

General Issues

The Advantages of Electrifying the Nation's Railroads

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Throughout history, it has been axiomatic that the nations that developed and used the most desirable forms of transportation for carrying the goods and materials then in demand flourished, while those nations that did not develop such transportation systems lagged. Camels carried goods during biblical times to the various centers of the Middle East, and villages and cities along the camel trails flourished to a greater extent than did those not on these trails. The Phoenicians were powerful when their ships plied the seas; afterward, Phoenicia fell into oblivion. Spain was a wealthy, powerful nation for as long as it controlled the sea lanes. Then England eclipsed Spain as a naval and industrial power.

Perhaps one of the most vivid modern examples of economic development's absolute reliance on transportation is shown in South Africa. This is the only African nation below the equator in which interior areas have developed economically. This is because, many decades ago, a railroad was built inland from the coast area to haul the gold, other ores, and diamonds from the interior. And so communities developed inland in South Africa, and commerce and agriculture have flourished in its noncoastal communities. Without the railroad, this would not have happened.

America's economy originally developed along the Atlantic coastal area. Ships hauled goods to and from Europe and between communities along the coast. Then canals were constructed, and roads were built inland. Then came the railroads, and America grew from coast to coast and became the world's most powerful industrial nation.

We are now slipping. Although there are many reasons for this, one of the most important and apparently least recognized is that many of the older industrial communities of our nation in the Midwest, Appalachia, and the northeastern states lack efficient transportation to move raw materials, fuels, and manufactured products economically to compete in the marketplace with those in other parts of the nation—and, for that matter, with those in other parts of the world. In the United States, we have developed highways, air transport, and in some areas barges. But the railroads, which should be the backbone of our transportation system, have been allowed to wither in the heavily populated industrial regions.

Let us be under no illusions. Modern industry desperately needs efficient railroads. Trucks can handle certain types of freight economically, particularly for door-to-door service, for short hauls, and in some cases for medium-distance hauls. Airplanes are superior for transporting some goods—particularly small packages and perishables for long distances—but railroads, properly constructed and maintained and using modern efficient rolling stock, switching yards, and signaling equipment, are absolutely essential if this nation is to continue to exist as a world power. This is particularly true in this era of energy shortages.

Unfortunately, the railroad industry in the United States has since its inception been manipulated to a large extent by entrepreneurs and bankers more interested in controlling the railroad for their own short-range financial schemes than in developing the railroads for long-range profitable growth. This pattern was observed in the early days of Vanderbilt, Fiske, and Gould and has existed for many years—right up to the debacles of the New Haven and Penn Central railroads. Fortunately, there are many railroads today that are well managed by transportation experts who supply good customer service and are investing substantial portions of their revenues in programs for modernization and maintenance.

But in our major eastern and midwestern industrial areas, there are only a few such rail companies in operation. And until and unless these vital regions have modern high-speed rail transportation, the United States will continue to flounder economically. We even risk the danger of slipping into a second-rate position as a world power.

It is therefore time to look at rail operations as a vital part of national policy. The United States can no longer afford to let rail operations be determined in a vacuum by piecemeal Interstate Commerce Commission (ICC) or court decisions that are based on yesterday's practices. Nor can these vital decisions that have such serious impact on the economy be made strictly on the basis of granting short-term advantages to a handful of financiers. Most importantly, particularly in view of the energy crisis, it is essential for the future well-being of our nation that our major railroads should be electrified. If we fail to do this, we are courting national disaster in the very near future.

The Pennsylvania Energy Council has estimated that a 34 percent saving in energy could be achieved by using electric power. Electrification of just 10 percent of the present rail trackage (in the densely populated, heavy industrialized areas) could result in a 40 percent reduction of diesel fuel consumption. In addition to the benefits to freight traffic, electrification of rail lines in and around our big cities would greatly relieve present traffic jams by reducing the number of automobiles on the road. A few judiciously selected commuter lines near our major cities could readily replace 250 000 automobile passenger trips/d, saving almost 151 000 000 L (40 000 000 gal) of gasoline a year without government coercion or the imposition of heavy penalties. Thus, the potential for fuel saving is substantial. Safety is another factor. Statistics indicate that a rail passenger will travel 20 times farther than a motorist before a serious accident befalls him or her.

To illustrate the potential for savings, it is important to emphasize that rail passenger service today attracts only 1 percent of the nation's passenger trips. With electrification, this would rise dramatically. Electrification would make possible short, fast, and frequent train service near and in our cities. A one-car, 100-passenger electric train can earn \$3/km (\$5/mile) with 75 percent utilization. If track capacity is inadequate to operate enough one-car trains, it implies that a two-car train on an existing system can be added for \$3.7/km (\$6/mile), with a revenue of \$4.3/km (\$7/mile) at a 50 percent load factor. How often do two freight cars earn a \$0.60/km (\$1.00/mile) profit between them?

However, the main economic consideration is that the hauling of freight offers the greatest financial and energy- and time-saving advantages for rail electrification. Although diesel-powered locomotives have offered the advantage of lower initial capital commitment and lower engineering and initial construction costs, diesel locomotives do not handle as well at full speed. In fact, acceleration with diesels is rather poor. A generation or so ago, steam-powered trains operated at 160 km/h (100 mph). Speeds with diesel engines are now down to 110 km/h (70 mph) or even slower. It is not unusual for a highway truck to pass a so-called streamlined diesel-drawn passenger train where the roadways are parallel. But high speeds are essential if the railroads are to provide maximum benefits to both freight and passenger customers and, at the same time, resolve rail energy requirements. Therefore, the need to electrify our railroads is urgent. There is nothing new about this concept in the United States. Before 1937—more than 40 years ago—the New York, New Haven, and Hartford Railroad Company; New York Central System; Chicago, Milwaukee, and St. Paul Railway; Great Northern Railway; Virginian Railway Company; and Pennsylvania Railroad had electrified thousands of kilometers of track quite successfully.

In 1937, there was a switch to diesel-powered engines that generated their own electricity to drive individual axles. This system had the advantage at the time of lowering the requirements for the initial capital needs for rail engineering and construction, as well as achieving good performance at low and middle speeds. Now, however, with the tremendous increase in fuel costs, diesels have lost most of their former advantages. They are no longer cheap to operate; they consume too much precious fuel; their turnaround time is slow; and they are not as fast as is required to meet today's freight or passenger needs.

The decisions that may have been correct 40 years ago do not apply in today's world of high-speed truck and air competition and of fuel shortages. The pendulum

has definitely swung in favor of high-speed electrified railroads for both passenger and freight service. Electrifying railroads offers the best chance to turn present money-losing operations into profitable operations, because electrification offers the greatest hope for our railroads to recapture the business of hauling the products that carry the higher rates. The bulk commodities that now move by rail generate revenue of about 1.7 cents/Mg·km (2.5 cents/ton-mile), and pay a rate of return on net investment of about 1¼ percent. It is obvious that there is no private-enterprise future for rails if the only effort made is to maintain the status quo.

Rail revenues have not kept pace with the economy. Future rail revenue must increase much more rapidly. Yet rates cannot be increased without the loss of more of the bulk traffic to waterways, which would in turn increase the pressure to increase rail rates again. Thus, new revenue cannot be derived by increasing the rates on the bulk loads now carried but only by offering improved services to attract the types of freight that pay 3.5 or 7.0 cents/Mg·km (5 or 10 cents/ton-mile) instead of 1.7 cents/Mg·km. The trucking industry is profiting and growing rapidly on rates that average 7.5 cents/Mg·km (11 cents/ton-mile). It is obvious that the railroads must develop new technologies to profitably sell service that will attract shipments in the higher revenue class. The present 100-car unit train so often cited as the epitome of rail efficiency grosses about \$95/km (\$150/mile) but, carrying bulk freight, it nets only a few dollars. However, if it were carrying high-rated manufactured products, a 50-car train of much lower weight, which would cause less track damage, could gross as much as a lower operating cost.

Also, operating expenses can be reduced through better maintenance. The rail carriers have cut the payroll from 1.2 million employees to about 0.5 million. Unfortunately though, many carriers have all but eliminated track maintenance. This is absolutely the wrong way to cut expenses since it raises the operating cost of the carriers, cuts the speed of service, and reduces the opportunity to compete effectively for the high-rated traffic. The record shows clearly that, as maintenance expenses of railroads are cut, revenues move downward and the chances for profitable operation are diminished. Railroads need to institute economies that increase revenues and profits rather than those that reduce them.

To make this progress, our railroads need capital to invest in new equipment, new track, and electrification. Under the existing circumstances, the carriers of the Northeast, Midwest, and Appalachian regions cannot possibly raise the required funds in the private financial markets. But it is a Catch-22 situation—unless they do modernize and become competitive in the handling of high-rated products to augment the carrying of heavy bulk products, railroad service will continue to deteriorate, and eventually the economy of the nation will suffer a major collapse. We must therefore find the financial way to modernize track and electrify our major railroads.

It is for this reason that I proposed 3 years ago a \$13 billion railroad construction trust fund to be used to modernize our railroads over a 6-year period. A good portion of this was for new track and electrification. It would take about \$18 billion to do the job today. At the time, the ICC had permitted a 10 percent freight rate increase earmarked for capital improvement. They too recognized the problem, but the solution they offered was really no solution because rate increases drive away customers. We have a highway trust fund, an aviation trust fund, and President Carter recently proposed a waterway trust fund. I do not know how the railroads can expect to survive without a similar type of federal fund that would provide the capital that the most hard-

pressed and most needy railroads cannot themselves raise in today's financial markets.

Under the rail trust proposal I suggested in 1974, funds would be made available to modernize all U.S. rail facilities. The improved track, centralized traffic control, and electrification would, after 6 years, save at least \$1.5 billion/year in operating costs for the railroads—and perhaps much more. The return on investment was estimated in 1974 to be 15 to 18 percent, but this did not project increased earnings from the new high-profit traffic that electrification could attract. Thus, the actual rate of return should be much better.

The dilemma that impedes railroad electrification under normal financing, even if it could be arranged, is quite apparent. Most eastern and midwestern railroads are losing money at present. The national rail system earns only 1½ percent on the old net investment. Though an electrification program would increase present rail net earnings tenfold, there are other investment projects that require less funding, that offer high rates of return for investors, and that are safer. Thus, important railroads, unable to raise equity funds, continue to slide down the drain. This slide must be halted. This major project of rail reconstruction must be financed. The need for implementing the rail trust fund concept is even greater today than it was in 1974. Improved track and electrification are the keys to future rail success and for profitable operation for the carriers. A few specific examples prove this point.

At present, the run from Harrisburg to Pittsburgh is a difficult one. Even an important expedited freight train needs nearly 11 h to make a one-way trip and 28 h to make the round trip, including fueling and servicing. Three such expedited trains per day require 15 diesel locomotive units, each train having 8.6 MW (11 500 hp). Contrast this diesel operation with one using electric power. A one-way trip could be cut to 10 h and the round trip to 24, since refueling is not necessary. Only two electric units would be needed to put 8.6 MW to the rail, so the locomotive fleet could be cut from 15 for each 3 trains/d to 6, a saving of 60 percent in motive power with better service provided.

If the railroads are to move more than bulk loads and be able to carry the high-profit loads efficiently, trains must do more than just start quickly, which is the main advantage of diesel power. They must be able to accelerate on the straightaway, decelerate around curves, and then get back up to moderate speed quickly. This can be done with electric powered trains.

There are those who would go the other way—cut the railroads' physical plant because it is currently said to be underutilized. I reject this bureaucratic suggestion to curtail service and shrink the plant. It is dangerous thinking for the future of the United States. The only way railroads will stay alive as a cost-effective business is to expand and improve service, to better use the plant, and thus to reduce the unit cost while increasing the net revenues.

Another example shows this can be done. There is now no overnight freight service by rail between Pittsburgh and Boston, which are only 1060 km (660 miles) apart. The rail could very well be electrified through Harrisburg, Philadelphia, and New York. The passenger tunnels do not permit large modern freight cars to pass through New York. With electrification, however, overnight freight trains, using captive freight cars within the clearance height, could be operated reliably. A freight train traveling at 80 km/h (50 mph), even allowing for reduced speed in strategic locations and counting

2 h delay for intermediate work, could make the run in 17 h; if it left Pittsburgh at 6:00 p.m., for example, it would arrive in Boston by 11:00 a.m. the next day.

The cost of operating such a train, with full overhead costs, could be roughly \$25/km (\$40/mile), or \$9.08/m³ (\$0.257/ft³), for a 30-car train over the full distance. At present, overnight freight by turnpike is a little faster but costs \$11.34/m³ (\$0.321/ft³). The energy difference however is striking—the equivalent of 20 000 L (5280 gal) of fuel saved by the electric train over that needed by trucks on the turnpike. This represents a 50 percent saving in energy requirements. Actually, all 40 000 L (10 560 gal) could be saved because the electricity for the rails could be generated by coal. The tremendous rate of use of these electric locomotive and freight cars is also worthy of note. Only six electric locomotive units are required—two operating each way each night and two in reserve. All six will average almost 16 000 km (10 000 miles) each month, assuming there is no weekend use. Most importantly, two trains operating between Pittsburgh and Boston could net a \$1 700 000 annual profit.

As another example, a six-car multiple-unit freight train going east from Pittsburgh overnight with cars destined for Philadelphia, Baltimore, and New York would cost \$4100/night each way. Assuming it carries 18 Mg (20 tons)/car and earns 7 cents/Mg·km (10 cents/ton-mile) for high-rated expedited shipments, revenue would be \$4452/night, excluding local trucking costs. The favorable impact on industry and employment with this type of transportation service would be enormous and would stimulate new business operations and the expansion of existing companies.

I hope that I have made my point that innovative new sources of revenue and profit would accompany rail electrification and that this factor must not be omitted from consideration. Using long, slow, heavy trains has not proved to be the most profitable way to run railroads.

I would like to make one additional point. The decision for rail electrification cannot be left only to the electrical engineers or to the motive power chiefs or to the rail purchasing agents. The decision must be based on total system considerations, including finance, estimates of future inflation of petroleum costs, future availability of fuel supply, service quality, international balance of payments, new types of service, noise and air quality regulations, and other factors both within and outside the control of railroad management. Where electrification becomes necessary or desirable and capital is not forthcoming, the concept of the railroad trust fund must be reexamined. The United States must move in this direction to ensure its economic future.

It is time to rebuild and modernize the railroads of the United States. Electrification makes a great deal of engineering and economic sense. Rail electrification will save enormous quantities of fuel for other uses. Electrification will increase rail efficiency and lower the cost of transporting goods. Electrification of our railroads will increase U.S. employment by many hundreds of thousands in the plants that manufacture the equipment and, more importantly, by making rail service more competitive and thus creating thousands of permanent new jobs.

We can help start a new industrial revolution in the United States if we use logical programs to conserve on fuel and improve transportation facilities. Electrification of our railroads is a major step needed to achieve this goal.