

DRAFT PAPER
**Linking Integrated Resource Planning with Interconnection-Wide
Transmission Planning**

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ABSTRACT

Changing regulatory policies in the electric industry have increased competition in the generation sector and encouraged open nondiscriminatory access to transmission. These policies have shifted the responsibility for coordination and investments in the electrical industry. The emerging competitive and decentralized electrical industry faces new challenges to develop institutions to collect information, assess resources, and undertake long-term planning for transmission and reliability. This paper identifies several technical and economic problems related to data collection and analysis that hamper creation of efficient electrical markets. In the Western states outside of California, a regional transmission organization (RTO) will probably not be formed in the near future. As an alternative, a number of ad hoc collaborative efforts are underway to examine resource adequacy, transmission planning, and other issues. This paper recommends supporting these efforts by linking load-serving entity (LSE) integrated resource plans (IRPs) with transmission planning and resource adequacy efforts at the regional and subregional levels, opening access to information on the electrical network, standardizing information and procedures, encouraging LSEs to reconcile load and resource forecasts in IRPs with forecasts compiled by WECC, and institutionalizing modeling and planning efforts.

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I. Introduction

In the West, power plants and their fuel sources are often remotely located far from load centers. The Western Interconnection is characterized by many miles of electric transmission lines criss-crossing the region's vast expanses. Electric transmission is vital to the economic wellbeing of the West, especially with the boom in the wholesale trade of electricity.

The expansion of the western electric transmission system has been sluggish, in part, because market restructuring has decoupled transmission planning from utility resource planning. Grid expansion is further impeded by regulatory uncertainty associated with FERC's push for open access to transmission lines, regional transmission organizations (RTOs) and standard rules for the operation of the grid. As a result, the demands placed on the region's aging transmission system work to skew the economics of certain lines and jeopardize the reliability of others by loading them beyond originally envisioned levels.

There are several institutions in the West working to modernize the grid. The Western Electricity Coordinating Council (WECC) promulgates and enforces reliability rules for the interconnection. Transmission operators ensure that the planning, design and construction of transmission infrastructure support the adequacy and security of the grid. The Seams Steering Group – Western Interconnection (SSG-WI) addresses issues arising from different RTO practices and procedures. The group's transmission planning effort covers the entire interconnection. There are also several sub-regional planning efforts.



Despite the work of these transmission related entities, the West faces fundamental challenges to ensuring open access to a reliable transmission system that supports competitive wholesale electricity markets. WECC's authority to enforce planning standards is based on voluntary participation and compliance¹. Neither WECC nor SSG-WI has a duty to perform transmission planning, let alone the authority to implement a plan. Further, SSG-WI and the subregional planning efforts rely solely on the generous contributions of staff and funding from utilities and stakeholders, so the continuation of their work is anything but guaranteed.

Effective planning for the western transmission system will require accurate predictions of future load growth and resources. Some of the best sources for such information are integrated resource plans (IRPs) of the region's utilities. Integrated resource planning is a public process by which investor owned utilities decide on how to meet load growth by conducting a comprehensive analysis of a full range of supply and

¹ The WECC Reliability Management System, which imposes penalties for non-compliance with standards, is based on contracts voluntarily entered into by control areas. Not all control areas in the Western Interconnection have signed RMS contracts.

demand-side resources under a common set of planning objectives and criteria. Public input, environmental impacts and demand side resources are typically emphasized.²

This paper looks at how integrated resource plans can be incorporated into interconnection-wide and sub-regional planning for the western electric transmission system. Many of the findings in the paper also apply to improving the quality of resource adequacy assessments in the Western Interconnection. Section II presents background on the regulatory changes in the electric industry and identifies unique technical features of the electrical grid. Section III discusses the economic challenges of creating efficient electrical markets. Section IV examines the limitations of current policy and planning efforts. Section V proposes methods to improve information and planning by coordinating integrated regional plans. Section VI presents conclusions from the analysis. The appendix presents a summary of existing planning efforts.

II. Background

A. The Electric Industry and the Changing Regulatory Structure

The electric industry historically developed as a combination of vertically integrated investor-owned and publicly owned (municipal, state and federal) regional monopolies that provided generation, transmission and distribution of electricity.³ In 1996, Federal Energy Regulatory Commission (FERC) introduced regulatory changes to deregulate the generating sector of the electric power industry. FERC's Order 888 functionally separated the activities of power generation from transmission and distribution activities, and permitted market competition among firms providing electrical generation. Order 888 also required that electrical transmission operators provide open access and non-discriminatory transmission services. The corollary Order 889 set procedures for firms to disclose information about their transmission activities.

In an attempt to improve open access and coordination across the electric grid, FERC's Order 2000 encouraged the electric industry to form new regional entities called Regional Transmission Organizations (RTOs). By 2004, RTOs have formed in different parts of the U.S., including New York, Pennsylvania-Maryland-New Jersey, New England, and California. In the Western states outside of California, however, it appears unlikely that an RTO will emerge any time in the near future. As a result, there is no single entity with the authority and responsibility to coordinate operations and planning in the Western Interconnection. Most recently in 2004, FERC's Order 2004 creates new transmission protocols that promote open and non-discriminatory access to the grid and

² For more information on integrated resource planning see The Tellus Institute, *Best Practices Guide: Integrated Resource Planning for Electricity*.

³ See Timothy J. Brennan, Karen Palmer, Raymond Kopp, Alan J. Krupnick, Vito Stagliano and Dallas Burtraw, *A Shock to the System: Restructuring America's Electric Industry*, Resources for the Future, 1996, 15-35. By 1996, investor-owned firms accounted for over 75 percent of retail sales in the U.S. Paul L. Joskow, Restructuring, Competition and Regulatory Reform in the U.S. Electricity Sector, *Journal of Economic Perspectives*, 11(3) 1997, 119-138, at 121.

requires firms operating in generation and transmission sectors to establish firewalls between their respective divisions.

The changing regulatory policies and technological innovations have altered the landscape of the electric power industry. The traditional utilities with vertically-integrated systems are no longer the sole owners and operators of generation and transmission.

B. The Technical Challenge of Efficiently Operating the Electrical Grid

The electric grid is a complex network of wires that links thousands of generators, transmission facilities, and distribution entities. Two important technical features distinguish the electrical grid from other transportation networks such as roads, trains, pipelines or telephones. First, electricity is a unique commodity because there is no economically feasible method for storage. As a result, power generation (supply) must always equal load (demand). An imbalance of power generation and load use can cause the entire electric grid system to collapse. The reliability of the entire network depends upon the successful coordination of power generators and power consumers connected to the grid.

Second, the problem of parallel paths creates special challenges for coordinating the grid operations and avoiding congestion. When multiple wires are interconnected to form a grid, electricity does not travel in a single route from point A to point B. Rather, electricity moves by the principles of physics (Kirshoff's Law) along parallel multiple lines and sometimes circuitous routes.⁴ The exact paths electricity flows are dependent upon the unique combination of power generation, load use, and the spatial relationship of the paths between these injections and withdrawals in the network. This loop flow effect of transporting electricity over the grid complicates the linkage between a given transaction and the lines used to transport the electricity traded.

The network system has important operating features that can be operated in a complementary manner to best utilize the available physical resources of the system. Coordinated investments in the network system can take advantage of complementary features that enhance overall productivity of the system by the appropriate spatial selection of new generators and transmission lines.

III. The Economic Problem of Creating Efficient Electric Markets

The policy of deregulating the electric industry hoped to harness the market and improve economic efficiency. In theory, it can be shown that perfectly competitive markets yield an efficient allocation of resources under the right set of conditions that include the assumptions of perfect information and a well defined system of property

⁴ William H. Hogan, Contract Networks for Electric Power Transmission, *Journal of Regulatory Economics*, 4, 1992, p. 215; Scott M. Harvey, William Hogan and Susan L. Pope, Transmission Capacity Reservations Implemented Through a Spot Market with Transmission Congestion Contracts, *The Electricity Journal*, 9, 1996, 42-55, at. 47.

rights.⁵ In practice, however, imperfect information and a poorly defined system of property rights in the current electricity market inhibits an efficient outcome.

A. Information

Perfect information is one of the simplifying assumptions in the theoretical world of perfect competition. Perfect information implies that information is free for all participants. Firms operating in the world of perfect competition simply observe market prices for outputs and all inputs, and adjust the quantity of output to maximize profits. But when we consider a world of multiple future periods and uncertainty, obtaining good information about the future can be very costly. Firms may invest in collecting this type of information to make optimizing business decisions.

In the electricity market, firms need information on the future demand for electricity, current and future generating capacity, future availability and prices for fuels, weather and hydrological data, and technological innovation. Forecasting future market information is made more difficult without a complete set of futures markets or insurance markets covering all contingencies. Current and future market data is essential in the electrical industry for making resource assessments, evaluating resource reliability, and pursuing transmission planning. These types of analyses require looking and considering the relevant regional network. Modeling these regional electrical networks is very data intensive and expensive. Given the high costs of generating such information, there is a strong incentive to collaborate and share costs for such tasks. It would be inefficient duplicate information collection and planning efforts.

B. Property Rights

In order for a market economy to produce an efficient allocation of resources, there must be a well defined system of property rights. Key property rights characteristics include: (1) universality – all resources are privately owned and all entitlements completely specified; (2) exclusivity – the owner of the resource shall accrue all benefits and costs of owning or using the resource, either directly or indirectly through transactions; (3) transferability – property rights shall be transferable from the owner to others; (4) enforceability – property rights should be free from seizure or encroachment by others.⁶

In the electrical transmission sector, property rights are poorly defined in terms of operating an efficient transportation system for electrons. Owners of transmission lines may own the physical wires and structures of their respective transmission lines. But when these lines are connected to the larger electrical grid, the owners cannot effectively exclude others from sending electricity over these wires because of the law of physics and the loop effects. Transmission owners lack the characteristics of exclusivity and enforceability over their property rights. Owners do not receive compensation for

⁵ See Hal R. Varian, *Microeconomic Analysis*, W.W. Norton & Co., 1978, 55 and 158-179; J.P. Gould and C.E. Ferguson, *Microeconomic Theory*, Richard D. Irwin, Inc., 1980, 213-215, and 443-457.

⁶

unauthorized use of their lines and they lose capacity on their lines that could be used by the owner or rented to other users. The owners have no technical way to prevent the encroachment on their lines by other users of the system except through expensive investment in DC lines or phase shifters..

The current practice in the transmission sector is for transmission operators to contract with users to send electricity from one point to another point in the grid. The point to point contract system, however, is a fiction that does not reflect the true benefits and costs provided by transmission resources. As a result, transmission prices generated by the current system do not provide the appropriate signals to the transmission owners or transmission consumers.

C. Externalities

The lack of exclusive and enforceable property rights, combined with inadequate price signals, creates a problem of congestion externalities over the electric grid system. When one party sends electricity over the network it potentially reduces the available capacity for other users. The available capacity can vary depending upon the unique levels of power generation and load at that moment. The negative impact of reduced capacity can be internalized by the market if prices reflect the congestion effect. In practice, however, transmission prices do not typically reflect the congestion costs on the entire grid and shortages develop for transmission services. Under the current system of firm and non-firm (first come, first serve) transmission access practices, congestion causes some generators to be unable to access to the grid.

Inadequate property rights and price signals also undermine the ability of the market to adjust over time. Transmission owners will not invest in new transmission lines if they can't exclude others from using a new line, and thereby derive the benefits transmission revenues or use these lines for their own generators. Moreover, distortions to transmission line investments can undermine and halt other productive investments in new generating resources, such as wind power, located beyond the existing transmission network.

D. Public Good

An additional obstacle for efficient electrical markets is the public good problem of reliability in the network system. As noted above, the electrical network must be operated to constantly balance power generation with changes in the demand for electricity. If generation does not match load, for a variety of possible reasons, the electrical system can collapse into widespread blackouts. The electric industry can avoid system failures by coordinating operations, planning for anticipated growth in demand, and investing in the infrastructure to provide adequate power in the future. All participants in the industry benefit from enhanced reliability. When one firm derives the benefits of enhanced reliability, it does not reduce or diminish the benefits derived by other firms. This is the crux of the public good problem. There is no effective mechanism to provide system reliability for one firm that is willing to pay for it, and


exclude another firm that does not pay from deriving the same benefits. As a result, efforts to finance investments into public goods like reliability lead to a free rider problem and the market does not provide the efficient level of reliability.

E. Market Power

Market efficiency is also threatened by the ability of certain market participants to exercise market power. The Western electricity crisis of 2000-2001 was in part exacerbated by certain firms manipulating output and raising prices to extract higher profits. Observers argue that conventional notions of market concentration levels are inadequate measures of a firm's market power. According to this analysis, the key lesson from this experience is that marginal players in electricity market may exercise power over price during periods of tight markets.⁷

IV. Limitations of Current Policy and Planning Efforts

During the era of vertically integrated electrical monopolies, these firms were responsible for generation and transmission activities in a region. These monopolies often made operating and investment decisions that considered the broader regional network and thereby internalized some of the congestion externalities and public good reliability problems.

In the new competitive era with competition in the generating sector, the responsibility for coordination and planning has shifted to either (1) new regional entities (e.g. RTOs), (2) new ad hoc entities, or (3) is not being done.  The Western states outside of California, there is not an RTO in existence and we are unlikely to see an RTO formed in the near future. As an alternative, key players in the electric industry, including state governments, PUCs, and industry participants, have worked in an ad hoc collaborative process to develop studies that examine the problem of system resource adequacy, transmission planning, market monitoring and other issues. These western regional planning efforts are more fully described in the appendix.



The current western planning efforts have had a problem obtaining accurate and consistent data about the electric industry. This problem arises for two reasons. First, utilities typically submit information to transmission planners in the West on an as-requested basis without regard to any formal data submission process and certainly not according to standards shared among the various planning efforts. This leads to discrepancies in the assumptions and modeling results among planning groups. These discrepancies increase the difficulty of reaching agreement among utilities, system operators, investors and regulatory commission on transmission additions that may provide benefits for stakeholders. The problem is exacerbated when beneficiaries are outside the geographic scope of the sub-regional study area.

⁷ Frank A. Wolak, "Lessons from the California Electricity Crisis," Working Paper of the Center for the Study of Energy Markets, 2003; Severin Borenstein, James Bushnell, and Christopher R. Knittel, "Market Power in Electricity Markets: Beyond Concentration Measures," Working Paper of the Center for the Study of Energy Markets, 1999.

Second, the organization structure of utilities may contribute to data consistency problems. Many utilities have separate departments for resource planning and transmission planning. It is not uncommon for utility staff that develop resource plans to operate independently and without coordination with utility staff that pursue transmission planning. So a utility's future outlook may be portrayed differently to public utilities commissions as compared to transmission planners. Again, this makes it difficult for utilities, system operators, PUCs and other stakeholders to reach some sort of common ground on projects that might benefit a variety of constituents.

FERC's Order 2004 imposed new firewall rules restrictions that limit communications between an integrated utility's generation and transmission divisions. Under these new rules, communications between these divisions must be available to other market participants and the public.

V. Linking Integrated Resource Planning to Transmission Planning

The most important step in the transmission planning process is modeling the electrical market to predict the future. Modeling the future of the bulk electric system requires many inputs including an assessment of current and future generation capacity, location of future generators, the costs of different fuels, the demand for electricity, future transmission lines, and anticipating future regulations for cost recovery of transmission lines. Some of this information can be found in utility reports to the Energy Information Administration (EIA), WECC, and the North American Electric Reliability Council (NERC). The Electric Power Supply Association also collects data on power plant construction.⁸ But integrated resource plans typically display this type of information in one single document.

The widespread coordination and use of integrated resource plans in transmission planning would improve the accuracy of modeling. It would provide consistency among the results of various planning efforts and participants would have an easier time identifying partners with whom the financing of system additions would be more feasible. The consideration of IRP in transmission planning would also help ensure public participation, a central theme of both processes.

Greater use and coordination of IRPs is not a panacea for transmission planning. Even if every utility operating within a study area submitted their plans, there would still be large holes in the data necessary to develop accurate models since merchant generators, municipal utilities and federal power marketing administrations are not required to submit any sort of standardized resource report to PUCs. The resource reports they do generate are often not available to the public. Finally, the generation information in IRPs may be irrelevant until a utility completes its RFP process and has a better idea of where exactly its energy will be coming from.

⁸ Hirst and Kirby, *Transmission Planning and the Need for New Capacity*, National Transmission Grid Study – Issue Papers D-27 (2002).

There are several ways to go about integrating IRP into transmission planning in the West. No one agency or organization has the authority to implement such a requirement so a collaborative effort is crucial. The options below would seek to utilize IRP information in a coordinated and useful manner for transmission planning.

Option 1. State and provincial PUCs should require load serving entities (LSEs) to compare their analysis of generation and transmission choices with the applicable sub-regional and interconnection-wide transmission plans. LSEs should be required to provide updates throughout the RFP process so that transmission planners are kept abreast of the specific location of new generation.

Option 2. State and provincial PUCs should require LSEs to reconcile their load forecast in the IRP with the load forecast submitted to the Western Electricity Coordinating Council (WECC). Inconsistencies in this information arise because data is submitted to WECC on a control area basis not by LSE, the submission of WECC and IRP information operates on different timeframes, and there can be a disconnect between utility departments responsible for preparing WECC reports and those generating its IRP. While WECC does not conduct formal transmission planning itself, the council does compile information on generation, load and transmission additions that planners often rely on. By reconciling what utilities report to WECC and what they include in their IRPs, transmission planners will gain access to more consistent data that make the results of different sub-regional planning efforts more relevant to one another.

Option 3. Create entities responsible for developing sub-regional models and planning reports that assess the generating capacity, load demand, and transmission resources in the region. These entities would compile data from regulated utility resource plans along with as much information that could be acquired on resource plans of non-jurisdictionals like municipals, co-ops and federal power marketers. Any gaps would be filled in by state regulators and other industry experts. The coordination of information and planning would improve the accuracy and interoperability of regional and sub-regional planning efforts. This proposal would build upon the current ad hoc collaborative efforts in transmission planning and institutionalize the function to a new well funded entity. The current collaborative efforts are not sustainable over time because of the expense to conduct such activities and the free rider effect discourages individual entities from contributing resources to such efforts.

VI. Conclusion

Linking integrated resource planning to transmission planning in the West will require the concerted efforts of many entities. The consideration of IRPs in transmission planning will result in more accurate system models, more consistency in transmission planning results throughout the region and increased partnerships in the financing of new transmission lines. Similarly, linking IRPs and regional resource adequacy assessments will improve the quality and credibility of such assessments, thereby enabling states/provinces and industry participants to act on information in such assessments.

Linkages between individual LSE IRPs and transmission planning and resource adequacy assessment can be improved through PUC orders requiring LSEs to: (1) consider regional transmission plans in their resource plans; (2) submit their resource plans and information on resource acquisition activities to transmission planners to enable the development of a comprehensive region-wide generation expansion scenario; and (3) harmonize the data LSEs report to WECC with what they represent in their resource plans. A longer track record is needed to achieve the funding levels and institutional buy-in necessary to make the consideration of IRP in transmission planning and regional resource adequacy assessments standard practice in the West.

APPENDIX

Recent Regional and Subregional Transmission Planning Efforts

Numerous transmission planning efforts are underway in the West. SSG-WI considers the entire western interconnection in their work while other efforts focus on smaller sub-regions. Transmission planners have yet to fully embrace IRPs as a source of information on new resources and load growth. Below is a review of transmission planning efforts in the West and how they treat IRPs.

TO BE ADDED BASED ON UPDATES AT CREPC MEETING