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The Case for New Electricity Transmission and Siting New Transmission Lines

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Prepared for

Edison Electric Institute

GF Energy LLC

GF Energy LLC is a pioneer in electricity restructuring strategies, serving senior energy company management and boards of directors with insight and momentum to motivate successful change.

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Many important issues dealing with electricity and the future of the electric industry are being debated among the public, policymakers, and other thought leaders across the country. This report has been prepared to help advance the public dialogue on these critical issues.

For more information about electricity issues and EEI, please visit our Web site at www.eei.org.

The Case for New Electricity Transmission and Siting New Transmission Lines

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Executive Summary

The United States has an electricity delivery system that is the envy of the world. For nearly a century, the system has consistently and efficiently delivered affordable electricity to consumers.

But our system is having difficulty keeping up with consumers' electricity needs in an increasingly connected world. While companies are building power plants to generate more electricity that consumers demand, growth in the transmission capacity—the "electron superhighway" that transmits electricity to consumers—is lagging.

When that "electron superhighway" was built starting 70 years ago, it was intended to serve the needs of individual local utilities and their customers. But today the system, owned and operated primarily by electric utilities, operates a web of transmission lines that sends electricity from some 5,000 power generation plants to thousands of stations that then transfer the electricity to the distribution systems that serve millions of consumers with a growing appetite for cable TV, live Internet connections and other systems that require a very reliable electricity supply.

The greatest obstacle to building this needed new transmission capacity is the process of obtaining government approval to build transmission facilities. There are several reasons for this:

- Individual states have authority over siting transmission facilities that increasingly serve the interests of many states in a region;
- Multiple layers of government review and approval can delay a project; and
- Some members of the public are opposed to public works projects of any kind.

Getting over the hurdle of siting transmission facilities will help ensure the continued reliability of the U.S. transmission system and guarantee affordable electricity for consumers. But it cannot be done without the cooperation and coordination of all interested groups—utilities, government agencies, consumers and environmental groups.

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Introduction

Our country is in the midst of a national policy debate over energy—how and where we produce it, how we use it, how much we will need in the future. This debate has taken on increasing urgency as consumers demand more electricity to power our growing "wired" economy. Yet often overlooked in this debate is how we will transmit that electricity to the consumers who use it. And in a time when we are using more electricity than ever before, all those new power generation plants we need can do little good if we do not have the ability to transmit the electricity they produce to consumers.

In the face of our nation's energy policy challenges, policymakers often overlook the issue of the long-distance transmission of electricity over the high-voltage lines that connect power plants to the local distribution companies that directly serve consumers. But transmission is just as vital as generation to ensuring consumers continue to enjoy the reliability and affordability of electricity supply they have enjoyed for decades.

Over the next few decades, we are likely to start building more small-scale, distributed generation in our backyards and neighborhoods. But that will not eliminate the need for electric wires as the economics of the new technologies will mean that the small generators will sell electricity back into the grid. It also will take many years for these new technologies to become cost-effective and accepted by consumers.

Yet, as our demand for electricity continues to grow and our economy becomes more market-oriented, the expansion of our nation's transmission capacity has lagged dangerously behind the additions we have made to our generating capacity over the past 12 years. That has created congestion in some sections of the transmission system, where too much electricity is being sent over too few transmission lines, especially in extremely hot or cold weather.

That congestion already has contributed to power outages and higher electricity prices in California and the Midwest; we live under the very real prospect of similar outages and higher electricity prices in other areas of the country in the next decade if we don't take action now to reduce congestion.

While this has become a matter of national concern, we have made it very difficult for the electric power industry to expand the transmission system to accommodate our electricity needs.

Indeed, the greatest hurdle to adding that new transmission capacity is the siting process, through which decision makers determine how and where to build the transmission lines, towers and substations that send electricity to consumers. Layers of federal, state and local government agencies must approve each project; they often work at cross-purposes, delaying projects for years and adding millions of dollars to their price tags.

Outdated laws create a balkanized process in which an individual state or county can halt a project that spans several states simply because the project will not directly benefit the residents of that state. And public opposition to public works projects of any kind stymies efforts to build transmission lines that can benefit millions of people.

At stake is the continued reliability and affordability of electric service enjoyed by millions of Americans on a system that has developed over the past 70 years into the premier electricity transmission system in the world.

The North American Transmission System

Transporting that electricity over the grid is a complex process that requires engineering and technical expertise backed by coordination among all transmission-operating companies. That ensures that power flows meet our electricity needs, and that electricity reaches the final consumer at the precise moment and in the exact amount that is needed.

Since electricity cannot be stored—unlike water and gas—utilities have an enormous burden to be able to deliver energy to the right place at the right time. This coordination is provided by operators in control centers around the country that are in constant communication by telephone and through highly sophisticated computer systems. All this is governed by an extensive series of local, state, regional and federal rules and regulations on how and where the system operates.

The U.S. transmission system we know today—about 158,000 miles of high-voltage transmission lines, the towers and the large transfer stations used to send electricity from 5,000 power plants to smaller stations that distribute the electricity to millions of consumers—was built starting in the mid-1930s. The system originally was intended to serve individual local utilities and their customers. That is why, on a map, utility transmission systems appear to be self-contained.

But over the years, utilities began building larger, more efficient generating stations located farther away from consumers. Many of these plants were built as alternatives to the smaller, more polluting plants that were located in densely populated city centers. These newer, larger plants required larger and longer transmission lines and related facilities.

Also, utilities began trading electricity, developing “interconnections” allowing them to trade electricity from one utility to another. This helped make the transmission system more reliable and more efficient, as utilities were able to take advantage of different load patterns, time zones and outages to help each other out in times of need. Overall, it has given consumers the benefit of more economic, efficient and environmentally acceptable sources of electricity.

The competitive changes that are sweeping today’s electric power market have further changed the nature of the transmission system, as electricity merchants and marketers that are not affiliated with utilities use the transmission grid to buy and sell electricity.

The U.S. transmission system is part of a larger whole: a 204,000-mile North American system that also serves Canada and portions of Mexico. It is not yet one monolithic system, however. Today, it consists of four integrated grids: the Western Interconnection, the Eastern Interconnection, Quebec and the Electric Reliability Council of Texas. (Alaska and Hawaii, of course, are not linked to the rest of the market.) These regions are essentially self-contained; the very few connections between them provide for limited opportunities for transactions among these grids but each is huge, serving North America's largest cities as well as rural communities.

The U.S. Transmission System

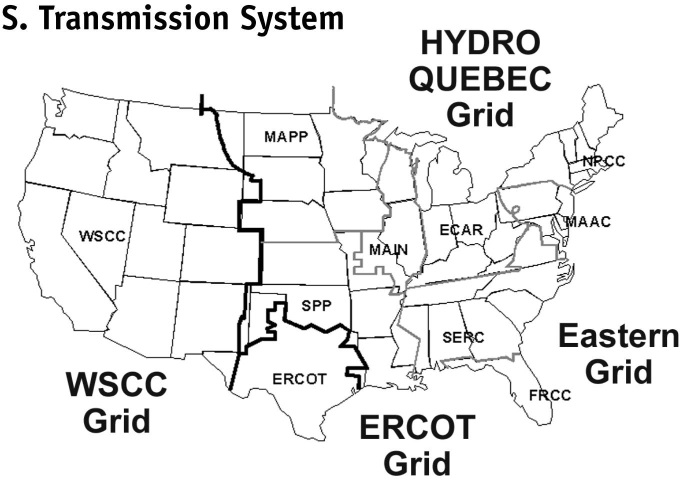

Figure 1. U.S. map showing the locations of the grids and of the 10 regional reliability councils.

Each of the four grids consists of a group of smaller regions whose borders are increasingly defined by constraints, or "bottlenecks," on the transmission system. In all, there are 10 regions contained in the North American transmission network. The regions in each grid use transmission facilities to trade electricity.

This is necessary when, for instance, one region does not have adequate generating capacity to meet its demand for electricity and must buy electricity from another region to ensure continued service to consumers. Or, independent power producers sell electricity in the open market to customers elsewhere on the grid. Often, this transmission of electricity can be a substitute for new generation plants by allowing a region to import power that otherwise would have to be generated within its borders.

This saves consumers money, because utilities are not investing in expensive power plants. And it helps improve air quality, as fossil-fueled power plants emit pollutants into the air; not building those new power plants means there are no new power plant emissions.

How the Transmission System Works

Operation of the nation's transmission grid requires constant, coordinated monitoring of conditions on the system and instant, real-time, split-second timing when adjustments must be made. The transmission system has numerous built-in redundancies, or backup systems, to ensure smooth operation and the reliable, uninterrupted flow of power to consumers.

For example, regulations require that for each transmission path in use, there must be a backup path in the unlikely case the main path fails. This helps make the U.S. electricity transmission system reliable, but also puts it in constant need of improvement and upgrade, particularly as sophisticated electronic control systems become available to squeeze more power through existing lines.

It is important to remember that electricity travels along the path of least resistance—it flows over whatever wire path is physically made available to it. Therefore, unlike water or natural gas, which can be directed on specific lines, all transactions on the electricity transmission grid must be coordinated as the actual path that electricity takes from power plant to consumer may be quite different from that which is called for in a contract.

This difference between "physical flows" and "financial flows" has allowed energy traders to make more efficient use of the system. But even so, we are running out of ways to get more electricity through the system.

That forces utilities to be aware not only of the power flowing over their own systems by their own generators, but also to be aware of the transfers of power between systems and how those transfers might flow through and affect their systems. And it means that we are moving toward a much more centralized system of large regional transmission organizations, called RTOs, which are designed to optimize use of the system and ensure fair and equitable access to the system for everyone.

When a utility wants to determine whether it has enough electric generating capacity and transmission capacity for its customers, it must determine whether its system can handle a problem, such as a lightning strike, without causing power interruptions to large areas. That is because when such problems arise, transmission operators must solve them in a split second to avoid causing a major outage.

Individual control areas coordinate the flow of power across a given transmission system. These control areas consist of one or several transmission operators. These operators ensure there is a balance between electricity generation from the power plants and the amount of electricity needed at any given moment to meet demand. In addition, there are many “ancillary” services, including load following and voltage support, that help maintain the stability of the system.

And utilities have agreed to rules determining that they must have an extra margin of electric power, known as “reserves,” to ensure reliability at times of peak demand, or when demand for electricity is at its highest. This also helps provide for electricity during times when parts of the system are “down,” or not working because they are under maintenance or other purposes. This is called a “reserve margin.”

In recent years, as competition has come to the generation business, reserve margins have tended to fall. This has put even more pressure on the transmission system to provide alternative paths for energy when it is needed. Operators use computerized systems to exercise second-by-second control over the network and to ensure that power transfers occur during specified times in pre-arranged amounts.

Transmission Constraints

The points in the transmission grid at which operations cannot take place are known by many terms: transmission constraints, “bottlenecks” or congestion points. These bottlenecks can limit the flow of power from one region to another, in much the same way that a three-lane highway reduced to two lanes will restrict the flow of traffic.

The way transmission is priced on the electron highway, this can force consumers on one side of the bottleneck to pay higher prices for the electricity they use because that bottleneck restricts, and often even denies, access to the less expensive power they would have obtained from another region.

In some places, the owners of congested lines find it more advantageous to keep the lines crowded than to build new ones, a situation that we must change as quickly as possible to protect the public interest. To accomplish this, regulators must find ways to provide transmission owners with stronger financial incentives to build more capacity and use their transmission more efficiently.

In the summer of 1998, transmission bottlenecks in the Midwest contributed to limits in the region’s ability to import enough electricity from outside to meet demand, causing spikes in electricity prices. In May 2000, constraints in the Northeast caused spot market prices to rise, and New England saw prices spike at

$6,000/MWh, compared to average electricity costs that range from $30 to $50/MWh. This year, California felt the pinch: Transmission congestion on a key north-south line there was a primary cause of rolling blackouts earlier this year.[1]

And it can happen again: Transmission constraints are putting continuing pressure on consumers in New York City, the Great Lakes region, the Southeast and New England.[2]

A key indicator of the constraints on the nation's transmission system is the number of transmission line loading relief requests. The flow over the transmission system constantly changes as utilities simultaneously supply power to their customers and conduct market transactions. Transmission system security coordinators call for line loading relief to curtail transactions that cause transmission facility overloads or violations of operational security limits.

Transmission line loading relief requests reached record levels during the summer of 2000, which was a mild summer by industry standards, according to the North American Electric Reliability Council (NERC), calling it "indicative of the persistence of congestion in various areas of the transmission system."[3]

According to NERC statistics, there were a record 788 line loading relief requests for the May-September 2000 period. The trends are increasing at other key time periods as well. There were 153 transmission line loading relief requests from January through March 2001, compared to 42 such requests for the same time period in 2000.[4]

To overcome these constraints, utilities can either expand the capacity of existing transmission lines or build new ones. Neither option is an easy task, primarily because of public opposition to construction of power lines and a lack of financial incentive.

Transmission and Restructuring

As with other network industries, such as natural gas pipelines and telecommunications, public policy toward the regulation of the electric power industry has been shifting dramatically. The electric power industry is moving away from its traditional structure of vertically integrated electric utilities operating under state and federal regulatory oversight, to a more decentralized competitive market

[1] "The Other Electricity Crisis: Transmission Lines," Christian Science Monitor

[2] "Reliable, Affordable and Environmentally Sound Energy for America's Future," Report of the National Energy Policy Development Group, May 2001, page 7-6.

[3] Reliability Assessment 2000-2009, North American Electric Reliability Council, page 5.

[4] Transmission Line Loading Relief logs and trends, North American Electric Reliability Council, http://tlr.nerc.com.

where companies tend to specialize in generation, transmission, distribution or energy sales. This competitive restructuring is focusing more on the generation and distribution of electricity, where the greatest benefits are found; the transmission of electricity will remain regulated.

Yet, even as it will remain regulated, the nature of the transmission system will change. Indeed, it must: With all the benefits that restructuring and competition promise to bring to consumers, the transmission system must meet the growing demands of increasing transactions on it. And simply put, the system now cannot meet the demands of a growing and restructured electric power industry without transmission owners being able to build more capacity and get paid a reasonable rate of return on that investment.

Remember, the system began as a means of serving the needs of individual utilities and their customers. The restructuring of the electric power market is altering the nature of the electric power business from one of local use to one that facilitates large regional competitive wholesale markets.

Federal regulators oversee the use of the transmission system as it accommodates electricity trading in interstate commerce. The Federal Energy Regulatory Commission (FERC) has instituted policies aimed at enhancing the ability to trade electricity in interstate commerce through the institution of Regional Transmission Operators (RTOs). These RTOs are intended to span several states in regions that largely mirror the regions within the four North American transmission grids.

FERC policy requires that these RTOs will have planning processes for the expansion of transmission to maintain reliability. This requirement challenges the traditional belief that transmission facilities serve only small regional or local markets. Thus, it is conceivable for the RTO planning process, under FERC's approval, to identify new regional transmission projects that state and local authorities flatly reject because they do not directly benefit from them.

The pressure on the system to handle the responsibilities of the new electricity market is tremendous. In some instances, demand for power from suppliers and marketers exceeds the available transmission capacity. This raises questions about the system's reliability and its ability to support development of competitive power markets across the country.[5]

[5] "Getting Electricity Where It's Needed: Electric Transmission Systems—Making the Vital Link to Consumers," Edison Electric Institute

The Case for New Transmission Facilities

For decades, our electric power system has safely and efficiently delivered electricity to consumers, who know only that they can read, hear music, watch television or surf the web with the convenient flip of a switch. For that reason, we often take our electron superhighway for granted, while motor vehicle, air travel and telecommunications dominate our public policy debates.

Along with our nation's expanding fiber optic system, our electricity transmission system constitutes the backbone of our wired economy. And like our highways and airports, our electricity transmission system is overloaded.

As with the growing need for new roads and airports to handle increasing travel, our nation's economic success has created record demand for electricity and a vibrant electricity trading market. These in turn require expansion of the electron highway to transport electricity to consumers. Yet statistics show that capacity on our electron highway has fallen by 16 percent in the last decade.

To get an idea of the demands placed on our nation's electricity transmission system, consider: Consumer demand for electricity is expected to rise by 25 percent over the next decade. That will require more than 200,000 megawatts of new generating capacity. [6] And electricity trading through our competitive wholesale electric power market has increased the volume of transactions on the electric grid by 44 percent in the last five years.

Yet our nation's 158,000-mile electricity transmission system, which transports electricity from the generating plants to the local distribution companies that serve consumers, has not been keeping pace with this growth. Annual investments in transmission have been declining by almost $120 million a year for the past 25 years. Transmission investment in 1999 was less than half of what it had been 20 years earlier.[7] And the North American Electric Reliability Council (NERC) says it will grow by only 4.2 percent through the rest of the decade.

Studies on the adequacy of the U.S. transmission system show a clear and long-term decline in the system over the past decade. The amount of new transmission added during the past two decades has consistently lagged growth in peak de-

[6] National Energy Policy Development Group, May 2001, page 7-5

[7] "Our Energy Future—Expanding the System," Edison Electric Institute

mand for electricity. And projections for the next five and 10 years show continued declines in the adequacy of our transmission grid.[8]

This increasing consumer demand for electricity and the growing market trade in electricity are creating congestion on our transmission system. Congestion on a highway causes traffic backups and commuter delays, and studies show it costs consumers millions each year in lost time and productivity. The same can be said for congestion in our transmission system.

Congestion in the transmission system can delay delivery of electricity to consumers, raising consumer costs and even causing blackouts. In one year, from 1999 to 2000, transmission congestion as measured by the North American Electric Reliability Council increased by 200 percent. And in the first quarter of 2001, transmission congestion was already three times the level it had been just one year earlier.[9]

Transmission represents 11 percent of the national average cost of delivered power.[10] But the potential benefits that can be derived by improving the transmission sector far exceed that contribution to the cost of electricity.

For example, increasing transmission capability to a market will increase the number of supply resources available to consumers in that market. That would give consumers access to less expensive sources of electricity and greater choice of suppliers and arrangements. The potential benefits to electricity consumers could easily exceed the cost of the investment needed to increase transmission capability and produce the benefits.

The flip side of this is that the potential shortage of electricity transmission capacity could force them to pay more for the electricity they use. Clearly, the issue of transmission shortages is a far-reaching one that presents a serious public policy challenge to our leaders.

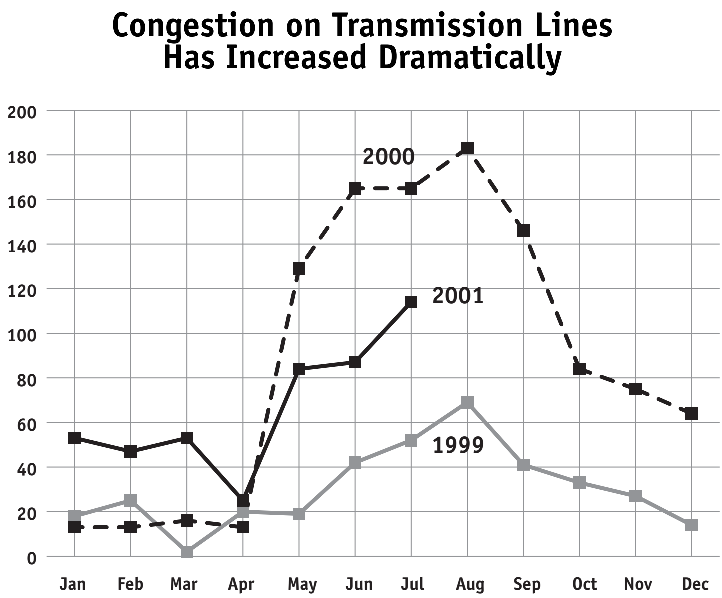

Figure 2. Transmission Line Loading Relief Requests 1999–July 2001.

Source: North American Electric Reliability Council

[8] "Transmission Planning for a Restructuring Electric Industry," Eric Hirst and Brendan Kirby, June 2001.

[9] "Getting Electricity Where It's Needed—Electric Transmission Systems: Making the Vital Link to Consumers," Edison Electric Institute

[10] "The Future of Electric Transmission in the United States: A Vision for Transmission as a Vibrant, Stand-Alone, For-Profit Business," Roger Gale, Joe Graves, John Clapp, January 2001.

Siting Transmission Lines

Before an electric utility proposes a new transmission line, it investigates the costs, benefits, environmental impacts and reliability implications of the new line. The company weighs the expense of construction and maintenance against the reliability benefits and projected short- and long-term savings that the line might offer. Engineers, using computerized models of the entire supply system, project how a new line will affect load supply, system reliability and customer service. Planners consider the area's topography and population distribution, the location of industrial and commercial enterprises and other local factors that will affect the construction of a new line.

The process of obtaining permission to build a power line varies from state to state. An array of federal and state agencies responsible for environmental, land use and economic regulations review construction plans and consider the views of the public.

In some states, permission comes from state authorities; in other states, each county or jurisdiction that the line will cross must approve of the project. An important part of the process is public hearings, which allow the utility to answer questions from those who might be affected by construction of the new line.

Public Perceptions

Some members of the public generally view with skepticism any kind of public works construction program, whether it is for a road, an airport, a power plant or a transmission line. This skepticism often is fueled by the well-known "Not in My Backyard" (NIMBY) syndrome that is marked by a person's opposition to a project that will affect him but benefit others, or out of general distrust of government agencies or corporations. The market fragmentation of the electric power industry into generation, transmission, marketing and distribution segments not easily identifiable with the familiar local utility may make matters worse.

Yet some opposition to transmission construction arises out of legitimate concerns about land use and related environmental issues. It is vital to debate issues of public lands use, private property rights and property values and the environment in the full view of, and with extensive participation from, the public. No large public works construction project can be of any benefit if it does not have the trust of the public.

Still, in view of the industry's need to increase capacity on the transmission system to continue providing consumers with reliable electricity service, there may be a short-term solution that for now could help avoid battles over transmission facility siting. Advanced technologies offer the hope of better control of transmission flow and voltage, thereby expanding transmission capability without a major construction process.

These technologies permit control of power flows over individual elements of the transmission system, possibly making it attractive for private investors, rather than only utilities, to build individual facilities. It is important to note that these advanced technologies now are available only for niche applications, such as those involving stability problems, and cannot take the place of needed transmission additions.[11]

In the face of public opposition to new transmission lines, we must keep in mind that these types of construction projects are proposed to serve a greater good. In the case of electricity transmission, the lines are intended to serve consumers' needs for electricity and the continued reliable operation of the transmission system.

Government Oversight

For all the contention surrounding public works projects of all kinds, electricity transmission finds itself alone in one important respect. It is a situation not faced by other major transportation projects such as interstate highways or natural gas or oil pipelines.

As a holdover from the days when the transmission system was used by individual utilities for their own purposes, all siting for electricity transmission lines is the responsibility of the states. Pricing, on the other hand, is regulated by FERC. This division of labor is fraught with problems.

That means that while consumers today benefit from the trading of electricity in interstate commerce—indeed, international commerce, as the North American transmission grid incorporates the U.S. with both Canada and portions of Mexico—individual states control where and how to place the transmission lines over which that electricity moves.

[11] "Transmission Planning for a Restructuring U.S. Utility Industry," Eric Hirst and Brendan Kirby, June 2001, page 39.

The federal laws granting states control of siting these facilities were written in 1935. And in 1935, there was little or no interstate commerce in electricity. Indeed, Congress did not anticipate the development of an interstate—or an international—electricity transmission system.

Building transmission lines in this kind of environment is a daunting task at the very least. For example, the Chisago-Apple River transmission line project began in 1996 as a proposal for a 39-mile, 230-kV line that would link facilities in Minnesota and Wisconsin. Because the project is in two states, involves an electric cooperative, crosses a wild and scenic river and involves a national park, agencies reviewing the proposal include the Public Service Commission of Wisconsin, the Minnesota Environmental Quality Board, the Rural Utilities Service, the Army Corps of Engineers, the National Park Service and local and tribal governments. Project managers now expect construction of a scaled-down line (161-kV) to begin in 2003 or 2004—six years after it originally was intended to be in service.

The federal government has several agencies with varying degrees of responsibility when it comes to siting transmission lines on federal land. A transmission project could involve any or all of these agencies: The Bureau of Land Management, the U.S. Forest Service, the U.S. National Park Service, the Army Corps of Engineers, and the U.S. Fish and Wildlife Agency. Crossing Indian lands requires separate permits. And these agencies do not necessarily work together in processing transmission line permit applications.

Even among the states, there are differences as to who is responsible for siting transmission facilities. A recent state-by-state survey on the subject of siting transmission facilities[12] found that approximately 12 percent of the states either do not conduct a state-level review of transmission line siting or were unaware whether they had jurisdiction regarding transmission line siting.

Approximately 78 percent of the states describe one primary state agency responsible for permitting of electric transmission lines, but often, local permits also are required. Of the states that describe one primary agency with permitting authority, the state utility commission plays the primary role 79 percent of the time.

Among the states, 33 percent said they require review of transmission lines of less than 100kV, 24 percent require review of transmission lines of greater than 100 kV and 19 percent require review of transmission lines only when the voltage exceeds 200 kV. Half of the state regulatory commissions surveyed said they see their role in the permitting process as an agency that aids in dispute resolution, either between utilities or between the utility and the public.

[12] Electric Transmission Line Siting Regulations, State-Level Directory, Edison Electric Institute

The point, however, is that in an age when our electricity system operates in a regional, national and international manner, individual states are the ones who decide whether transmission facilities are built. These individual states—some of whose laws forbid approval of projects if the benefits do not accrue to them—decide whether to build a system that will benefit consumers in a multi-state region. If one state or county rejects the proposal, the entire project comes to a halt. And where transmission lines cross federal lands, parks, forests and rivers, project approval by various federal agencies is necessary—and might even require environmental impact statements and public hearings.

Experience shows that when faced with the question of whether to approve a new transmission project, individual states often say no. Even if they say yes, the process imposes delays that are costly to consumers and the industry, and creates a whole new set of issues. Overall, consumers suffer.

One example of this came earlier this year when the Connecticut Siting Council blocked a 330 kilovolt underwater transmission line to Long Island, citing concerns about shellfish destruction. However, the Connecticut attorney general also noted that the project "completely failed to make the case for any benefit to Connecticut."[13] Similarly, public objection to American Electric Power's proposed line from West Virginia into the western part of Virginia has centered on the argument that the power will be sold elsewhere, not used locally.[14]

Increasingly, consumers in areas affected by transmission congestion find generators trying to build power plants closer to city centers to bypass the transmission constraints. This creates another public dilemma—is it better to build transmission, or have to build more power plants close to people's backyards. Generators, however, are building cleaner power plants, but that does not always satisfy local communities.

In addition to utilities and other generating companies building electric generators near where electricity is consumed, there is increasing enthusiasm for building very small generating plants of 50 megawatts or smaller. That concept, known as "distributed generation," has many merits and is being debated in cities and towns around the country.

However, the technology for the smaller units that could fit into a person's home is not immediately available, and it will be years before the distributed generation microturbines and fuel cells provide enough electricity to make a dent on the need for transmission.

[13] "Citing Shellfish, Conn. Rejects Electric Cable," Newsday, March 29, 2001.

[14] "The Other Electricity Crisis: Transmission Lines," Christian Science Monitor, February 20, 2001.

In short, the choice for consumers is more transmission or more local power plants. Prudent public policy is to do both, balancing the options to provide the most reliable and cost-effective electricity.

But it remains clear that we continue to need transmission systems to transport electricity from the generator to the consumer. This is particularly true for generating plants that use wind, hydropower or other renewable sources of energy that the public says it wants.

Those types of environmentally preferred power plants only can be placed in very specific, and often rural, locations that, for example, provide access to windy conditions and bodies of water. And often, they are located far from the populated areas that most need the electricity they produce. Only by expanding the U.S. transmission infrastructure can these kinds of generating facilities be linked to customers.

Environmental Concerns—Land Use

All construction projects raise environmental concerns, and transmission line projects are no exception.

When it comes to electricity transmission line projects, property owners are concerned about whether a transmission line will affect their property values, and whether a transmission line will restrict access to their property. Residents nearby worry that transmission towers will impede scenic views, interfere with recreational activities and harm wildlife. Still others are concerned about the effects of electric and magnetic fields emanating from live power lines.

These are all valid concerns—and all are concerns that each electric utility considers when deciding whether and where to build a power line.

Engineers for a utility building a transmission line conduct intensive studies that evaluate the best route for the project. Where possible, they attempt to use existing rights-of-way to minimize disruption to land and property. They also meet with the public in nearby communities to discuss their plans. Public input into these plans is an essential element of the process.

And once the project construction is completed, the company manages the vegetation underneath the lines to provide habitat for wildlife. The goal is for the construction and maintenance of a transmission line to be as least disruptive to the environment as possible.

Environmental Concerns—Electric and Magnetic Fields

Electric and magnetic fields (EMFs) are invisible lines of force that are created wherever electricity is generated, transmitted or used. EMFs are produced by power lines, electric wiring, electrical equipment, computers and appliances. Electric fields are generated by voltage and exist independently of current flow in a cable or conductor.

Along with aesthetics, EMFs are a key point of public opposition to construction of power lines. The question of whether EMFs from transmission lines could cause health problems has been the subject of countless scientific and medical studies and debates over the last 20 years. Yet for all that research, the studies, taken collectively, found no conclusive evidence of links between EMFs and health hazards.

Furthermore, a congressionally mandated study on the issue by the National Institute of Environmental Health Sciences (NIEHS) reached a similar conclusion in 1999, finding "weak" evidence for a risk of cancer and other human disease from EMF around power lines. The probability that EMF exposure is truly a health hazard is small, the report states. "The weak epidemiological associations and lack of any laboratory support for these associations provide only marginal, scientific support that exposure to this agent is causing any degree of harm."[15]

In spite of the scientific research, EMFs related to transmission lines remain one of the most common subjects of public concern when it comes to transmission line construction. Public response to the various studies has fueled much of the "Not in my Backyard" (NIMBY) opposition to transmission line projects throughout the country.

Environmental Concerns—Air Emissions

In many parts of the country, public opposition to construction of new power plants centers on the effects of the emissions on human health and air quality. In these instances, the primary option is to transmit electricity generated in a distant location to the area where the power is most needed. That requires transmission lines.

In these instances, transmission lines can be considered a substitute for generation. So while transmission lines and related facilities do require access to land, they also minimize human exposure to emissions and pollutants from power plants.

[15] "NIEHS Report on Health Effects from Exposure to Power Line Frequency Electric and Magnetic Fields," National Institute of Environmental Health Sciences, June 1999, page 36.

This is beneficial in cases where the population in a distant area is more welcoming of power plants than the population that needs electricity[16] or in cases where the electricity is to be generated by renewable resources such as wind or hydropower.

Though there is no comparable analysis for the U.S., one European analysis shows that the active use of transmission to supplant fossil-fuel sources by renewable energy sources in Central and Western Europe could eliminate, in 10 to 15 years, about 1,500 million metric tons per year of CO2, 5 million metric tons a year of NOx and 15 million metric tons per year of SO2.[17]

Similar savings could be available in the U.S., especially if power plants can be built where it makes most sense to site them for environmental reasons instead of having to build them to where transmission is available. A robust transparent transmission system that allows electricity to move long distances could be a major tool in further improving the environment. Contrast that with the process we have today, where companies are under pressure to build power plants near existing transmission lines, which might not be the most environmentally correct place to build.

[16] "Power Expansion Tied to Transmission Capacity, Chris Mulick, Tri-City Herald "Power on the Line" series, October 4-7, 1999.

[17] Electrical Transmission, Sten Bohlin, Kjell Eriksson, Gunnar Flisberg, ABB Power Systems A.B, Ludvika Sweden, Global Energy Network Institute (www.geni.org).

Conclusion and Solutions

There is a clear need for adding capacity to the U.S. electricity transmission system. The greatest obstacle to building these additions is gaining government approval to build transmission facilities. There are several reasons for this: Individual states have authority over siting transmission facilities that increasingly serve the interests of many states in a region; multiple layers of government review and approval can delay a project; and the public is increasingly opposed to public works projects ranging from road construction to electric transmission lines.

Lowering the siting hurdle for transmission facilities will help ensure the continued reliability of the U.S. transmission system and guarantee affordable, reliable electricity for consumers. But it will require cooperation by all—utilities, government agencies, consumers and environmental groups.

Following are some suggested solutions to easing the problem of siting electricity transmission facilities:

- **Lower the siting hurdle for transmission. Do transmission planning and siting on a regional, not a local, basis.** Transmission operations and needs are regional in nature, so the siting process should be regional as well. Just as highways and airports reflect the needs of a given region, so too does electricity transmission. Planning should be done through the Regional Transmission Operator (RTO) of a given region. This does not foreclose local input, however, as states, local governments and the public can and should collaborate on the best way to expand and build transmission facilities.

- **Give FERC some authority over transmission siting projects, in conjunction with state and local governments.** The commission already has authority over the siting and construction of interstate natural gas pipelines. It should have some authority over siting and construction of interstate electric transmission lines.

- **Evaluate transmission projects using indirect costs as well as direct costs.** The indirect costs of not building transmission lines, such as the price consumers pay for not having access to many sources of electricity and the economic cost of blackouts, can be just as important as the direct construction and operation costs of a transmission line. They must be factored in when determining whether to build a transmission line.

- **Federal, state and local agencies must coordinate their efforts.** The myriad federal, state and local agencies that evaluate electricity transmission project proposals must coordinate their efforts to avoid duplication and delays that are costly to consumers. The process also should include timelines and deadlines so that decisions are not delayed indefinitely. Such a process is now being organized for the interstate natural gas pipeline industry.

- **Companies must start outreach and education at the earliest stages of their projects.** A key to public support of a public works project is public understanding of a public works project. The same can be said for a transmission line project, which can affect many people who may not see any direct benefits from the transmission line. Open, frank discussion of the project, its benefits and drawbacks, and the owner's responsibilities in building and operating the transmission line, will help further that understanding.

- **Reduce the chance of battles over transmission siting in the short-term by using alternative, advanced technologies to increase transmission capacity.** Advanced technologies offer the hope of better control of transmission flows and voltages that will allow for expanded capability on the system without requiring new construction. Among them are superconducting, low-cost direct current (DC) connections and Flexible AC Transmission System (FACTS) devices, which refer to a variety of power-electronic devices used to improve control and stability of the transmission grid. However, these are short-term fixes that do not preclude the need for expansion of the transmission grid.

Electric Industry Terms

Ancillary Services — Services or tariff provisions related to generation and delivery of electric power other than simple generation, transmission or distribution. Ancillary services related to transmission services include: energy losses; energy imbalances; scheduling and dispatching; and system protection.

Direct Access — An arrangement in which customers can purchase electricity directly from any supplier in the competitive market, using the transmission and distribution lines of electric utilities to transport the electricity.

Distribution — The facilities of the electric system that deliver electricity from substations to customers. The distribution system "steps down" power from high-voltage transmission lines to a level that can be used in homes and businesses.

Federal Energy Regulatory Commission (FERC) — A federal agency, established in 1977, which regulates the wholesale electricity market, i.e., power and transmission sales and service between utilities and between utilities and non-utility generators. An independent agency of the Department of Energy, FERC is composed of five members appointed by the President and confirmed by the Senate. Commissioners serve five-year staggered terms, and each has an equal vote on all regulatory matters.

Gigawatt — One gigawatt equals 1 billion watts, 1 million kilowatts, or 1 thousand megawatts.

Grid — The transportation network (or "highway") over which electricity moves from suppliers to customers.

Kilowatt — A measure of electricity consumption equivalent to the use of 1,000 watts of power over a period of one hour. Ten 100-watt light bulbs burning for one hour would consume one kilowatthour of electricity.

Loss (Losses) — The general term applied to energy (kilowatthours) and power (kilowatts) lost in the operation of an electric system. Losses occur principally as energy transformations from kilowatthours to waste heat in electrical conductors and apparatus.

Megawatt – A unit of power equal to one million watts. Put another way, it's the amount of electric energy required to light 10,000 100-watt bulbs.

North American Electric Reliability Council (NERC) — A nonprofit organization formed in 1968 by the electric utility industry to ensure reliable, adequate power supply in North America. NERC plays an important role in establishing the standards, rules, and forms of cooperation that make a major contribution to system reliability.

NERC Regions:

ECAR	East Central Area Reliability Coordination Agreement
ERCOT	Electric Reliability Council of Texas
FRCC	Florida Reliability Coordinating Council
MAAC	Mid-Atlantic Area Council
MAIN	Mid-America Interconnected Network, Inc.
MAPP	Mid-Continent Area Power Pool
NPCC	Northeast Power Coordinating Council
SERC	Southeastern Electric Reliability Council
SPP	Southwest Power Pool
WSCC	Western Systems Coordinating Council

Open Transmission Access – Enables all participants in the wholesale market equal access to transmission service, as long as capacity is available, with the objective of creating a more competitive wholesale power market.

Public Utilities Commission (PUC) — A common name for the state regulatory agency that governs retail utility rates and practices and, in many cases, issues approvals for the construction of new facilities. There are regulatory commissions in all 50 states, as well as the District of Columbia. The state commissions generally vary in size from three to seven members, and most states provide that commissioners shall be appointed by the state governors. In some states, commissioners are elected. Also called Public Service Commission.

The Case for New Electricity Transmission and Siting New Transmission Lines

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