3

Our nation's transmission systems must be modernized to ensure their continued reliability and facilitate fair and efficient regional wholesale electricity markets that lower costs to consumers. To achieve these goals, we must complete the transition to a restructured industry.

Relieving Transmission Bottlenecks by Completing the Transition to Competitive Regional Wholesale Electricity Markets

The current upheavals and challenges facing our nation's electricity transmission system result, in part, from the incomplete transition to fair and efficient competitive regional wholesale electricity markets. In the view of many, the incomplete transition to a restructured industry poses the greatest challenge facing the electricity system today. Lack of clarity in the regulatory structure inhibits effective planning and needed investment. The transmission system is too important to leave in an extended state of uncertainty. We must complete the transition soon.

Core elements of the transition include establishing regional transmission organizations (RTOs) and increasing regulatory certainty and focus to stimulate investment in innovative solutions to address transmission bottlenecks. Completion of the transition will result in a stable business environment that rewards those who take action to improve the transmission system. The economic rewards from improving the transmission system must be greater than the rewards from maintaining the status quo or decreasing the system's ability to reliably support fair and efficient competitive wholesale markets.

3

Establishing Regional Transmission Organizations

FERC Order 2000 was a major milestone in the movement toward fair and efficient competitive regional wholesale electricity markets. Order 2000 calls for the formation of large RTOs to coordinate markets and ensure the reliability of the nation's transmission system.

FERC outlined four characteristics that RTOs must, at a minimum, demonstrate:

- Independence. RTOs must be independent of market participants;
- Scope and Regional Configuration. RTOs must serve a region of sufficient scope and configuration to permit each RTO to effectively perform its functions;
- Operational Authority. The RTO must coordinate security for its region; and
- Short-term Reliability Authority. The RTO must have exclusive authority for maintaining short-term reliability of the grid it operates.

FERC also identified eight functions that RTOs must perform:

- Tariff Administration and Design. Each RTO must be the sole provider of transmission service in its region and the sole administrator of its own open-access tariff;
- Congestion Management. Each RTO must ensure the development and operation of market mechanisms to manage congestion;
- Parallel Path Flow. Each RTO must implement procedures to address parallel path flow issues within its region and with other regions;
- Ancillary Services. Each RTO must be the provider of last resort of all ancillary services required by FERC Order No. 888 and subsequent orders;
- Open Access Same Time Information System (OASIS) Administration. The RTO must be the single OASIS site administrator for all transmission facilities under its control, with responsibility for independently calculating Total Transfer Capability and Available Transfer Capability;
- Market Monitoring. Each RTO must provide for objective monitoring of the markets it operates to identify design flaws, market power abuses, and opportunities for efficiency improvements and must propose appropriate actions;
- Planning and Expansion. Each RTO must plan and direct necessary transmission expansions and upgrades to enable it to provide efficient, reliable, nondiscriminatory service and must coordinate such efforts with the appropriate state authorities; and
- Interregional Coordination. RTOs must develop mechanisms to coordinate their activities with other regions.

In the summer of 2001, FERC adopted a more directive posture toward RTO formation and began to use existing regulatory authorities to accelerate the process. More recently, FERC has completed a benefit-cost analysis of RTOs and concluded that savings from RTO operation will save between $1–10 billion annually.[23]

RTOs are a means to an end. DOE supports the establishment of well-designed RTOs as an effective way to address many of the market and reliability coordination problems currently facing the nation's transmission systems. Whether RTOs represent the appropriate end-state for the evolution of the U.S. electricity transmission system will depend on their ability to ensure reliability and secure the benefits of fair and efficient competitive regional wholesale electricity markets.

[23]FERC. 2002. *Economic Assessment of RTO Policy.* Download from http://www.ferc.gov

Much work remains to realize this vision. The rules for RTO formation and operation must be clear and rapidly adopted. They must include stable market rules that stimulate the supply and demand sides of markets, interconnection and reliability standards, and transmission pricing mechanisms that reward efficient operation and investment.[24] RTOs must be able to address transmission bottlenecks in their regions.[25]

The Impacts of Transmission Fees on Trade and Congestion

Transmission fees have a substantial impact on electricity trade and congestion. In many regions, users must pay each utility a separate fee for use of its transmission system. This is generally referred to as "rate pancaking." Pancaked transmission rates create economic distortions in bulk-power markets by preventing some trades that would be profitable if not for the multiple transmission fees involved. One of the benefits of large RTOs would be the elimination of pancaked transmission rates.

DOE used POEMS to analyze a scenario that eliminates rate pancaking and instead uses a single access charge to ship power anywhere within an RTO. Five RTOs were assumed for this scenario:

- **Northeast (composed of PJM Interconnection, New York ISO, and ISO New England);**
- **Southeast and Florida;**
- **Midwest;**
- **Texas (ERCOT); and**
- **West (Western Systems Coordinating Council or WSCC).**

Not surprisingly, both electricity trade and transmission congestion between regions increase dramatically when transmission fees are structured as a single access charge. This is a reflection of the increased business activity that would lead to more efficient markets but also to increased loading of interregional transmission facilities. The total volume of electricity traded across regions increases by nearly 20 percent annually, and the average number of congested paths doubles.

The economic impacts of eliminating rate pancaking are even more dramatic. The benefits to consumers from more efficient trade are more than $1 billion per year.*

*This analysis is not an estimate of the benefits of RTOs, nor does it represent DOE's position on appropriate geographic boundaries for RTOs. This analysis only illustrates the importance of transmission fees in shaping trade and congestion patterns. Eliminating pancaked rates is only one of the expected benefits of RTOs.

[24]See Section 4, "Relieving Transmission Bottlenecks Through Better Operations," for specific recommendations to improve transmission system operations.

[25]See Section 5, "Relieving Transmission Bottlenecks Through Effective Investments," for specific recommendations on how RTOs should address transmission bottlenecks.

Effective operation of RTOs will be technically challenging. The tools and technologies originally developed to support centrally planned, vertically integrated operations are inadequate to manage reliability in competitive, region-wide electricity markets where power flows are driven by market participants whose behavior cannot be predicted using only traditional monitoring and dispatch concepts. DOE will work with industry to facilitate the development of transmission enhancement and control technologies that can help ensure reliable operations on a regional scale.[26]

So far, there have been several proposals for the organization and operation of RTOs (see Table 3.1). As expected, there are substantial differences in these proposals, in part because of regional differences in the electricity industry. It will be some time before the various RTO business models can be fully evaluated and fine-tuned. DOE can contribute to this process by helping FERC, the states, industry, and other stakeholders acquire appropriate tools to evaluate the performance of RTOs in meeting functional requirements. DOE can also help by sponsoring forums to determine what economic and reliability data must be collected to conduct these evaluations, who should collect them, and under what circumstances the information should be made publicly available.

The movement toward RTO formation has been slow because today's transmission facilities are owned by many different companies and agencies. Aligning and harmonizing the incentives of these owners to form RTOs that support regional markets involves many different decision and policy makers. Each transmission owner has its own perspective and responds to the incentives (or mandates) created by the economic and legal environment in which it operates. In addition, many states and the federal government have laws that hinder transfer of the assets or operational control of transmission systems to RTOs. These barriers will need to be identified and addressed.

Table 3.1

Current Status of RTO Applications

Name	Status
Alliance RTO	Denied
California ISO	ISO operational
Crescent Moon RTO	Under discussion
West Connect RTO	RTO proposed
ERCOT	Operational (not under FERC jurisdiction)
GridFlorida Transco	Provisionally approved
GridSouth Transco	Provisionally approved
Midwest ISO/ITC	RTO approved
New England RTO	ISO operational. RTO denied
New York RTO	ISO operational. RTO denied
PJM / PJM West	ISO operational
RTO West/ TransConnect	Stage 1 approved
SeTrans Grid	Under discussion
Southwest Power Pool	RTO proposed, now merging with Midwest ISO
American Transmission Company	Operational ITC. Approved under Midwest RTO
TRANSLink Transmission	Proposed ITC under Midwest RTO

Source: Federal Energy Regulatory Commission, as of January 30, 2002.

[26]See Section 5, "Relieving Transmission Bottlenecks Through Effective Investments," for additional discussion of advanced transmission technologies and specific recommendations.

In some cases, tax laws may be a barrier to the formation of RTOs both in transferring operational control of certain transmission assets to an RTO and in transferring ownership of the assets.[27] Federal tax law restricts the use by private firms of transmission facilities that are financed with tax-exempt bonds, or that are owned by certain cooperatives. Under existing statutes and regulations, municipal utilities could lose some or all of their ability to use tax-exempt financing, and certain cooperatives could suffer adverse tax consequences, if they turn operation of their transmission facilities over to an RTO. Temporary Treasury regulations, which are scheduled to expire in 2004, address some of the private use issues arising from participation by municipal utilities in open access. For example, the temporary regulations specify certain open access transactions that do not result in private use, or otherwise do not adversely affect the tax exemption of outstanding bonds. Finalization of the temporary regulations by the Treasury Department, in a manner that enables municipal utilities to transfer operational control of their transmission assets to an RTO in appropriate circumstances, will provide needed certainty in this area. In addition, proposals to remedy this and other tax obstacles are currently pending before Congress.

DOE and the Administration can play a significant role in advancing the formation of effective RTOs. DOE's Power Marketing Administrations (PMAs) have been supportive of RTO formation and have been key participants in RTO discussions. Bonneville Power Administration (BPA), Western Area Power Administration (WAPA), and the Southwestern Power Administration (SWPA) all operate extensive federal transmission systems. However, some legal barriers may prevent PMAs from shifting complete operational control over federal transmission lines to a non-federal entity such as an RTO. PMAs also have a unique relationship with their public power utility customers. These issues need to be evaluated carefully and appropriate measures must be taken to allow PMAs to become full participants in RTOs.

The Tennessee Valley Authority (TVA) is a large federal utility that operates federal transmission as well as significant generation facilities. TVA was originally formed to facilitate unified resource development in the Tennessee Valley. Today, among other things, it manages the Tennessee River system and provides electricity to eight million customers in the southern U.S. The unique circumstances of its creation and its special relationship to customers must be considered as part of any plans for TVA to participate in wholesale competitive markets, but should not inhibit its full participation in an RTO.

[27]Greater horizontal consolidation of transmission assets through the creation of independent transmission companies is described in the next subsection.

RECOMMENDATIONS

- RTOs should be responsible for maintaining the reliability of the grid and ensuring that transmission bottlenecks are addressed.
- DOE, with industry, will assess current system monitoring and control technologies that support efficient, reliable, and secure operation of RTOs and coordinate development of a plan for future research and development.
- DOE will work with FERC and stakeholders to develop objective standards for evaluating the performance of RTOs and will collect the information necessary for this assessment.
- DOE will work with the Energy Information Administration (EIA), FERC, National Governors' Association (NGA), the National Association of Regulatory Utility Commissioners (NARUC), the National Association of State Energy Officials (NASEO), industry, and consumer representatives to determine what economic and reliability data related to the transmission and the electricity system should be collected at the federal level and under what circumstances these data should be made publicly available.
- NGA and NARUC should identify state laws that could hinder RTO development.
- DOE will review federal laws that may prevent PMAs from full participation in RTOs, direct them to participate in the creation of RTOs, and take actions to facilitate their joining RTOs.
- DOE will work with TVA to help it address any issues that inhibit its participation in wholesale competitive markets, including full participation in an RTO.

3

Increasing Regulatory Certainty and Focus

Establishment of RTOs is an important step toward a more stable business environment for transmission system operations and investment. In order to complete the transition to a more stable business environment, additional efforts are necessary to increase regulatory certainty and focus to ensure investment in innovative solutions that will address transmission bottlenecks.[28] These efforts require solving the problems that emerge from:

- The current ways in which owners profit from existing and new transmission investments;

[28]For additional background on this discussion, see the Issue Paper, "Alternative Business Models for Transmission System Investment and Operations," by S. Oren, G. Gross, and F. Alvarado.

- Coordination of the tradeoffs between transmission investments and operation when the organizations that own the transmission system are not the same as those that operate it; and, finally,
- The interconnectedness of the AC transmission system itself, which means that investors in new transmission facilities cannot always charge "rent" for unauthorized use of their facilities because electricity flows over all available paths.[29]

Ensuring Beneficial Transmission Investments Are Profitable

New generation facilities are being built in significant numbers in almost every region of the country while new transmission facilities generally are not. From a business perspective, the explanation is simple: new generation developers have figured out how to produce power more efficiently and to make an attractive return on investments in the current market, while would-be new transmission developers have been frustrated in their efforts to achieve similar goals because their returns depend on regulatory policies and tariffs.

DOE believes that uncertainty about recovery of transmission system investments is a major barrier to new investments in needed transmission facilities. For investor-owned utilities, the costs of transmission are recovered in rates authorized by federal and state regulators. FERC authorizes rates for transmission service that are based on a target rate of return on transmission investments. State regulators authorize rates for retail service, also based primarily on a target rate of return that takes the costs of transmission into account along with all the remaining costs of providing electricity service, including generation, wholesale power purchases, and distribution costs. Recovering the cost of transmission becomes a local responsibility while the benefits of increased market efficiency and reliability are regional. The key to spurring new transmission investments lies in ensuring that the rewards offered by

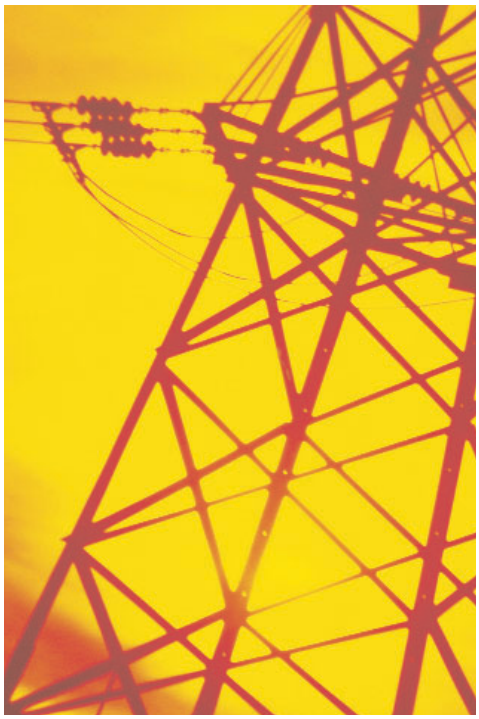
[29]This phenomenon, called loop flow, is described in more detail in the subsection *Loop Flow and the Emergence of Merchant Transmission*, below.

this system of regulation are commensurate with the risks of undertaking these investments and finding innovative approaches to align costs and benefits.

Industry participants have asserted that current rates of return for transmission system investments are not high enough. Authorizing higher rates of return is not the only approach to stimulating needed investments in transmission facilities over the long term. Reducing regulatory uncertainty should also be a focus of efforts to stimulate needed investments. Because transmission assets are long lived, regulatory uncertainty increases the risks to investors and, therefore, increases the returns they need to justify transmission system investments. Increasing regulatory certainty, therefore, should lower the returns needed to justify these investments.

Reconciling conflicting regulatory signals should be a core strategy for reducing regulatory uncertainty. In some states, rate freezes may undermine the benefits that could be realized by new transmission investment because the costs of these investments might not be fully recovered. In fact, rate freezes can create strong incentives not to build transmission. That is, utilities can increase profits under a rate freeze (as the rate base depreciates, costs decline, and load/revenue grows) by not making significant new rate-based investments, which would increase their net cost structure relative to frozen assets. Hence, the utilities' financial interest in avoiding new investment may conflict with the benefits that new investment might provide to the region as a whole. In these cases, state regulators should balance the reasons for the rate freeze against the need to stimulate adequate transmission investment.

More closely aligning the incentives of transmission owners with those of the public and consumers should be another element of eliminating regulatory uncertainty and sharpening the focus of regulatory decisions. For example, one approach that needs to be considered is shifting some responsibility for congestion (both its costs and the benefits from investment to reduce these costs) to transmission owners so that they have an incentive to address transmission bottlenecks. The current form of rate-of-return regulation is based on investment costs. Simply passing costs of congestion through to consumers disconnects the decision to invest from the benefit to the consumer of the investment and thus provides no



incentive to transmission owners to address bottlenecks.

Rate-of-return regulation, therefore, may be inconsistent with newer forms of regulation that seek to emulate the role of competitive market forces in eliciting efficient behavior from regulated firms. A basic tenet of competitive markets is that investors are rewarded based on the value and innovativeness of their actions (not on the cost of their investments, which is the basis for rewards under rate-of-return regulation). A new class of regulatory approaches, called performance-based regulation (PBR), offers greater promise in offering incentives toward this end. Examples of PBR can be found in the telecommunications industry in the U.S. and in regulated utility industries around the world, most notably in the UK.

PBR is attractive because it provides targeted incentives to regulated firms to achieve specific objectives (e.g., to increase market efficiency, ensure reliability, and make timely investments). In order to ensure that these objectives are met, it is necessary to define performance measures that directly relate to the objectives and to ensure that firms have adequate control over the means of meeting the objectives. If the goal is to minimize the cost of transmission service, a firm must be able to balance improvements in operations with investments in new transmission facilities, including the deployment of advanced technologies. Similarly, if the transmission owner bears no responsibility for costs of congestion, there is no incentive to reduce it.[30] PBR in the UK has led to a substantial reduction in congestion costs (see text box).

The Role of Performance-Based Regulation in Promoting Efficient Transmission

One of the best-known PBR mechanisms for electricity markets is found in the UK, for transmission services provided by the National Grid Company (NGC). Though it could not be transferred directly to the U.S., this approach also illustrates the role that incentives for enhanced transmission system operations can play in stimulating efficient transmission operation, including investment in innovative transmission technologies.

NGC's PBR mechanism employs a profit-sharing approach to reward NGC for reducing the charges that are passed on to consumers for recovery of congestion relief costs incurred by NGC. The profit-sharing scheme is based on NGC's performance relative to a predetermined "yardstick" set by the regulator in view of historical performance and expected efficiency improvements. NGC has reduced the costs of congestion through a combination of operational efficiency improvements, improved forecasting, investment in transmission expansion, and adoption of technologies that improve transmission grid utilization. NGC has pioneered an innovative approach in which some of these technologies, in contrast to conventional approaches, are mobile. NGC moves them around the system in order to target areas in need of relief, which vary from year to year in response to changing market trading patterns.

Source: S. Oren, G. Gross, and F. Alvarado. 2002. *Alternative Business Models for Transmission System Investment and Operations*, Issue Papers.

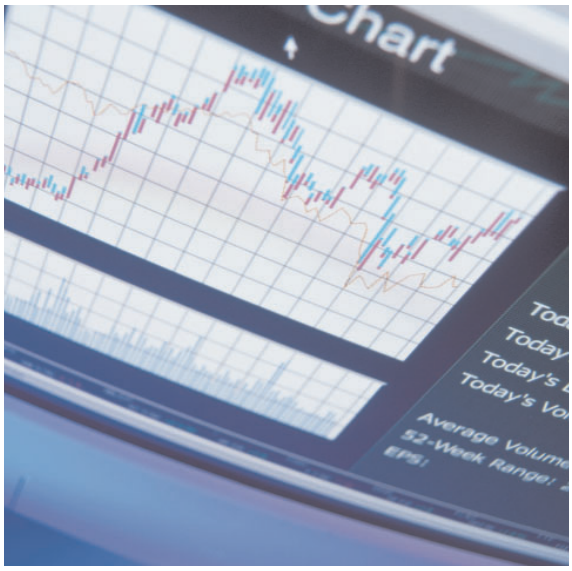
[30]For example, one way owners might, in turn, address increased responsibility for managing congestion costs is by pricing it explicitly, thus providing an incentive to market participants to reduce these costs through adjustments to their own actions to use the transmission system. This concept is discussed further in Section 4, "Relieving Transmission Bottlenecks Through Better Operations."

Finally, it may be appropriate to consider other methods for increasing the profitability of transmission investments, especially when investments address important regional or national interests.

Coordinating Transmission Investment and Operation

During the 1990s, many states passed electricity industry restructuring legislation to introduce wholesale and sometimes retail competition. In addressing wholesale competition, state legislation typically reinforced FERC Orders 888 and 889 by directing utilities to accelerate the process of separating transmission and generation functions, including divesting generation assets, or by providing strong incentives for divestiture. States directed utilities to ensure that operation of the transmission system would support the emergence of competitive wholesale markets for generation. Insulating transmission and generation operations from each other typically entailed allowing transmission owners to retain possession of their transmission assets but transferring operational control of them to an independent entity.

Independent System Operators (ISOs), the new institutional structures authorized by FERC in recent years to operate transmission assets, have led to a disconnection between transmission investment and operational needs. A major challenge to investment and innovation when control and ownership of transmission are separated is the creation of



a financial linkage between those who benefit from the investment (the public) and those who finance it (the owners). Today in the U.S., there are five ISOs operating transmission systems: California, New England, PJM, New York, and Texas. Although these entities operate the systems, they cannot ensure that needed transmission is built.[31] Unless managed carefully, disconnections could lead to underinvestment and poor operations, which would raise electricity costs and reduce reliability. As recommended earlier, if we are to succeed in completing the industry's transition to a fair, efficient, and competitive market, RTOs must be able to address transmission bottlenecks.

Independent transmission companies that own and operate transmission assets are a new development and offer perhaps the greatest potential for improving the coordination of transmission operation and investment. These companies achieve a complete corporate sepa-

[31]Texas is building transmission in part because the state's utility commission regulates both the ISO and the transmission-owning utilities and supports the ISO's transmission planning efforts with expeditious regulatory review of proposed transmission expansion.

ration between generation and transmission. They are formed by divesting the transmission assets from vertically integrated firms to wholly independent firms that have no generation assets. Creation of these independent companies is a reflection of private investors' desire to separate and consolidate the very different risks and rewards offered by generation and transmission businesses today.

It is imperative that private-sector initiatives such as independent transmission companies be allowed to flourish. Tax laws that may encumber the economic transfer of transmission assets must be reviewed.

Loop Flow and the Emergence of Merchant Transmission

A unique feature of transmission facilities is the existence of "externalities" associated with interconnected AC networks. Loop flow, in particular, in which electricity passes over systems that are not parties to its sale and transmission, is an unavoidable feature of bulk-power AC transmission because electricity takes the path of least resistance and does not follow prescribed routes.[32] For developers of new transmission lines, the situation is akin to building a new road but then having no means to effectively control (or charge for) the flow of traffic over it.

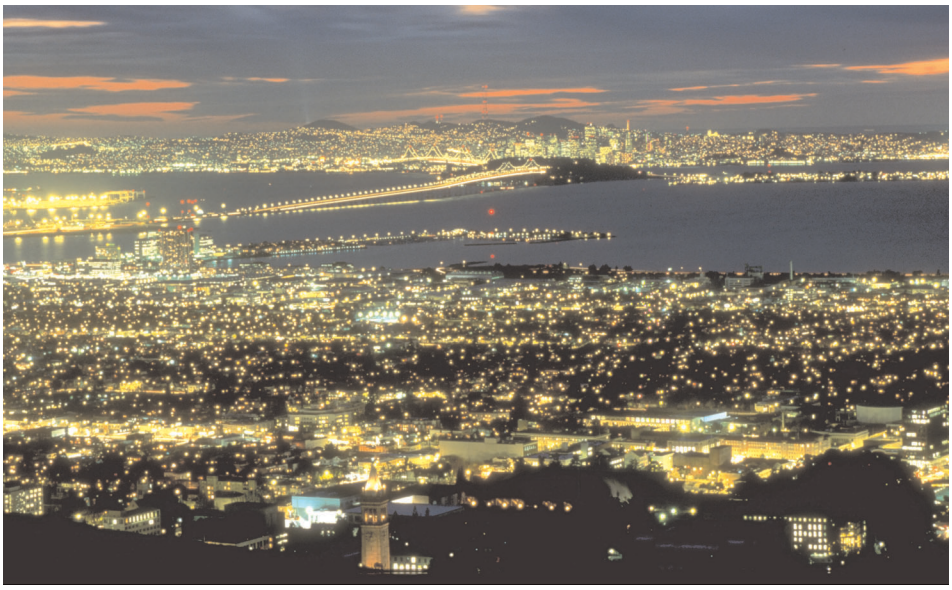
RTOs are expected to better address loop flow by internalizing it within the large geographic boundaries of each RTO. Greater horizontal consolidation of transmission assets, as reflected in the formation of independent transmission companies that combine the assets of many individual transmission-owning utilities (also leading to larger geographic boundaries), is yet another approach for internalizing loop flow, in this case within the boundaries of a single firm.

Merchant transmission, a new entrant in the transmission market, has relied on a technological solution to the problem of loop flow. To date, all merchant transmission projects have relied on DC transmission technologies

[32]Flexible AC transmission system (FACTS) devices can control flows over transmission lines; however, these devices are expensive and have seen limited application to date. See Section 5, *Ensuring the Timely Introduction of Advanced Technologies*, and the Issue Paper, "Advanced Transmission Technologies" by J. Hauer, T. Overbye, J. Dagle, and S. Widergren.

(e.g., Transenergie's recently approved link between Connecticut and Long Island, and Neptune's proposed Regional Electric Transmission System in the Northeast), which permit facility owners to directly control flows over their investments and avoid the problem of loop flow.

A merchant transmission project is one that is financed by private investors with no regulatory support (i.e., no regulator ensures that the investor has the opportunity to earn a reasonable return on that investment). In return for lack of regulatory protection, the owner of a merchant transmission facility can, in principle, charge market-based rates. Although merchant transmission is a potentially powerful approach to resolving many of the difficulties (including those related to planning, expansion, and pricing) facing traditional transmission systems, we do not know to what extent projects financed in this manner can meet current and future needs for new transmission. Nevertheless, merchant transmission projects could introduce competition directly into an aspect of the industry that has long been regarded as a natural monopoly. And it seems clear that when private investment in transmission can be undertaken in ways that avoid the problems of loop flow, this investment may be in the national interest.

RECOMMENDATIONS

- DOE will work with NGA, regional governors' associations, NARUC, and other appropriate state-based organizations to promote innovative methods for recovering the costs of new transmission-related investments. These methods should consider situations where rate freezes are in effect and also examine incentive regulation approaches that reward transmission investments in proportion to the improvements they provide to the system.
- DOE will research and identify performance metrics and evaluate designs for performance-based regulation.
- The Department of Treasury should evaluate tax law changes related to electricity modernization. Treasury should review its current regulations regarding the application of private use limitations to facilities financed with tax exempt bonds in light of dynamics in the industry and proceed to update and finalize its regulations. This will give greater certainty to public power authorities providing open access to their transmission and distribution facilities.
- Entrepreneurial efforts to build merchant transmission lines that pose no financial risk to ratepayers and that provide overall system benefits should be encouraged.
- DOE and the Department of Treasury will evaluate whether tax law changes may be necessary to provide appropriate treatment for the transfer of transmission assets to independent transmission companies.