines cause an ISO manager to actually dispatch generation units out of merit, whereas lines left at their security limits unnecessarily decrease the reliability of the electricity system.

Coexistence of Bilateral Contracts and an ISO-Type-B Proposal

To a large extent, an ISO's manager's hands are tied under a type-A proposal. Perhaps, the economic outcomes would be better if fewer restrictions were place on an ISO's activities. This possibility is investigated by constructing a type-B (modified consumer sovereignty) proposal (See Table 4). Under this proposal, the ISO is allowed to collect more information from the managers of the power and bilateral-contract exchanges. This information is contained in the preferred dispatch schedules that the managers have drawn up for their retail and wholesale clients. The ISO uses this information to provide maximal relief of any transmission congestion caused by honoring these schedules. It also uses the information to determine the amount of ancillary services required to support the actual dispatch. Lastly, the ISO uses this

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[111](...continued)
increases up to a point and then begins to decrease thereafter, and (2) larger control areas within the coverage area are more technologically efficient than smaller control areas.

[112] Ibid., 41.

TABLE 4: SUMMARY OF KEY ASPECTS OF TYPE-B PROPOSAL
Characteristics: (1) Bilateral-trade contracts negotiated with indirect participation of ISO. (2) ISO assures integrity and reliability of the electricity system by maximally relieving transmission congestion. (3) Physical transmission realities require that an ISO must recognize all possible transmission constraints. (4) ISO collects all the pertinent information from the bilateral and power exchanges to maximally relieve transmission congestion. (5) ISO supplies ancillary services required to support the maximal relief of transmission congestion. (6) ISO sets the prices for ancillary services. (7) Adequate confidentiality agreements are necessary for the information used to maximally relieve transmission congestion.
Market Design: (1) Competitive generation (2) Wholesale spot market (i.e., power exchange) (3) Wholesale bilateral trades (i.e., bilateral exchange) (4) Retail bilateral trades (i.e., bilateral exchange) (5) Monopolistic transmission (i.e., an ISO) (6) Distribution (7) Retail-spot (i.e., regulated retail sales) markets
Market Rules: (1) Preferred generation dispatch schedules are prepared with feedback from the ISO. (2) Economic transactions in the bilateral and power exchanges have to account for transmission constraints that are common knowledge. (3) ISO cannot clear the generation market. (4) ISO avoids transmission congestion using methods that maximally relieve transmission congestion. (5) ISO has access to the information that is contained in the contracts for bilateral trades. (6) ISO extends adequate confidentiality agreements to buyers and sellers in the bilateral exchange.

TABLE 4: SUMMARY OF KEY ASPECTS OF TYPE-B PROPOSAL — *CONTINUED*
Market Behavior: (1) Buyers and sellers in the bilateral exchange have to recognize all common-knowledge transmission constraints. (2) Feasibility of preferred generation dispatch schedules for bilateral trades is determined on the basis of feedback from the ISO. (3) ISO cannot make the actual dispatch a least-cost dispatch.
Expected Market Outcomes: (1) Market rules facilitate the coordination of the power and bilateral-trade exchanges. (2) Market rules allow the ISO to move toward achieving a fully optimized electric system. (3) Market rules ensure that information relevant to the electricity system's optimization is reported to the ISO. (4) Market rules place a higher priority on protecting the negotiations in the bilateral exchange and the bids in the power exchange than on managing production costs. (5) Preferred generation dispatch schedules are tied reasonably tightly to the management of the grid. (6) Preferred dispatch schedules are prepared with full information on transmission constraints. (7) Reliability of the electricity system is enhanced by maximally relieving transmission congestion. (8) ISO is granted explicit authority by regulators to access information in bilateral-trade contracts. (9) ISO cannot replicate the operational efficiencies of a fully optimized electric system because it is not empowered to re-dispatch preferred dispatch schedules to achieve least-cost dispatch. (10) ISO can approach the full optimization of the electric system because it is empowered to maximally relieve reliability constraints. (11) ISO can accurately estimate the costs of ancillary services to its customers because costs depend on the state of the transmission network, which is known to the ISO at all times. (12) ISO can own and operate, if necessary, the generation and other facilities that are used to produce the ancillary services that relieve transmission congestion.

information to establish prices for the ancillary services. However, the ISO is not empowered to use this information to arrange voluntary bilateral trades among the markets' participants.[113]

Although an ISO has more information for decisionmaking in a type-B proposal as compared to a type-A proposal, a type-B proposal has its "pluses and minuses." On the minus side, it does take a step backward in the area of protecting the integrity of bilateral trades. An ISO would find it much easier to adjust the submitted preferred dispatch schedules in the name of transmission reliability. On the plus side, a type-B proposal enhances network reliability by maximally relieving the congestion implied by strict adherence to the terms and conditions of the preferred dispatch schedules. On net then, a type-B proposal rearranges costs by adding some to the private accounts of the buyers and sellers and taking some away from society's public accounts.

The power of a type-B proposal resides in an ISO's ability to access the information that is contained in the contracts for bilateral trades. In this regard, it would seem that an ISO will have to be granted explicit authority to access this information. Several pieces of evidence support this claim. First, the contracts for bilateral trades contain competitively sensitive information on costs. Second, some buyers may have

[113] This proposal is very similar to a proposal presented by Ilic′ et al. Under this proposal, the ISO links the competitive electric-services market, essentially the market consisting of power and bilateral-contract exchanges, with a centrally directed (by the ISO) ancillary-service market by collecting information on the transactions occurring in the electric-service market, assessing the feasibility of these transactions, computing ancillary-service requirements that have to be supplied to ensure a feasible dispatch for supplying the electric-services market, and finally supplying the economic participants in the electric-services market with charges for the ancillary services. See Ilic′ et al., "A Framework for Operations," 63. In this proposal, the ISO does not direct the ancillary-service market. The ISO is the ancillary-service provider. In addition, the ISO can take the steps necessary to maximally relieve congestion in the above proposal, whereas it is not clear that the ISO has this authority in the scenario constructed by Ilic′ et al. Finally, the ISO is not allowed to arrange for voluntary trades of electricity or electric power in either proposal.

been able to win price concessions that are not available to other buyers.[114] Third, a bilateral contract may contain information on a generator's maintenance scheduling that, if available to its competitors, might enhance its competitors' profit-making potential. Consequently, no participant in the bilateral-contract exchange would have an incentive to voluntarily disclose the information that an ISO needs to maximally relieve the congestion on the transmission network *sans* an economic dispatch.

However, mandatory information disclosure raises another set of important questions. Who should have access to the information involuntarily disclosed? How can regulators ensure that the involuntarily disclosed information is adequately, protected? What are the penalties for information leaks? What are the trade-offs between discouraging leaks and discouraging information gathering? A variety of different answers will be offered for these questions. However, one common thread will run through all of them — regulators will have to take explicit steps to put together adequate confidentiality agreements that ensure adequate protection of competitively sensitive information.

But exactly what is the boundary limiting the ISO's use of information under a type-B proposal? An ISO operating within the confines of a type-B proposal is allowed to take all of the steps necessary to maximally relieve congestion on the transmission grid *without* having the authority to make the actual dispatch a least-cost dispatch. Obviously, this boundary suggests a priority order for negotiated power transactions and the management of the transmission grid. It places a higher priority on protecting the negotiations and a lower priority on managing the costs of electricity production.

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[114] Some buyers may have been able to win discounts from sellers because the sellers believed that it was in their competitive interests to do so.

However, it is unfair to say that negotiated transactions are not tied reasonably tightly to the management of the grid. The reason is that relieving congestion takes precedence over the preferred dispatch schedules during the actual operation of the electric-power market. That is, under a type-B proposal, one of an ISO's S_1 functions is to determine the feasibility of the proposed transactions in the bilateral-contract exchange in the context of the operation of the actual power system. But, it is fair to say that an ISO subject to the conditions of a type-B proposal cannot replicate the operational efficiencies of a fully optimized electric system.

The primary reason is that all of the pertinent information relevant to the electricity system's optimization is not reported to an ISO. Instead, the ISO manager receives only the information contained in a preferred dispatch schedule, which is a subset of the information actually required to optimize the dispatch of generation resources. For example, only limited information on the costs of the generating units is presented in each of the preferred dispatches. Furthermore, a preferred dispatch schedule is prepared by a client manager without full information on transmission constraints. Since an ISO subject to the conditions of a type-B proposal is not allowed to redispatch the submitted set of preferred dispatches the ISO cannot compensate in real time for the adverse effects on costs of the less-than-full information on transmission constraints. Therefore, an ISO operating in this information environment cannot fully optimize an electricity system.

Obviously, an ISO's efficiency with respect to assisting in the determination of an efficient spot price for electric power would increase if it is allowed to *economically dispatch* all of the available generation. With this authority in hand, an ISO would go beyond simply deciding whether the submitted bilateral trades could be honored and physically dispatched. Instead, an ISO would be preoccupied with obtaining the best possible estimate of the expected use of the transmission network in order to minimize the adverse economic effects of transmission constraints.[115] However, to perform this function effectively, an ISO would have to collect the pertinent information from all bilateral contracts, assess their economic and physical feasibility, compute and procure the service requirements necessary to support economic dispatch, and finally set the charges for the services.[116]

Still, an ISO that cannot economically dispatch all of the available generation can approach the full optimization of the electric system under a type-B proposal. It can achieve this end by using a two-stage process. First, an ISO can rank the preferred dispatch schedules from lowest cost to highest cost using its full information on the current parameters of the transmission network. Second, it chooses the generation dispatch and the mix of ancillary services that maximally relieve congestion. It is important to note here that an ISO is empowered to supply ancillary services under a type-B proposal. *In particular, it is granted the authority to own, operate and control some must-run generation and other related facilities.*[117] This capability enhances an ISO's ability to relieve transmission constraints. Furthermore, an ISO can supplement its relief of transmission constraints by using its capability to estimate the costs of ancillary services, and then reporting these estimated costs to its customers before they develop their preferred dispatch schedules. An ISO can provide accurate estimates of

[115] Ilic′ and Hyman, "Getting it Right the First Time," 13.

[116] Ilic′ et al., "A Framework for Operations," 63.

[117] If an ISO is required to maximally relieve the transmission congestion, then it needs to control the pricing, availability, and dispatch of ancillary services. This need indicates that an ISO has legitimate reasons for wanting to *own* some of the generation units that are used to produce ancillary services. In principle, this generation would be treated in the same fashion as the bottleneck transmission facilities. Recall that the owners of the bottleneck transmission facilities are the stockholders of the regulated utility who presumably have no control over the decisions relating to the operation of any facilities that are used to support the production of electric power or electricity. The same would be true for the must-run generation subject to the operation and control of an ISO.

the costs of ancillary services because these costs depend on the electrical state of the transmission network, which is known to an ISO at all times.

Comparison of Type-A and Type-B Proposals

The type-B (modified consumer sovereignty) proposal deviates from a type-A (consumer sovereignty) proposal in two important respects. First, an ISO is more of an interventionist in a type-B proposal because it is required to maximally relieve transmission constraints. In contrast, an ISO under the conditions of a type-A proposal is responsible for linking the bilateral-contract and the power exchanges to the ancillary-services market by securing some or all of the ancillary services for the participants in these exchanges; this leaves open the question as to an ISO's actual responsibility in the area of relieving transmission constraints.

Second, the two ISO proposals deviate from each other when it comes to how the generation used to supply ancillary services must be obtained. Consider the following characteristics of the two different ISOs. Both have the responsibility of forecasting expected load independently of the exchanges and then comparing their forecasts to the generation commitments reported by the two exchanges. For both ISOs, the "difference in load" as compared to the list of preferred dispatch schedules always is positive because the ISOs' forecasts consist, in part, of spinning reserves, reserve margins, and must-run generation for reliability purposes. Both ISOs also have the responsibility of obtaining the generation for these purposes.[118] However, they do

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[118] Each ISO also has to compute charges for ancillary services, which are paid by the actors in the two exchanges. Ilic′ et al. suggest a single charge equal to the highest bid for generation accepted in the ancillary-service market plus a congestion cost depending on load conditions affecting the transmission network. See ibid., 65.

so differently. An ISO subject to the conditions of a type-A proposal has to obtain this generation competitively. It fulfills this obligation by obtaining competitive bids.[119] An ISO subject to the conditions of a type-B proposal may own generation in addition to obtaining it through a competitive-bidding process.

The type-B proposal through the ISO's ownership of some must-run generation provides a safety net as the ISO goes about the business of obtaining the required ancillary services. Why? The residual portion of the ISO's must-run generating units can be brought into service when the ancillary-services market is not running smoothly. Suppose, for example, that a participant in the ancillary-services market wins a bid to supply operating reserves, but the associated finite minimum operating level cannot be efficiently integrated into the electric system. Then the residual portion of the ISO's must-run generation may be a better substitute. Suppose further that some of the participants in the bilateral-contract exchange decide to negotiate new contracts or revise existing contracts throughout the day, and then report them to the ISO. These additions and revisions may be less likely to have an adverse effect on reliability, if the ISO can fall back on its must-run generation rather than relying exclusively on additional purchases from the ancillary-services market.[120] Consequently, more of these additions and revisions may be accommodated by an ISO.

Allowing an ISO to own some of the must-run generation has another safety-net feature. The primary purpose of the ancillary-services market is to supply the

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[119] Ibid.

[120] Suppose that some buyers and sellers in the bilateral-contract exchange decide to negotiate new contracts or revise existing contracts throughout the day, and then report their new requirements to the ISO who must make every effort to accommodate them. These new requirements may be less likely to have adverse effects on transmission reliability, if an ISO can fall back immediately on must-run generation that it controls rather than having to rely on a competitive-biding process to obtain additional resources for the ancillary-services market.

generation resources used to ensure the reliable operation of the electric system. As a result, Ilic′ et al., who presented a justification for the type-A proposal, suggest that an ISO should cautiously define entry conditions for this market. They make two suggestions in this regard: (1) technical requirements for participation in this market should be more strict than the technical requirements for participation in either of the exchanges; and (2) participants in this market should be required to commit to supply the ancillary services as the *quid pro quo* for performance rewards.[121] However, it is well-known that it is very difficult to obtain commitments from anyone.[122] Moreover, it is not likely that an ISO will be given the authority to order particular generating units to run and/or conform to the more strict conditions of entry into the ancillary-services market. As a result, the ownership of some must-run generation by an ISO represents a safety net when voluntary participation in the ancillary-services market is too thin in relation to the quantity required of ancillary services. [123]

With respect to the similarity of the two proposals, a feedback loop can be incorporated in both. As noted by Ilic′ et al., prices of ancillary services can be revealed to the participants in bilateral-contract and power exchanges before they are required to supply the electric power to meet their economic obligations.[124] As Ilic′ et al. note further, the *ex ante* release of estimated prices for ancillary services is preferred to the

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[121] Ibid.

[122] T. Schelling, *The Strategy of Conflict* (Cambridge, MA: Harvard University Press, 1960).

[123] Suppose that voluntary participation in the ancillary-services market by generation companies is *too thin* in relation to the quantity required of ancillary services. If an ISO does not have the authority to order the owners of particular generating units to run these units for reliability purposes, it may well be that ISO ownership or leasing of some of the must-run generation is the best last-line of.defense for transmission reliability.

[124] Ilic′ et al., "A Framework for Operations," 66.

ex post release of actual prices because the ancillary-services market is a coordinated market meant to produce nondiscriminatory and efficient prices for these services.

The *ex ante* revelation of estimated prices is particularly important for participants in the power exchange. Because these prices are determined by the joint effects of bilateral contracts and competitive bids on system reliability, the participants in the power exchange can reassess their bids when estimated prices are provided *ex ante*.[125] If the iterations induced by this feedback loop converge rapidly enough to the equilibrium hourly quantities demanded of electric power from the spot market, then the feedback loop ensures that the required reliability controls are in place at all times. Perhaps then, either type of ISO will be less likely to be placed in the position of interrupting loads or denying transactions consummated in either the power exchange or negotiated in the bilateral-contract exchange in order to meet its primary responsibility of keeping the electric system in tact.

As succinctly summarized by Ilic′ et al., an ISO interacts with the ancillary-services market and the power and bilateral-contract exchanges.[126] Its role is multi-dimensional: it collects information on loads and generation; it projects the feasibility and reliability of the expected state of the power and bilateral-contract exchanges; it supplies or contracts for the ancillary services that are required to establish the pre-determined level of reliability for the electric system; it coordinates the delivery of ancillary services in real time; it monitors the activities of the participants in the power and bilateral-contract exchanges; and finally, it sets prices for ancillary services.

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[125] Ibid.

[126] Ibid., 69.

CONCLUSIONS

For a variety of reasons, it is not likely that a credible threat to existing transmission and distribution providers will arise even if laws ensuring exclusive franchises for providing the associated services are removed from the books. Changing nothing else, this means that the current owners of transmission and distribution facilities are in positions to earn extraordinary economic profits, if they are given pricing freedom in exchange for losing the legal rights to be the sole providers of transmission and distribution services within a prespecified geographic territory. Therefore, the circumstances currently describing the production of transmission and distribution services indicate that ending exclusive franchises is not a substitute for governmentally mandated open access to transmission and distribution facilities.

The expected continuation of monopolistic transmission markets has forced the pertinent policymakers throughout the world to separate generation facilities from transmission facilities and transmission facilities from wholesaling and retailing facilities. Furthermore, the expected continuation of monopolistic distribution markets will induce different policymakers to separate generation facilities from distribution facilities and distribution facilities from retailing facilities. As a result, market forces are present that are consistent with the formation of a transmission-distribution provider in the future.

It is extremely important that the correct form of separation is selected by policymakers. Two forms of separation currently exist in the United States. The first addresses the issues associated with a geographic area that was previously covered by a tight power pool. The second addresses the issues that arise when a geographic area is not currently covered by a conventional tight power pool, but instead, the area has a significant power need that is facilitated by either a loose power pool or loose trading agreements.

A review of descriptive evidence indicates that the initial distribution of property rights over transmission facilities and related assets fundamentally affects the form of separation selected by policymakers in different parts of the world. The GridCo, PoolCo, and WireCo are found primarily in countries where transmission facilities were owned initially by the government and were transferred subsequently to private individuals. ISOs are found in the United States, where the ownership of transmission facilities was never in the government's hands. However, any failure on the part of an ISO to control self-dealing and discrimination in the supply of transmission services may cause the ISO to evolve into either a GridCo, PoolCo-WireCo, or TransCo configuration.

Under present conditions in the United States, an ISO is necessary for the effective restructuring of the electricity industry. It allays fears of discrimination in the supply and delivery of transmission access to unaffiliated generators and those wholesale and retail customers purchasing services from unaffiliated generators. However, an ISO does not necessarily supply protection against self-dealing among any affiliated generation and transmission companies.

An ISO must perform several S_1 functions in order to ensure network reliability and the absence of self-dealing abuses. They are the scheduling of imports and exports, interconnecting with other grids, coordinating with other ISOs, fulfilling requests for transmission service, disclosing information to transmission users, sharing information with other ISOs, monitoring conformance of transmission users, penalizing nonconformers, monitoring real-time power flows on the grid, identifying transmission constraints, dispatching generation transactions, limited rescheduling of generation to maintain reliability, dispatching ancillary services to relieve congestion, curtailing generation transactions to maintain reliability, and reacting to infeasible bilateral trades.

Three public-policy decisions pertaining to ownership of an ISO and the rights of this ownership have shaped the present conditions in the United States' electricity industry. The initial characteristics of transmission ownership in the United States and the transaction costs associated with changing these characteristics induced policymakers to allow the current owners to retain their ownership of transmission facilities and assets. The same circumstances characterize the generation and retail markets. Therefore, the government did not issue mandates concerning changes in the ownership of generation companies and retailing enterprises. These actions meant that a regulated utility could own generation and retailing facilities *and* the ISO. Consequently, the government's only recourse in the area of eliminating self-dealing abuses was to prevent the ISO's owners from meddling in the day-to-day operations of this company.

The ownership decisions underlying the initiatives to restructure the United States' electricity industry therefore ensured that a GridCo, PoolCo-Wire, or TransCo would not be part of the context of restructuring in this country. But as usual, costs are associated with these decisions. They create risk and uncertainty that would not exist under a GridCo, PoolCo-WireCo, or TransCo. Regardless of the intensity of the regulatory oversight imposed on an ISO, it cannot obviate the risk that this company will act anti-competitively for the benefit of its owners. With respect to the new uncertainty, it is reasonably evident that blame for transmission or transmission-related failures cannot be assessed until after a detailed investigation of the causes.

The assignment of blame is not a trivial concern. Since the beginning of the debate on the transformation of the electricity industry, a key question has been: To what extent can an ISO and bilateral contracts coexist given the physical realities of the transmission network that may prevent an ISO from doing what is necessary to fulfill the terms and conditions of some contracts? The potentially disruptive influences of these physical realities come to the forefront whenever policymakers provide buyers and sellers with contracting opportunities that rest upon a highly restrictive definition of the least possible interference from an ISO. Therefore, it is reasonable to expect that some of these disruptive influences will be mitigated if an ISO is allowed to collect all the pertinent information from the power and bilateral-contract exchanges and then maximally relieve any congestion associated with the submitted preferred dispatch schedules.

An ISO's interventionist capability under the type-A and type-B proposals is located in the dispatch of ancillary services and not the merit order dispatch of generation units. Therefore, either proposal, as it mitigates the disruptive influences of the physical realities of transmission, places a higher priority on protecting the negotiations in the bilateral-contract exchange and the bids in the power exchange than on managing the costs of electricity and electric-power production. But still, the scheduling of generation units by an ISO under either proposal is tied reasonably tightly to the management of the grid because relieving congestion takes precedence over the preferred dispatch schedules supplied by managers working in the bilateral-contract and power exchanges. However, it also is clear that an ISO and the participants in both exchanges cannot replicate the operational efficiencies of a fully optimized electric system whenever an ISO is not allowed to redispatch the preferred dispatches of both exchanges for the purpose of minimizing the hourly cost of electric power.

If an ISO is prevented as a matter of public policy from maximizing the operational efficiency of an electricity system, then at the very least an ISO should be provided with a safety net as it goes about its business of obtaining the required ancillary services to relieve transmission congestion. An effective way to provide this safety net is to allow an ISO to own some must-run generation in addition to obtaining ancillary services through a competitive-bidding process. If this authority is granted to an ISO, then the residual portion of its must-run generating units can be brought into service whenever voluntary participation in the ancillary-services market is too thin in relation to the quantity required of ancillary services. As a result, additions and revisions to the exchanges' preferred dispatch schedules are less likely to have an adverse effect on network reliability and security.

The analysis presented in this report indicates that the United States' policymakers have some way to go before they adopt either the GridCo, PoolCo-WireCo, or TransCo formats. These alternative formats for a transmission provider require the divestiture of transmission facilities privately owned by regulated utilities. At present, such a divestiture is not likely to occur either voluntarily or involuntarily. With respect to voluntary divestitures, it is contrary to the economic self-interest of the regulated utilities to divest themselves of their transmission facilities because these investments are a potential source of market power. With respect to involuntary divestiture, no formal cases in the United States' judicial system against regulated utilities that support the use of this antitrust remedy currently exist. Consequently, the conditions presently existing in the electricity industry are not consistent with a conclusion that the United States is one step away from a GridCo, PoolCo-WireCo, or TransCo.