GRIDLOCK—TRANSMISSION INVESTMENT AND ELECTRIC RESTRUCTURING

by Steven Taub and Mark Smith

Who will invest in the electric power transmission network? Currently there is no entity in the emerging industry structure—neither generators, transmission owners, independent system operators, distribution companies, traders, retail marketers nor end users—facing the proper incentives to invest.

This investment paralysis, or “gridlock,” is rooted in the partial unbundling of the power industry into horizontal segments, creating a muddled mixture of competition and cooperation that has not aligned the desire to invest in transmission with the ability to recover that investment. Complicating this lack of incentives is the fact that the costs and benefits of transmission investments that were internalized by vertically integrated utilities in the future will fall on different parties, politicizing investment decisions. Existing regulatory institutions and the emerging independent system operators are not well equipped to resolve these issues.

Gridlock creates an investment bias in favor of generation projects, even if the overall cost-benefit analysis would favor a transmission project. Without investment, transmission congestion will become increasingly frequent, balkanizing the electric power markets. This will lead to chronically inefficient wholesale power markets with volatile prices, low liquidity, and persistent problems with local market power. Sustained underinvestment in transmission may eventually threaten the reliability of the bulk power system.

The key to breaking out of gridlock is incentives, but they will require delicate balancing or they will have unintended consequences.

Pressure for further structural change is mounting: several utilities are developing for-profit transmission companies. The Federal Energy Regulatory Commission’s (FERC’s) upcoming proposal for restructuring the transmission sector will catalyze the debate over the future management of the grid.

Optimizing Electric Transmission Networks as a Whole

The complexities of the electric transmission system network result from the inability to control directly the flow of power on the system. This fundamental physical reality requires that the grid be viewed as an integrated whole, making it difficult to manage and optimize. As Figure 1 shows, a seemingly simple power market transaction to move 1,000 megawatts (MW) from Ontario to neighboring New York can affect power flow hundreds of miles away from either party.

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Efficient investment decisions require an analysis of the transmission network as a whole to internalize loop flows like those shown in Figure 1. They must also consider all of the potential options and their costs and benefits (see Figure 2). One major benefit of transmission investment is a reduction in the level and duration of differentials in wholesale power prices at different locations. Wholesale price differentials have been a persistent feature of the wholesale power markets because transmission system bottlenecks prevent arbitrage. Another potentially substantial benefit of transmission investment is lower ancillary service prices due to decreased demand.

For many decades transmission investment has been primarily driven by the need to interconnect new power plants to the grid. Figure 3 illustrates the historically close relationship between investments in transmission and the installation of generating capacity by utilities and nonutility generators. Interconnections between neighboring utilities to enhance reliability and allow sharing of generating capacity were also common after the cascading blackout of the northeastern United States in 1965.

Future decisions to invest in the transmission system will depend on a balancing of costs and benefits, often independently of generating plant construction. In theory there exists an optimal level of investment to achieve an economically efficient level of transmission congestion, balancing the price differentials and ancillary service costs against the cost of investments in the transmission system (see Figure 4).
Gridlock exists because nobody is in a position to analyze the system as a whole, develop the optimal investment plan, raise the necessary capital, and find a way to capture the benefits to recover the investment and earn an adequate return.

**Investment Signals and Responses**

Wholesale electricity prices are a key signal to investors. High energy and capacity prices are a signal that investment is needed in generation, and high price differentials and ancillary service prices are signals that investment is needed in transmission.

The high prices and differentials in the Midwest during the summer of 1998 sent a clear signal that there is a need for investment either in generating plants to alleviate regional power shortages or in transmission facilities to allow power to flow into the regions where it is needed. Generators are responding to these price signals: 1,400 MW of new capacity is now under construction in the East Central Area Reliability Coordination Agreement (ECAR) and Mid-America Interconnected Network (MAIN) regions, the epicenter of the price spikes. Unregulated generation companies and vertically integrated utilities are developing another 6,500 MW slated to come online in those regions by 2001. Some of these investments...
Figure 3
US Transmission Investment and Generating Capacity Additions

Figure 4
Some Level of Transmission Constraints Is Economically Efficient

Source: Cambridge Energy Research Associates.
are being made to ensure reliability, but many have been undertaken to capture the financial opportunity of booming market prices.

Price differentials between the Midwest and the adjacent Mid-Continent Area Power Pool (MAPP) and Pennsylvania–New Jersey–Maryland (PJM) markets spiked to unprecedented levels during June and July 1998 (see Figure 5). This situation is not unique to the Midwest; price differentials rose across North America, and market-based ancillary service prices in California were high enough to lead the Federal Energy Regulatory Commission (FERC) to impose a cap of $250 per megawatt hour. Gridlock has almost completely blocked a response by transmission projects to these price signals.* Despite over 20,000 MW of new generation being developed nationwide, investor-owned utility (IOU) transmission investment plans, as shown in Table 1, are flat.

Gridlock—Why Are We Stuck?

Complexity, cost, and public opposition are significant challenges to transmission investment, but utilities have overcome these obstacles hundreds of times in the past. What has changed? One simple fact has caused the current affliction: nobody is motivated to invest. There are a number of regulatory, financial, and structural reasons for this predicament:

*The only proposal to strengthen the interconnections between eastern Wisconsin utilities and their neighbors to the south and west.

Figure 5
Midwest Spot Power Differentials

Source: Cambridge Energy Research Associates.

Obtained and made public by the Natural Resources Defense Council, March / April 2002
Table 1
Transmission Investment by Investor-owned Utilities (billion 1992 dollars)

<table>
<thead>
<tr>
<th>Year</th>
<th>Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>2.30</td>
</tr>
<tr>
<td>1996</td>
<td>1.97</td>
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<tr>
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</tr>
<tr>
<td>1998 forecast</td>
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<td>2.63</td>
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<tr>
<td>2000 forecast</td>
<td>2.57</td>
</tr>
</tbody>
</table>

Source: Edison Electric Institute.

Regulatory Obstacles
- Network boundaries and regulatory jurisdictions are not aligned. States and sometimes even local governments retain an important role in siting and permitting transmission facilities despite the federal preemption for interstate commerce. State regulators must also approve transmission investments that are to be collected through cost-of-service rates. This tangle of overlapping jurisdictions makes regulatory approvals a complex process fraught with opportunities to delay or scuttle investment plans.

- Regulations are in flux. The FERC has advocated regional transmission organizations and is in the process of developing a Notice of Proposed Rulemaking (NOPR) for an Order that would compel transmission owners to join them. Until the FERC acts or abandons this effort, transmission owners, unsure of the disposition of their current assets, seem unwilling investors for fear of creating additional stranded investment.

Financial Hurdles
- Revenues are uncertain. Revenue streams to recover transmission investments are not clearly defined under the new ISO structures and transmission pricing schemes. For example, PJM and New York propose to award transmission congestion contracts* to transmission investors, but the number of contracts to be awarded will only be determined when the project is complete, and the value of the contracts is difficult to predict.

- Raising capital is difficult. Utilities may prefer to commit capital to more profitable, unregulated investments. Even those seeking low-risk returns on regulated investments will be reluctant to invest where they have no control of operations or pricing and are exposed to additional liability for future capital investments at the ISO’s discretion. The ISOs themselves lack the financial strength to raise capital on their own. Investors will naturally be wary if it is not clear where the revenue will come from to repay debt and generate returns on equity.

- Assignment of costs and benefits is problematic. Utility and ISO operating rules and generation interconnection procedures require transmission system studies to identify where the grid needs to be upgraded to handle increased loads or new power plants. But how much investment is necessary and who decides? Who should bear the costs of transmission upgrades?

*Congestion contracts are financial instruments that entitle the holder to receive congestion payments collected on a particular transmission path.
Allocations of costs and benefits to specific generating projects and transmission service requests depend on their sequence. How should the ISO evaluate service requests and interconnection applications by competing developers when it does not know which plants will be built or which contracts will be signed? Will owners of existing transmission rights be compensated for the effects of new facilities? Since constraints are network phenomena, cost and benefit assignments will always be somewhat arbitrary and vulnerable to attack.

**Structural Problems**

- **Ownership of the existing grid is fragmented.** Over 100 private companies and a number of federal, state, and local governments and cooperatives own the existing transmission assets. The nature of the network makes it difficult for any of these parties to act unilaterally to change the grid because their actions may be detrimental to others. Even if they are able to act, the net effect of many decisions made on the basis of only a small part of the network will be unlikely to optimize the entire grid.

- **Unbundling is only partially accomplished.** Many transmission owners also own generation, and they will undoubtedly consider the effect of grid investments on those assets.

- **ISOs are nonprofit institutions.** Lacking a profit motivation, the ISOs will make investment decisions based on political compromises and other criteria. This decision structure is more likely to favor goldplating or underinvestment, not optimization.

- **The ISO is focused on reliability.** The ISOs were created as a way to provide open access while maintaining reliability. Often there is no clear decision-making process, and where processes are articulated, they utilize committee structures with complex voting rules. The ISO has no motive to initiate an investment unless reliability is threatened.

- **ISOs depend on the transmission owners.** The ISOs do not own the assets they manage and must have the owners' cooperation to modify them. In most cases the ISO can only recommend action, not compel it. The ISO may also have to depend on the utilities' willingness to exercise their power of eminent domain to condemn land for new rights of way to overcome fierce local opposition.

- **Politics are inevitable.** As the entity charged with managing the grid, the ISO is caught between competing interests (see Figure 6). The costs and benefits of transmission investments, once internalized by a vertically integrated utility and recovered in average-cost prices set by regulators, will fall on different parties in the future. Restructuring has created natural adversaries where previously there was only one entity. State and federal government intervention is likely, especially if voters complain that they will see little of the commercial benefits of the capital expenses they pay for in rates, or if reliability is threatened. Several governors and members of Congress have already indicated their desire to maintain their states' low-cost power as a way to support economic development and as a populist campaign position. The technical complexity of the issue and the lack of available information outside the ISO and transmission owners' hands will cause suspicion of the ISO and the transmission-owning utilities unless the ISO is able to cast itself as an honest broker.

None of the ISOs in operation or under development is well equipped to address the complex technical, economic, business, regulatory, and political issues that surround transmission planning and investment in a restructured world. The emerging structure—ISOs with committees that recommend when and how to modify the grid owned by multiple utilities with competing interests—is a recipe for gridlock.
What Are the Implications of Gridlock?

What does gridlock mean for the North American electric power industry? CERA sees five major implications:

**Investment Bias in Favor of Generation**

There are many developers weighing the costs and benefits of generating plant investments and acting on projects that offer an attractive rate of return, but no one is evaluating the costs and benefits of potential transmission investments. This lack of attention means that when both generation and transmission projects are attractive options to capture a particular benefit, the generating plant is the one likely to be built even if the overall cost-benefit analysis would favor a transmission project. In effect, gas pipelines connected to new peaking capacity have become an alternative to major new transmission investments.

**Increasing Balkanization of Power Markets**

As the transmission system is unable to keep pace with load growth and generation investments, congestion will become increasingly frequent. This will tend to isolate regional power markets into smaller and smaller areas, especially during times of peak loads. Taking advantage of the marketers' inability to wheel power, developers will build plants and cogeneration facilities near industrial facilities, municipalities, and other loads. Ultimately, end-users frustrated by price volatility or perceived market power may install their own generators. This balkanization will make the existing transmission congestion contracts increasingly valuable assets.
The October 28, 1998, decision by the FERC regarding a cogeneration facility in Maine is an important signpost for balkanization. The FERC struck down the New England Power Pool's (NEPOOL's) long-standing requirement that new generators be fully integrated with the pool, meaning they must invest in transmission that allows them to serve loads anywhere in the region. In contrast, existing generators have the option to pay for other generators on the system to be ramped up or down, or "redispached" to accommodate their transactions when constraints arise. By allowing new generators to substitute redispatch for transmission upgrades, the FERC has encouraged balkanization and made it less expensive to build generation—potentially reducing the need for transmission upgrades in the first place.

Growing Price Volatility, Falling Liquidity, and Persistent Price Differentials

The loss of load and resource diversity that comes with balkanization will amplify the natural volatility of the wholesale power market. Price differentials will persist because there will be only limited ability to arbitrage them through the natural gas pipeline system. In the longer term, power market liquidity will develop much more slowly, and generation market concentration will increase. This may lead to chronically inefficient wholesale and retail power markets.

Volatility will create a booming market in hedging instruments—particularly for the more liquid trading points. Traders, retail energy merchants, and large industrial and commercial users need to insulate themselves from price volatility and the growing risk of curtailment. This means a demand for liquid, location-specific financial hedging instruments.

Consolidation of power traders will be another natural result of increased volatility, as demonstrated in the fallout from the June 1998 Midwest price spikes: small power marketers without adequate financial strength will not be able to convince potential trading partners of their creditworthiness, and players unable or unwilling to bear the financial risks of volatility will exit the business. Volatility and balkanization also favor scale because larger trading organizations can hedge by controlling assets and/or taking positions in multiple regions and have the resources to develop a sophisticated understanding of the transmission system.

Reliability Is Threatened

As existing systems age and load grows, gridlock causes increased congestion and more frequent equipment failures. Larger power systems are inherently more reliable than small ones because they are less vulnerable to a single contingency and the operators have more options available to them when contingencies occur. Ultimately, reliability problems emerge as a greater number of highly concentrated markets are forced to operate independently.

Experiments with Transmission Companies

Pressure for further structural and regulatory changes is already building as the industry begins to question long-term viability of the ISO model. Several utilities are developing for-profit independent transmission companies ("grid company" or "gridco") that they believe will solve many of the problems that are causing gridlock (see Figure 7). These companies would continue to be regulated monopolies, but they would be independent of both the generators and the distribution utilities.

The combination of control and ownership gives grid companies three major advantages over ISOs:

- A grid company will have a profit motive to encourage action and guide its decisions.
- Control of operation and pricing would make it substantially easier for grid companies to raise the capital necessary to improve the transmission network.
Are Grid Companies the Answer?

If the root of gridlock is lack of incentives, then incentives are also the way to solve the problem. For-profit grid companies address some but not all of the necessary elements. Transmission management institutions, whether nonprofit or for-profit, must have incentives to

- maintain reliability and safety by buying ancillary services, operating the grid, and controlling maintenance and generator and load interconnections
- offer nondiscriminatory access to the grid
- expand quickly to achieve a critical mass to internalize loop flows, enhance reliability, and eliminate rate pancaking
Decision Brief

- align their geography with the extent of the transmission system—not regulatory boundaries
- operate and price transmission to facilitate an efficient market for electric power
- invest to optimize the efficiency of the power market in the long term
- adopt new technologies such as high-voltage direct current (HVDC), superconductivity, power flow controllers, and information technology where appropriate

Although these criteria are easy to articulate, they will be difficult to implement. The complexity of the problem creates the potential that actions will have unintended consequences. For example, performance-based rates can unintentionally create the incentive to minimize costs by deferring maintenance or avoiding investments, potentially leading to chronic underinvestment or reliability problems.

Some of the goals listed above are in conflict—for example, maintaining reliability while encouraging an efficient, unfettered market. One conflict that directly affects the gridlock problem is the potential contradiction between offering nondiscriminatory access to generators and making investments in transmission. Incentives must create the proper balance between transmission and generation, which often compete to be the marginal source of capacity and energy in the market. Without the careful attention to incentives, a monopoly grid company or ISO will favor its own transmission solutions over new generation.

Who Holds the Key?

The consequences of gridlock—inefficient investment, balkanization, market failure, unreliable electricity—are severe, but they may not be severe enough to precipitate a crisis. Without such a crisis, the industry and the FERC must both realize there is a problem before there will be any urgency to break the stalemate. Recent innovative grid company proposals are a sign that transmission owners are beginning to recognize the current state of paralysis. The FERC's upcoming NOPR on regional transmission entities will be an important indicator of its understanding of gridlock. The worse it perceives the problem to be, the more radical its NOPR is likely to be. The NOPR could well cause transmission issues to emerge as the dominant issue of electric restructuring in 1999.

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April 1999
RAILROADS AND COAL

Because of coal’s importance to the economy and because it is consumed in huge quantities all over the country, while production is focused in a limited number of areas, an efficient coal transportation system — with railroads at its core — is critical to our nation’s economic well-being.

According to the U.S. Department of Energy’s Energy Information Administration (EIA), some 65 percent of coal shipments were delivered to their final U.S. destinations by rail in 1999. The rail share is far higher than water (14 percent), trucks (11 percent), and the aggregate of conveyor belts, slurry pipelines, and tramways (10 percent). Over the past decade, the rail share has trended slightly upward, largely reflecting the growth of coal from the Powder River Basin in northeast Wyoming and southeast Montana that often moves long distances by rail.

Coal is by far the most important single commodity carried by rail. In 1999 (the latest year for which data are available), coal accounted for 26 percent of carloads, 44 percent of tonnage, and 22 percent of revenue for Class I railroads.

Coal-fired power plants, which consume the vast majority of coal in this country, compete against one another and against power plants fueled by other energy sources. For example, non-coal fuel sources account for nearly half of U.S. electricity generation. Consequently, railroads must work closely and cooperatively with mines and utilities to maximize efficiencies and enhance competitiveness. Over time, for example, higher capacity freight cars (which now carry almost 110 tons of coal per car on average) and more powerful locomotives have increased railroads’ coal-carrying efficiency significantly. Highly-efficient unit trains, which carry 50 or more carloads of coal from a loading facility straight through to a customer without interruption using dedicated equipment, account for most rail coal shipments.

Railroads have worked hard to keep service as responsive, and rates as low, as possible. Since it recognizes both distance and weight, revenue per ton-mile (RPTM) is a useful surrogate for railroad rates. In 1999, rail RPTM for coal was 1.64 cents, easily the lowest such figure among all major commodity groups. In inflation-adjusted terms, 1999 RPTM for coal was 61 percent lower than in 1981 and 35 percent lower than in 1990.

Numerous studies have confirmed that rail coal rates have been falling steadily. For example, an April 1999 study by the General Accounting Office found that “in general, real rail rates for coal shipments have fallen since 1990.” More recently, an October 2000 EIA study examined changes in railroad coal rates. The EIA’s findings were unambiguous: “Although the share of coal transported by railroads increased, the average rate per ton to ship contract coal by rail fell steadily (a 25.8 percent decline) during the study period. The rates for coal in all sulfur categories were lower in 1997 than in 1988.” EIA noted that “the decline in average contract coal rail rates during the study period was a response to competitive markets.”

Today, many of our nation’s coal mines, coal-fired power plants, and the railroad lanes serving them are at or near full capacity. Rail coal volume in 2001 through March is higher than the same time period of any recent year, and is up 7.2 percent over last year — reflecting both the higher demand for coal in light of high natural gas prices and the efficient, cost-effective service railroads are providing.
Economic Impact of U.S. Freight Railroads

Freight railroads move just about everything — from lumber to vegetables, from coal to orange juice, from grain to automobiles, from chemicals to scrap iron — and connect businesses with each other across the country and with markets overseas. They also contribute billions of dollars to the economy through investments, wages, purchases, and taxes.

America’s Freight Railroads Carry...

- More than 40 percent of the nation’s intercity freight;
- Approximately 70 percent of vehicles from domestic manufacturers;
- 64 percent of the nation’s coal to coal-fired power plants (coal generates more than 50 percent of the nation’s electricity);
- Some 40 percent of the nation’s grain.

...and Move Tens of Millions of Tons Every Day

- Class I railroad freight volume in 1999 was 1.43 trillion ton-miles. U.S. railroads hauled more than 27 million carloads of freight in 1999, including more than 9.0 million intermodal trailers and containers. Intermodal volume has nearly tripled since 1980.
- Class I railroads operated 20,256 locomotives in 1999 which hauled a fleet of 1,368,836 freight cars with an aggregate capacity of 134.4 million tons — an increase of 24 percent since 1990. It would take three million trucks to equal the capacity of the rail car fleet.
- U.S. railroads operated 145,000 route miles in 1999, enough to circle the globe almost six times.

Railroads Move Freight at a Lower Cost Than Ever Before

- On average it costs 28 percent less to move freight by rail now than it did in 1981, and 57 percent less in inflation-adjusted dollars. These rate reductions have saved American consumers tens of billions of dollars.

Railroads Directly Boost the Economy

- U.S. freight railroads directly contribute some $13 billion a year to the economy in wages and benefits to nearly 200,000 employees and billions more in purchases from suppliers.
- Almost 700,000 retired railroad workers and family members receive $8 billion in retirement benefits each year.
- In 1999, Class I railroads paid $2.3 billion in payroll taxes, $379 million in federal income taxes (in addition to incurring $1.3 billion in deferred income tax liability), and nearly $694 million in other taxes.

Association of American Railroads
America's Freight Railroads

Economic Facts-At-A-Glance

Investing in the Future: Capital Expenditures

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<th>Year</th>
<th>Expenditures</th>
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<tr>
<td>1999</td>
<td>$6.6 billion</td>
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Source: AAR

Lower Rates Help Rail Customers

Costs Per Ton-Mile

- Inflation-Adjusted 1999 Dollars
- Current Dollars

Source: AAR

Moving More Freight

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<thead>
<tr>
<th>Year</th>
<th>Millions of Carloads Originated</th>
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</tr>
<tr>
<td>1999</td>
<td>28</td>
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</table>

Source: AAR

The Gap Persists

- Railroad Cost of Capital
- Railroad Return on Investment

Source: AAR

Association of American Railroads

Obtained and made public by the Natural Resources Defense Council, March / April 2002
Investment: Essential to Railroads and Their Customers

As the U.S. freight railroads well know from their experiences in the years before the Staggers Rail Act of 1980, a rail system deteriorates rapidly when railroads are capital-starved. Capital is the lifeblood of the freight rail industry and today, thanks to infusions of capital and the massive investment made possible by deregulation, railroads have been reborn. Since 1980, major freight railroads in the United States have invested more than $26.5 billion to maintain and improve their infrastructure and equipment, and to create a national system that is the envy of the world.

Prior to Deregulation, Rail Investment Was Woefully Deficient

- In the 1970s, railroads simply lacked the ability to invest at adequate levels. Due largely to stifling regulation, during the 1970s the rail industry’s rate of return averaged two percent and rail bankruptcies were commonplace.
- In the mid-1970s, 25 percent of the nation’s rail miles had to be operated at reduced speeds because of dangerous conditions. Congress estimated that, absent meaningful change, the rail industry’s capital shortfall would approach $20 billion by the mid-1980s.

Deregulation Gave Railroads the Means to Invest

- By giving railroads the opportunity to earn revenues sufficient to cover their cost of operations, deregulation sparked an industry transformation.
- As income increased, so did investment. Investment led to greater efficiency, sharply improved safety, better service, and dramatically reduced rates — down 57 percent in real terms from 1981 to 1999.

Today, U.S. freight railroads reinvest more in plant and equipment as a percentage of revenues than any other major U.S. industrial sector. Class I railroad revenues reached $33.5 billion in 1999. Of that, railroads reinvested $6.6 billion, or 19.8 percent.

Capital expenditures per mile of road owned were more than $66,000 in 1999, almost 2 1/2 times the comparable inflation-adjusted 1983 figure.
Reregulation Would Threaten Rail Investment and the Viability of the Rail System

U.S. freight railroads are overwhelmingly privately owned and operated. Because they receive no appreciable government funding, they must earn enough year after year to cover the massive spending they require.

The industry is committed to expending the resources needed to continue to improve service, expand capacity, and offer their customers reasonable rates. But, they would be unable to do so if reregulation prevented them from earning revenues and attracting the capital necessary to cover their total costs and make the required level of investment.

The cash generated by the rail industry since Staggers has been insufficient to sustain the capital investment required. Railroads have found it necessary every year since 1980 to obtain funds from outside sources: from 1981 to 1999, of the cumulative $81.9 billion in capital expenditures, approximately 64 percent was provided from internally-generated funds and 36 percent from external capital providers. Thus, artificial or unrealistic restrictions that impede the rail industry’s opportunity to generate sufficient returns will compromise its ability to retain and attract the capital it needs to sustain its investment and operations over the long term.

Railroads will have to invest an estimated $162 billion (in 1997 dollars) by the year 2020 — the equivalent of rebuilding the entire rail system twice — simply to maintain their current share of the freight market. This can occur only if railroads are allowed to operate under a stable and limited set of regulatory constraints.

Railroads are far more capital intensive than other major

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industries. For example, in 1998 (the latest year for which comparable non-railroad data are available), railroads' capital expenditures were equal to 21.7 percent of revenue, compared to an average of just 3.9 percent for all manufacturing industries.

Similarly, data for Fortune 500 firms in selected industries that are major rail shippers or competitors reveal the capital intensive nature of railroading. Compared on the basis of total assets required per dollar of revenue produced, railroads have significantly higher asset needs — $2.57 of assets for each dollar of revenue produced.

### Capital Expenditures as a Percentage of Revenue for Various U.S. Industries: 1998

<table>
<thead>
<tr>
<th>Industry</th>
<th>Ratio of Expenditures to Revenue</th>
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<tbody>
<tr>
<td>All manufacturing</td>
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<tr>
<td>Food manufacturing</td>
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<tr>
<td>Wood product manufacturing</td>
<td>3.0%</td>
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<tr>
<td>Paper manufacturing</td>
<td>5.5%</td>
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<tr>
<td>Chemicals manufacturing</td>
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<tr>
<td>Fabricated metal product mfg</td>
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<tr>
<td>Machinery manufacturing</td>
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<tr>
<td>Computer &amp; electr. product mfg</td>
<td>4.8%</td>
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<tr>
<td>Transportation equipment mfg</td>
<td>3.3%</td>
</tr>
<tr>
<td>Class I Railroads</td>
<td>21.7%</td>
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Source: U.S. Bureau of the Census, AAR

### Ratio of Assets to Revenues of Fortune 500 Firms for Selected Industry Groups: 1999

<table>
<thead>
<tr>
<th>Industry</th>
<th>Number of Firms</th>
<th>Total Revenues ($ Billions)</th>
<th>Total Assets ($ Billions)</th>
<th>Ratio of Assets to Revenues</th>
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<tr>
<td>Chemicals</td>
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<td>Forest &amp; Paper Products</td>
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<td>105.3</td>
<td>134.0</td>
<td>1.26</td>
</tr>
<tr>
<td>Industrial &amp; Farm Equipment</td>
<td>11</td>
<td>81.2</td>
<td>88.3</td>
<td>1.09</td>
</tr>
<tr>
<td>Metals</td>
<td>8</td>
<td>44.2</td>
<td>54.6</td>
<td>1.24</td>
</tr>
<tr>
<td>Mining, Crude Oil Production</td>
<td>3</td>
<td>17.0</td>
<td>24.6</td>
<td>1.45</td>
</tr>
<tr>
<td>Motor Vehicles &amp; Parts</td>
<td>14</td>
<td>452.8</td>
<td>634.6</td>
<td>1.40</td>
</tr>
<tr>
<td>Railroads</td>
<td>4</td>
<td>36.4</td>
<td>93.5</td>
<td>2.57</td>
</tr>
<tr>
<td>Telecommunications</td>
<td>13</td>
<td>289.6</td>
<td>638.0</td>
<td>2.20</td>
</tr>
<tr>
<td>Trucking</td>
<td>1</td>
<td>8.8</td>
<td>4.4</td>
<td>0.50</td>
</tr>
<tr>
<td>Gas &amp; Electric Utilities</td>
<td>37</td>
<td>266.3</td>
<td>584.8</td>
<td>2.23</td>
</tr>
</tbody>
</table>

Source: Fortune, April 17, 2000
Railroads: Building a Cleaner Environment

Investments in new technology and infrastructure have made the railroad industry environmentally “cleaner and greener” than ever before. Over the past five years alone, railroads have invested billions of dollars in more than 4,000 locomotives that are more fuel-efficient and environmentally friendly.

Railroads Are More Environmentally-Friendly Than Other Modes

• The U.S. Environmental Protection Agency (EPA) estimates that for every ton-mile, a typical truck emits roughly three times more nitrogen oxides and particulates than a locomotive. Other studies suggest that trucks emit six to 12 times more pollutants per ton-mile than do railroads, depending upon the pollutant measured.

• According to the American Society of Mechanical Engineers, 2.5 million fewer tons of carbon dioxide would be emitted into the air annually if 10 percent of intercity freight now moving by highway were shifted to rail.

• Railroads are committed to substantial reductions in atmospheric emissions. They endorse an EPA proposal that calls for a 60 percent reduction in nitrogen oxide (NOx) emissions from locomotives manufactured beginning in 2005.

• According to the EPA, railroads account for just 7 percent of total transportation-related NOx emissions and less than 5 percent of transportation-related particulate emissions, even though railroads account for 40 percent of the nation’s intercity freight ton-miles.

Railroads Are the Most Fuel-Efficient Form of Ground Transport

• Railroad fuel efficiency has increased 64 percent since 1980, when a gallon of diesel fuel moved a ton of freight an average of 235 miles. In 1999, railroads moved a ton of freight an average of 386 miles per gallon.

• If just 10 percent of the freight moved by highway were diverted to rail, the nation could save as much as 200 million gallons of fuel annually.

• On average, railroads are three times more fuel efficient than trucks.

Public Policy

• National transportation policy should recognize the freight railroad advantages in energy efficiency and pollution abatement.

Association of American Railroads
America's Freight Railroads
Environmental Facts-At-A-Glance

Gains in Railroad Fuel Efficiency

Toward a Cleaner Environment
Railroad Plans to Reduce NOx Emissions

Modal Comparisons of Nitrogen Oxide Emissions

Railroads: The Best Choice for the Environment

Source: Environmental Canada, Transportation Systems Division, Ottawa, Canada, 1994
Additional comments by Hamberger not included in bullets:

Railroads and barges comprise the foundation of the domestic coal distribution system, together handling three-quarters of all coal shipments. Trucks and conveyor systems generally are used to move coal over shorter distances. Lake carriers and ocean vessels move large coal shipments over water. Association of American Railroads want to remove anticompetitive 4.3 cents sales tax railroad and barges pay in legislation: HR1024 and S661. Railroads move more coal than any other commodity and account for 22 percent of total rail freight and more than 40 percent of total Class I freight tonnage transported.

According to Mr. Edward Hamberger, President of Association of American Railroads, Class I from 1980 to 2000 ton-miles, the movement of a ton of freight one mile, a standard freight volume measurement--rose from 919 billion to 1.47 trillion, a 60% increase. The rail network is used more intensely and far more productively than in the past, and in some cases running at full track capacity today. For instance, ton-miles per mile of road owned rose from 5.6 million in 1980 to 14.8 million in 2000 a 165% increase. During this period of huge traffic expansion, railroads carefully managed their cost and generated enormous productivity growth 172% while reducing their operating costs 41% inflation adjusted basis, but operating revenue declined 36%.

As traffic congestion on our highways becomes even more acute and pressure to reduce emissions, conserve fuel and promote safety continues to increase, railroads are likely to be called upon to do even more based on their advantages over other modes. The demand for additional passenger service utilizing freight lines is widespread and growing. In addition to infrastructure capacity, configuration of infrastructure is a critical issue in determining feasibility of running passenger trains on freight-owned tracks. Also passenger railroad companies should be required to work out a deal with freight companies that own the tracks they want to use, the Government should not demand passenger railroads can use these tracks without such agreements. There are different engineering and maintenance standards that will have to be addressed if passenger and freight trains eventually share same tracks, for example curves are different for slower moving freight trains than faster passenger trains. Unfortunately most knowledgeable people would agree that most readily attainable gains of companies sharing the cost of upgrading infrastructure costs have mostly already been made. Gains from this area going forward are more evolutionary not revolutionary. Government should be willing to help with upgrading Class I lines. Believes Government should pass HR1020 for Class II and III railroads.

Since the railroad industry depends on the capital markets to fund a large portion of their investment, and that the return on investment does not provide a return equivalent to alternative investments of similar risk, the railroad companies will be challenged to increase thses returns by say limiting capital expenditures. Railroads will continue to face pressure from investment community to maximize returns and are most likely unable to accommodate the financial demands required to improve infrastructure while trying to appease lenders return on investment requirements.
## U.S. Railroad Mileage

<table>
<thead>
<tr>
<th>Class</th>
<th>Owned</th>
<th>Leased</th>
<th>Trackage Rights</th>
<th>Govt. Owned</th>
<th>Other</th>
<th>Total Incl. Trackage Rights</th>
<th>Total Excl. Trackage Rights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I Subtotal</td>
<td>88,848</td>
<td>8,642</td>
<td>21,566</td>
<td>1,587</td>
<td>323</td>
<td>120,986</td>
<td>99,400</td>
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<tr>
<td>Regional Railroads</td>
<td>14,473</td>
<td>1,654</td>
<td>2,563</td>
<td>2,409</td>
<td>151</td>
<td>21,250</td>
<td>16,687</td>
</tr>
<tr>
<td>Local Railroads</td>
<td>14,149</td>
<td>1,257</td>
<td>1,154</td>
<td>4,158</td>
<td>401</td>
<td>21,118</td>
<td>19,964</td>
</tr>
<tr>
<td>S&amp;T Railroads</td>
<td>4,562</td>
<td>255</td>
<td>731</td>
<td>1,646</td>
<td>110</td>
<td>7,304</td>
<td>6,573</td>
</tr>
<tr>
<td>Canadian</td>
<td>581</td>
<td>0</td>
<td>976</td>
<td>0</td>
<td>0</td>
<td>1,557</td>
<td>581</td>
</tr>
<tr>
<td>TOTAL</td>
<td>122,613</td>
<td>11,808</td>
<td>27,010</td>
<td>9,800</td>
<td>985</td>
<td>172,215</td>
<td>145,205</td>
</tr>
</tbody>
</table>

Source: AAR
Summary of
Energy Policy Act Transportation Rate Study: Final Report on Coal Transportation
(U.S. Department of Energy - Energy Information Administration, November 2000, 90 pages)

This study was mandated by a provision in the Energy Policy Act of 1992. It was prompted by concerns of some in Congress that railroads would take advantage of shifts to low-sulfur coal induced by sulfur dioxide emission restrictions by raising their rates for hauling coal, especially low-sulfur coal from the Powder River Basin (PRB).

The study examined changes in transportation rates for coal purchased and delivered under supply contracts of more than one year duration shipped by rail from U.S. producers to certain U.S. investor-owned electric utilities from 1988 to 1997. Confidential rail rate data were obtained from Federal Energy Regulatory Commission (FERC) utility surveys. EIA augmented FERC data with data from the STB's Waybill Sample and industry reports.

Rail coal movements captured by the EIA study represent a majority of all coal deliveries to utilities, with the exact percentage varying from year to year. In 1997, for example, the quantity of coal hauled by railroads and covered by the study's augmented database was 367.2 million tons - an amount equal to 65 percent of the 563.3 million total tons of coal railroads delivered to all utilities in 1997. As expected, from 1988 to 1997 the share of low-sulfur coal rose (from 48.4 percent to 64.9 percent of movements), while the share of medium- and high-sulfur coal fell. The study noted that the rail share of total domestic coal tonnage rose from 57.5 percent in 1988 to 61.8 percent in 1997, driven largely by an increase in rail-hauled low-sulfur PRB coal.

The report's findings were unambiguous: "Although the share of coal transported by railroads increased, the average rate per ton to ship contract coal by rail fell steadily (a 25.8 percent decline) during the study period. The rates for coal in all sulfur categories were lower in 1997 than in 1988. ... The general finding of declining rates was also substantiated when the rates were calculated as a rate per ton-mile, a rate per million Btu, or rates between specific supply and demand regions. ... Clearly, the majority of the contract coal shipped by rail during this period traveled via lower real-dollar rates than in earlier years, and there is no evidence of widespread inflation of shipping rates by the major coal-hauling railroads following enactment of the [Clean Air Act Amendments of 1990]. In fact, the greatest decline in coal rail rates per ton - a 36.0 percent decline in constant dollar terms - was for low-sulfur coal, the very category over which concern may have been greatest." The report noted that "the decline in average contract coal rail rates during the study-period was a response to competitive markets..."

A footnote in the study notes that "Because the rate data in this report represent regional data aggregations, they do not address alleged inequities in rates to and from isolated locations, or for "captive" shippers (with only one practical coal transportation option), or for small shippers who may not have access to technologically efficient loading equipment or may not qualify for high volume discounts." Rail detractors can be expected to seize upon this statement to dismiss the unambiguous major finding of the report: significantly lower rail rates for contract coal essentially across the board from 1988 to 1997.
U.S. Lower-48 Natural Gas Resources Subject to Access Restrictions

* Approximately 29 Tcf of the Rockies gas resources are closed to development and 108 Tcf are available with restrictions.
Kevin, it was good to talk to you again the other day. I appreciate your willingness to assist in organizing a meeting to discuss the interests of the landfill gas-to-energy industry with the appropriate policy representatives within DOE.

The industry representatives would be Curt Ranger, President, DTE Biomass Energy and Jerrold Jung, President, Michigan CAT, two Michigan based companies. Curt Ranger is also currently serving as the Advocacy Committee Chairman for the Solid Waste Association of North America (SWANA). In general terms we would like to discuss the role of landfill gas as a part of the national energy strategy. More specifically, we would focus on the benefits derived from nonconventional fuel tax credits.

The dates I have available for a meeting are August 29 and September 11, 12 and 14. If these dates are not workable, please let me know and I will look later into September.

Thank you for your consideration. If you have questions I can be reached at 202-347-8420. - Renze