

# An Examination of Some Economic Obstacles to Electrification

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It has been said at this conference that a great new era in railroad electrification is coming. I recognize that there is a tremendous weight of evidence in favor of that. We cannot go on spending \$32 billion/year for imported oil. Production in the United States is down from 556 000 000 m<sup>3</sup> (3.5 billion bbl) in 1970 to 477 000 000 m<sup>3</sup> (3 billion bbl) in 1975, even though the wellhead price for crude oil has quadrupled and the United States accounts for three-quarters of all the drilling activity in the free world. Even the oil from Alaska—318 000 000 m<sup>3</sup>/d (2 million bbl/d) are expected to be flowing by 1977—will only stop the decline temporarily.

However, it may be a little early to write off oil as our industry's primary fuel. It is true that petroleum resources are finite; it is also true that intensified drilling activities in the 4 years since the Arab oil embargo have not yielded enough to ease our concern about worsening shortages and escalating prices.

But I am reminded that in the early 1920s experts were also predicting the imminent exhaustion of domestic oil supplies, and by the end of the decade their predictions had been proved overwhelmingly wrong. I am also reminded that it took 8 years of fruitless drilling before the Standard Oil Company of California first discovered oil in Saudi Arabia. It took 9 years of similar frustration before Atlantic Richfield Company first struck oil on Alaska's North Slope. I think that, as we strive to conserve energy and push forward with the development of our enormous coal reserves, we should not totally disregard the consideration that 5 or 10 years from now a technical innovation or a major new strike could change our energy outlook significantly.

Personally, I doubt that we will ever again be able to consume our oil resources as recklessly as we did before 1973. I think the minor belt tightening we are doing now in energy consumption is just the prelude to even stricter conservation practices, which will be with us for decades until our technology enables the family of man to use solar energy universally or some other new energy source is found. And I believe that electrification of heavily used railroad main lines is inevitable. However, I am also sure that electrification is some distance down the road and that our progress toward electrification should continue to be at a very deliberate pace.

At Burlington Northern, we are continuing to study the subject thoroughly. We anticipate that diesel fuel, which now costs about 9 cents/L (34 cents/gal), will rise to between 36 and 44 cents/L (\$1.35 and \$1.65/gal) by the year 2000. That is significant to Burlington Northern, which uses an average of nearly 4 million L (about 1 000 000 gal) daily. We are even more concerned about the future availability of diesel fuel than we are about the price.

The same study shows that, while electric rates will also continue to rise, the increases will not be as rapid, and all-electric train operations will be more economical than diesel-electric operations. But several things must happen before Burlington Northern can embark on electrification.

First, there is the important question of the source

of the large amounts of capital that will be required. A few years ago, the matter of electrification was being evaluated very seriously by Burlington Northern and a number of other carriers. We thought then that we could finance it from revenues and our usual capital sources. Today such optimism no longer appears to be justified. Cost estimates have gone up dramatically. Government studies tell us that it would cost \$8 to \$10 billion to electrify just 32 000 km (20 000 miles) of high-density railroad lines, and our own studies verify this. Although railroad industry revenues and payloads are rising, they are not rising enough or fast enough.

Although capital formation continues to be the principal roadblock to electrification, there are other issues that must be addressed. For example, once a railroad makes the decision to electrify, it will immediately face the need to develop an environmental impact statement covering the construction and operation of the transmission system and catenary. Some environmentalists are going to view those transmission lines and catenaries as blights on the landscape. In addition, other environmentalists will raise questions about radiation and interference with telephone communications, radio broadcasting, and human life.

I would not suggest that environmental protection problems are unsolvable, but a lot of time and effort—and a good deal of frustration—will be involved. I was recently reading about a 5.8-km (3.6-mile) relocation of a two-lane road on US-202 around a small town in New Hampshire that has been delayed 10 years in order to resolve the environmental objections and complete a suitable environmental impact statement, which was 211 pages long.

I think there are several technical problems associated with electrification that have not been addressed adequately thus far. One is the potential for personal injuries that is offered by a 50-kV system in densely populated areas, where catenaries will be heavily exposed. And there are still some problems with phase breaks where commercial three-phase power is being used and electric locomotives are loaded and unloaded at the breaks. Considering all the factors involved, including the additional capital required, I wonder whether consideration should not be given to conversion of the commercial power to single-phase alternating current or high-voltage direct current for traction purposes.

Furthermore, I have not been convinced that our industry's suppliers have developed electric locomotives that are suitable for operation on high-density rail lines. I have great difficulty believing that the demonstration locomotives being tested by American and European manufacturers are the best locomotives, for example, for Burlington Northern to use on 11.8-Gg (13 000-ton) unit coal trains.

Stanley Crane originally raised the issue of the economic life of electric locomotives, questioning the anticipated 30-year life of an electric compared with the 15-year life of a diesel (1). We all see the GG-1 as the epitome of the long-lived locomotive. Some of the classes of electric locomotives used on the Pennsylvania Railroad had very short lives because of poor design, poor construction, and changing requirements. The Great

Northern Railway's W-1s lasted only 9 years. It could be argued that those engines could have run for another 21 years, but in fact the system was obsolete. And electrification lasted only 5 years on the Detroit, Toledo and Ironton Railroad Company during the period when the Ford Motor Company was in control of that road. So we should look very carefully at the economic life of electric locomotive systems—not just the locomotives.

To return to the costs for a moment, we must remember that we not only will have the cost of actually installing the catenary system, but we will also be investing in new locomotives, improved roadbeds and plant to handle higher speed electric locomotives, new plant and machinery to maintain the electric fleet, and new training programs to teach people how to operate the new systems. There will be a loss of flexibility. A diesel is much easier to shift from one location to another, and it will be impossible to shift units to meet seasonal traffic demands in areas that are not electrified. In the event of accidents in which both track and catenary are damaged, we also foresee much longer downtime to repair both track and catenary than if only the track were damaged. Addition of sidings and double track would significantly increase the cost of electrification.

I raise these points only to pose some of the questions that must be answered before we can proceed with electrification. We know the advantages that would accrue once electrification became a reality. The fuel cost factor is, of course, a major consideration. But electric locomotives would also require less servicing between runs and fewer major overhauls, which would reduce overall maintenance between 30 and 50 percent. Also, the greater power of electric locomotives would permit faster over-the-road transit time because they are capable of higher speeds.

It is a very encouraging sign that this conference has been called to deal with some of the really difficult problems of electrification. I am here to raise questions, but I would not presume to answer them. I do want to impress you with the seriousness with which the railroads view our role in the new era we have entered.

The energy shortages that gave rise to this conference are changing every facet of our lives. Some of the changes we do not like very much, and perhaps we never will. But one change that I as a railroad man do like is the growing dependence on the railroads in our new scheme of things. The continuing shortage of energy and the increased cost of fuels are going to make railroads more necessary than ever, and that is good.

No matter how you look at it, railroads are more efficient users of fuel than any other transportation mode, and they will be even more so in the future. They are also the most efficient and least expensive haulers of coal, on which our energy programs are becoming increasingly dependent.

Burlington Northern, which is currently the fifth largest coal-hauling railroad in the country, has seen a tremendous increase in the amount of this commodity hauled over the past several years. In 1970, we hauled 19 Tg (21 million tons) of coal. By 1980, we expect to be carrying 113 to 136 Tg (125 to 150 million tons).

This will happen because we are the principal carrier serving areas of the West that are the heart of the expanding low-sulfur coal industry, which will be a vital factor in serving electric generating plants, including those that will be involved in rail electrification service.

Our railroads and others involved in the growing coal transportation service are benefiting greatly from the increased profitability and stability this business offers. Not very long ago, many people were predicting that the railroads were about to go the way of the barge

canals of the nineteenth century. But people have since rediscovered that railroads are, in fact, absolutely necessary to carry the bulk of the goods on which we all depend.

As a result, there is a new optimism in railroading today. There is renewed hope that the challenges can be met and the problems that have impeded growth can be solved. Indeed, there is a feeling that our industry is entering a new era of greatness that will surpass anything yet seen.

This is not to say that the future of the railroad industry as part of our private enterprise system is assured. There are still many challenges ahead. But I believe that we are in the best position we have been in for years to pull ourselves together and solve these problems. The new importance of the railroads and the new and increasing sources of revenue will, I think, enable us to pull ourselves up and do those things that need doing to keep us in the private sector.

What are these things? One is the need for the industry to trim down and consolidate into fewer, more efficient systems. Our current national system is a fractured, balkanized structure that hinders our ability to work together and deliver reliable, assemblylike transportation service to our customers. Consolidation would, I believe, make a larger percentage of each railroad's traffic local to that railroad by reducing the number of interline moves. This would in turn produce more efficient on-time service.

Second, we must install an industrywide computer-based scheduling system that provides a complete itinerary for every freight car, from origin to destination. And we will have to invest even larger sums on improvements in plant and equipment, including electrification.

As we accomplish these goals and become even more competitive with petroleum-dependent motor carriers, barges, and airlines, we will have taken a large step toward the financial stability necessary to keep the industry healthy and functioning.

It is not going to be easy, but I firmly believe that, if our country is to meet its energy conservation goals and continue to prosper, the railroads must prosper also. There remains the question of how and when electrification can be accomplished.

I see one threat to the railroads that could also put electrification beyond our reach for decades to come—the threat posed by coal slurry pipelines. Hearings have been held in the House of Representatives on a measure that would grant the right of eminent domain to proponents of slurry pipelines, so that they could compete with the railroads and barge lines that now move coal through the Rocky Mountain and midwestern states. In order to move coal by pipeline, it has to be crushed and mixed half-and-half with water to form a slurry. Many people in the West oppose these pipelines because each one of the 15 now planned or under discussion would waste enormous amounts of water from areas of our country that are haunted by the specter of drought.

I am opposed to that; I am also opposed to slurry lines because they would use 20-year and 30-year contracts to exclude the railroads from hauling most of the coal that will need to be moved in the years ahead. Obviously there would still be some coal business left for us, but the best of the business would be skimmed off, leaving the railroads with the least profitable part of the traffic.

I will not go into all the ramifications this situation could hold for our industry, but I think it is appropriate to point out that railroad electrification is dead in our time—stone-cold dead—if these monopolistic coal slurry pipelines are allowed to be built.

After all, if a minimum of 27 Tg/year (30 million gross tons/year) would be required on a segment of main

line before electrification could be justified, then the railroads would need a traffic level of 875 Pg·km (600 billion gross ton-miles) over the 32 000 km (20 000 miles) of main line in the United States that are being considered for electrification.

Last year the class 1 railroads of the United States had a traffic level of slightly less than 3000 Pg·km (2000 billion gross ton-miles). That was an increase of only about 300 Pg·km (200 billion ton-miles) since 1966. Since coal last year accounted for 29 percent of the loads the railroads hauled, where will the traffic to justify electrification come from if slurry pipelines are allowed to monopolize the best of our future growth in the coal-hauling business?

Coal is both the largest and the fastest growing part of the rail industry's traffic mix today. Last year we hauled more than 360 Tg (400 million tons) of that fuel. William Dempsey of the Association of American Railroads has estimated that increased coal production

would raise our industry's coal traffic to 660 Tg (725 million tons) by 1985 (2). That figure never will be realized if coal slurry pipelines are allowed to be built, and our hopes for electrification of our industry's busiest main lines will be frustrated.

#### REFERENCES

1. Southern Rail Planning Electrification of Section. *Journal of Commerce*, Vol. 332, No. 23, May 23, 1977, section 1, p. 2.
2. W. H. Dempsey. Statement to the House Committee on Ways and Means. *In Tax Aspects of President Carter's Energy Program*, Hearing Before the House Committee on Ways and Means, 95th Congress, 1st Session, May 26 and June 1, 3, and 6, 1977, U.S. Government Printing Office, Washington, D.C., 1977, pp. 4-7.