Part C
Interstate Transportation

INTRODUCTION

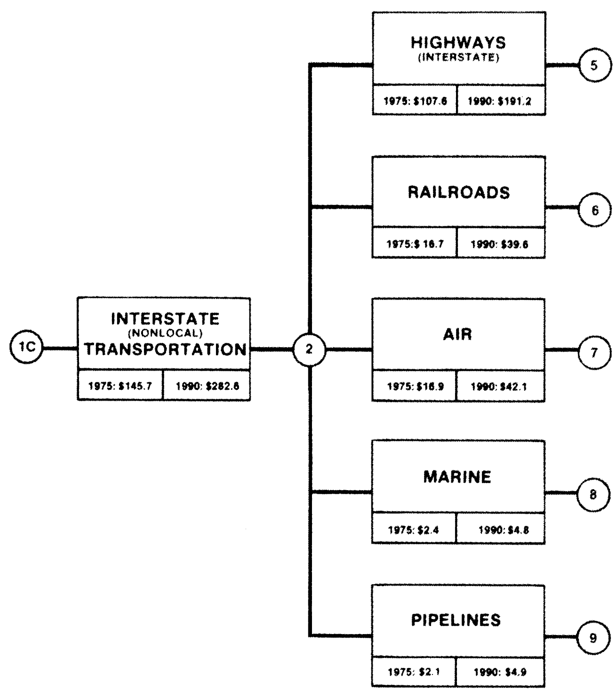
In chapter II, projections were provided for the 1990 demand for passenger and freight services. In each case, the forecasts represent the best estimates available, but they are still only estimates. Nevertheless, it is apparent that even if the forecast of 49-percent increase in overall passenger-miles and 69-percent increase in overall ton-miles is in error either way by 10 percent, the changes in the next 15 years will be substantial.

From the planning perspective, this must be viewed in terms of both problems to be solved and opportunities to be promoted. The problems appear in the form of preventing instances of undercapacity, which might stand in the way of the Nation's full development, or minimizing instances of overcapacity, which might represent poor use of our national resources. The opportunities appear in the form of action on issues in such a way as to achieve greater national productivity and efficiency and better performance of the national transportation system. In recognizing how vital the proper resolution of these matters is to our economy, however, it is also important to assure that in consonance with the policy principles cited in chapter II under "Freight," such problems are resolved and such opportunities are met by action from the private sector, working through free market forces to the maximum extent possible.

This desire mandates the striking of a delicate balance between Government and the private sector. In 1976, a number of issues stand before the Nation: their resolution will influence considerably the way in which our system will respond to this increased demand, and the efficiency with which it will perform in 1990. They include such items as user charges for the waterways and general aviation; railroad revitalization; regulatory reform in air and motor carriers, international aviation; truck sizes and weights; Amtrak; development of the western coal fields, and domestic use of Alaskan North Slope oil and gas. Most of these have strong transmodal implications, and the Federal action eventually adopted in each case will invariably tend to benefit one mode at the expense of competing modes.

In order to frame these issues properly, it is vital to recognize that all transportation components constitute an interrelated system, and we are interested in improving the operation of that system as a *system*, rather than as an assemblage of parts. In order to enlarge upon this system's portrayal, however, and increase our level of understanding, we must differentiate between local and interregional movement; among modes; and between passenger and cargo. The relative magnitudes of the Nation's transportation modes appear in figure C.1.

Part C introduces these analytical separations. The discussion of freight and passenger movement is shared by this part (concerned



NOTE: The amounts shown are the transportation bills for 1975 and 1990 in billions of 1975 dollars.

Figure C.1. Transporation Tree.

with interstate aspects), part D (intrastate, local, and urban movement), and part E (the international aspects of our transportation system). It will also become necessary with chapters VI through X to differentiate along modal lines, considering each in order of size of national expenditure: highway, rail, air, water, and pipeline. This will follow chapter V, a general analysis of intermodal issues. Within each modal section, references to passengers and freight will be separated as necessary for clarity.

These structural differences have been adopted as useful, but the rich variety and many human values of transportation preclude their being especially stringent. For example, the physical distinction between interstate transportation treated here, State and local transportation treated in part D, and international transportation treated in part E is often one of degree rather than kind. In general, interstate and international transportation are assumed to be long haul, while State and local transportation are thought of as short haul. However, even this simplistic classification suffers limitations: The trip between Detroit, Michigan, and Windsor, Ontario, is a short daily-commute, international trip for many workers in the auto industry; travel from Chicago, Illinois, to Gary, Indiana, is a local, interstate trip; while the trip from San Diego to Eureka, California, is an 820-mile intrastate trip. In addition, a few standard metropolitan statistical areas (SMSA's) involve such large counties (e.g., Tucson, Arizona, or San Bernardino, California) that a "local" trip there could not be contained within several Eastern States.

The decision about which movements are treated in part C ("Interstate") as opposed to those treated in part D ("Intrastate, Local, and Urban") is thus necessarily somewhat arbitrary. For the passenger system, interstate transportation will include:

- Automobile trips in excess of 30 miles one way or requiring overnight stay,
- Recreational and off-the-road vehicles,
- All intercity bus trips,
- All passenger rail except commuter lines,
- All domestic aviation including recreational flying,
- All domestic passenger water transportation including recreational boating.

For the freight system, it will include:

- Intercity trucking movements under Interstate Commerce Commission (ICC) regulation or any movements beyond 100 miles one way or not completed in the same day;
- Highway facilities of the Interstate System and those directly under Federal jurisdiction. In addition, the discussion will include some aspects of those State highways used extensively for interstate or long-haul traffic.
- All rail freight,
- All domestic air freight,
- All domestic waterborne freight,
- All pipelines except water, sewer, local gas distribution, and short intraindustry lines.

In the material that precedes this part, passenger transportation and freight transportation were dealt with as separate entities. However, it is essential to bear in mind that passenger and freight movements largely share the same route facilities. Highways and airways are used most heavily for passenger movements, but both carry significant levels of freight; rail and waterway now primarily handle freight, but each has small passenger components that were larger in earlier periods. The joint use of facilities by passenger and freight is also important, because it provides for the sharing of capital costs; on the other hand, it sometimes creates conflicts that may be detrimental to either or both components, and might require a higher cost.

In terms of physical requirements, passengers tend to be fairly homogeneous with regard to size, weight, needs for temperature control and ventilation, and tolerance for acceleration, vibration, and noise. In contrast, freight items include solids, liquids, and gases; they may be fragile manufactured goods, perishable agricultural products, inert bulk mineral products, or active, dangerous chemicals. Passengers tend to act on their own behalf and are self-motivated. In contrast, freight, whose value may vary from a few dollars per ton to thousands of dollars per ounce, is completely passive and requires directive action over every phase of the movement.

Chapters V through X present a wealth of detail about each mode. In each modal chapter, as orientation for the reader, data on the role of that mode in the overall system are summarized. The magnitude of modal activity will be provided, using brief statistics on size of national expenditure, miles of right-of-way, size of fleet, tonnage and passengers carried, and so on. This will be facilitated by the use of the tree diagram to highlight the relative position and place of the area under discussion in juxtaposition with all others. Recognizing that the past is prologue, an abbreviated history of the development of that mode will be provided as necessary to illustrate the projected future.

For each mode, there are selected issues that will color and constrain its transition into the future and that provide certain options to the Nation. Those that are of an intermodal nature will be discussed first in chapter V; those that are unimodal will be found in their respective modal chapters. To the extent they can be elaborated, each modal discussion will consider the projected operations for that mode in 1990.

CHAPTER V
Transmodal Issues

Ideally, the Nation's transportation system should combine competition and coordination in such a way that the modes each provide those services for which they are best suited, but compete in a manner to give the consumer a broad choice of levels and types of service and to encourage maximum efficiency. As described in Chapter II, in "Modal Complementarity," today's system does operate this way, displaying both substantial intermodal competition in most markets and a great deal of intermodal complementarity in all markets.

In consonance with its objectives of assuring the national well-being, facilitating interstate commerce, and promoting the efficient utilization of each mode, the Federal Government has assumed a variety of roles. As these roles became institutionalized, they have, through time, led to a posture of inconsistent Government treatment and preference in regard to the various modes.

Major differences in Government posture toward the various modes are to be found in the maintenance of right-of-way and the presence of regulation. Rail and pipeline transportation differs from water, truck, and air in that the railroads and the pipelines own their line facilities, pay for the cost of constructing and maintaining them, and, in some cases, pay property taxes on these fixed assets, as do other private enterprises. In contrast, the waterways, the highways, and the airways are publicly owned. For those carriers in the latter group, this means that the rights-of-way are for use by all comers, each competes by performing services over common routes, and the very high fixed right-of-way costs, even when covered by user charges, have essentially been converted to variable costs.

The degree to which costs of these public rights-of-way are recovered by the Federal Government also differs among the modes. The Federal Government pays the cost out of general revenues of improving and maintaining waterways that may not be navigable in their natural state. Those who ship via the waterways pay nothing for their allocated share of its costs. In contrast, those who ship by truck pay in large part for the costs of highway construction and maintenance through user charges, in the form of taxes on motor fuel and tires, and through licensing fees. These costs are shared with the private automobile and commercial bus users who also pay user charges. In addition, most payments are on a pay as; and if used, basis. Commercial air carriers, both passenger and freight, similarly help pay for airway and airport costs.

The differences cited thus far are complicated further by differences in the way the Government regulates various markets. Using ton-miles as the indicator of activity, all railroad, 40 percent of truck, and 15 percent of inland waterway operations are subject to the jurisdiction of the ICC. The preponderance of air freight, 85 percent of oil pipeline, and all domestic deep sea common carriage operations (about 5 percent of the total), are regulated by other agencies. As a result, there exist unregulated competition to service commodity movements in some markets, and restricted competition in others. Overall, around 60 percent of all intercity freight ton-miles are subject to economic regulation.

In considering the nature of the Nation's 1990 transportation system, it is important to remain aware of how dynamically the traffic shares handled by each mode shift. This is in response to changing trends in market demand, Government policies, and technological innovation. This is significant over the years, as may be seen in table V.1, which shows the shifts in relative market share over the last half century for each mode. For these reasons, those issues that will have particular intermodal ramifications in the transition to the system of 1990 are treated in this section first, as being of particular interest and sensitivity.

PASSENGER INTERMODAL ISSUES

The relative share of each mode in competition for interstate passenger traffic may be seen in table V.1. Above in "Transportation Today," data were provided showing the uneven Fed-

Table V.1
1929-1975 Volume of U.S. Domestic Freight and Passenger Traffic

MODE	1929	1939	1944	1949	1959	1969	1974	1975
	Billions of Freight Ton-Miles and Percentage of Total							
Rail[1]:								
Amount	455	339	747	535	582	774[2]	856	761[3]
Percent	74.8	43.1	64.5	47.0	37.5	36.5	35.0	33.5
Trucks:								
Amount	20	53	58	127	279	404	495	441
Percent	3.3	6.7	5.0	11.2	18.0	19.1	20.2	19.4
Water[4]:								
Amount	106[5]	338	220	361	461	528	585	557
Percent	17.4	43.0	19.0	31.7	29.7	24.9	23.9	24.5
Oil Pipelines:								
Amount	27	56	133	115	227	411	506	510
Percent	4.4	7.1	11.5	10.1	14.6	19.4	20.7	22.4
Air:								
Amount	.003	.01	.07	.20	.80	3.2	3.9	4.0
Percent[6]	—	—	—	—	—	0.2	0.2	0.2
Total Ton-Miles	608	786	1,158	1,138	1,550	2,120	2,446	2,273
	Billions of Passenger-Miles and Percentage of Total							
Private Carrier								
Auto:								
Amount	175.0	275.4	181.4	409.4	687.4	977.0	1,143.4	1,164.0
Percent	79.9	88.6	58.2	85.4	89.9	85.8	85.9	86.1
Air[7]:								
Amount	—	0.1	—	0.8	2.1	8.8	11.0	11.1
Percent	—	—	—	0.2	0.3	0.8	0.8	0.8
Total Private Carrier:								
Amount	175.0	275.5	181.4	410.2	689.5	985.8	1,154.4	1,175.1
Percent	79.9	88.6	58.2	85.6	90.2	86.6	86.7	86.9
Public Carrier								
Air:								
Amount	—	0.8	2.9	7.8	30.5	111.1	135.4	136.9
Percent	—	0.3	0.9	1.6	3.9	9.8	10.1	10.2
Bus:								
Amount	6.2	9.5	27.3	24.0	20.4	24.9	27.6	25.6
Percent	3.2	3.0	8.8	5.0	2.7	2.2	2.1	1.9
Rail:								
Amount	34.0	23.7	97.7	36.0	22.4	12.3	10.4	10.0
Percent	15.5	7.6	31.4	7.5	2.9	1.1	0.8	0.7
Water:								
Amount	3.3	1.5	2.2	1.4	2.0	3.8	4.0	4.0
Percent	1.4	0.5	0.7	0.3	0.3	0.3	0.3	0.3
Total Public Carrier:								
Amount	44.1	35.5	130.1	69.2	75.3	152.1	177.4	176.6
Percent	20.1	11.4	41.8	14.4	9.8	13.4	13.3	13.1
Total Passenger-Miles	219.1	311.0	311.5	479.4	764.8	1,137.9	1,331.8	1,351.7

[1]Railroads of all classes, including electric. [2]Excludes ton-miles of mail and express for 1969 and later. [3]Preliminary estimate. [4]Includes Great Lakes, Inland waterways, and domestic ocean trade. [5]Excludes ton-miles of domestic ocean trade. [6]Less than one-tenth of 1 percent of all years before 1969. [7]A dash indicates less than 1 million passenger-miles and less than one-tenth of 1 percent.

Source: Derived from data in Transportation Facts and Trends, 1975, Transportation Association of American and Yearbook of Railroad Facts, 1976, Association of American Railroads.

eral aid to the competing passenger modes. The comparative significance of these subsidies may be seen by the following tabulation, which shows the approximate average out-of-pocket percentage increases in expenditures that travelers would pay if Federal subsidies were removed:

Mode	Percent Increase To Travelers
General Aviation	15
Local Service Air Carrier	15
Trunk Air Carrier	5
Amtrak Rail Passenger Service	29–160
Auto	Nil
Bus	Nil

The figures indicate what proportion of the true costs of these services has been passed on to the general taxpayer.

From the point of view of national benefits, there is little justification for these subsidies out of general revenues on the basis of improved speed, safety, emissions, or energy use. Table V.2 presents rough estimates of the costs per passenger-mile of each mode, including social costs such as safety losses, environmental degradation, and petroleum use, which are generally not adequately reflected in the prices paid for service. To facilitate comparison, the figures have all been converted to monetary equivalents and then reduced to an index with the relative costs of auto travel scaled at 100.

Comparing bus and rail, it appears that there is little or no justification for subsidizing rail service in competition with virtually unsubsidized interstate bus services. In fact, the only justification one can see is the possible need to keep a national passenger rail system intact in the event there becomes a liquid fuel shortage of a permanent nature. If public policy, after national debate and discussion, does not accept the justification then a restructuring of the Nation's rail passenger services to make them come closer to economic viability appears warranted. This could mean dropping passenger service on the least economic lines, shifting the resources to markets that hold more promise; providing different types of services at fares that more nearly approximate costs; and reducing costs of services that are retained. These topics are discussed in greater depth in chapter VII, "Railroads."

Table V.2
1975 Relative Costs per Passenger-Mile of Various Interstate Passenger Services[1]

Item	Auto	Air[2]	Bus	Rail
Cost	33.80	55.40	25.70	90.60[3] 87.30[5]
Speed[4]	59.80	8.33	59.80	48.00
Safety	3.30	.34	.10	.18
Emission[6]	2.40	.70	.65	.60
Energy[7]	.70	1.50	.75	.97
TOTAL	100.00	66.27	87.00	180.62[3] 140.35[5]

[1]The figures shown are sensitive to the load factors and speeds used in calculation.
[2]Only air carrier is used since the data did not provide enough detail to segregate intercity air taxi from other types of general aviation, nor does it contain supplemental air carriers (1 to 2% difference in costs).
[3]Speed used is 38.2 mph indicated as the average speed in the statistical abstract.
[4]The speed only represents the line-haul speed. Terminal times for the commercial modes have not been included. They would make the automobile even more attractive.
[5]Speed used is 70 mph.
[6]The damage by all air polluting activities is estimated at $48 billion. A weighted percentage of the tons emitted by mode is used to derive the costs of emissions.
[7]Energy represents the costs of storing the energy by barrel at approximately $1.25 per barrel as discussed in the performance and measures section.

Federal subsidies to general aviation and local service air carriers, except as a matter of rural development, similarly do not appear justifiable on the basis of the measures shown. This is discussed in more detail in Chapter VIII.

Table V.2 is based on 1975 statistics. It is expected that major improvements in terms of reduced social costs will be made in auto and air travel. Regulations already in force should improve auto safety and reduce emissions and energy consumption per passenger-mile as more of the fleet meets the relevant standards. The introduction of technological improvements already under development may decrease aviation emissions and energy consumption. Less improvement percentagewise is expected in bus and rail nonmarket cost factors.

WATERWAY USER CHARGES

In the early stage of rail development, the Federal Government provided land grants, special loans, and tax benefits to the railroads. These served legitimate national interests such as permitting the West to develop more rapidly, promoting industrial development through increased economies of scale, and enlarging the market for agricultural, mining, and forestry products. In addition, the Federal Government received reduced rates for shipments of mail, military troops, and Government property from the land-grant railroads for many years, the value of which may have exceeded the value of the land grants. These early subsidies no longer contribute to rail operation and maintenance costs, nor eliminate the need for a return on capital for the railroad industry.

The steamboat proved unable to compete effectively with railroads. By 1880, our internal waterborne freight operations, preeminent in the early phases of our Nation's freight movement, had almost disappeared from the commercial transportation scene. By the first decade of the 20th century, however, a serious movement to spur water development had begun, embracing water resource development projects for such diverse purposes as conservation, irrigation, recreation, power development, flood control, and many others. As only one of many benefits, the added cost of improving navigation was viewed as incremental to the other purposes. Since these projects are paid for by the Federal Government, many communities and regions actively promoted them for their areas.

National railroad mileage reached its peak in 1916 at 254,000 miles. It was widely assumed at that time that the development of commercial navigation on the inland waterways would serve to restrain increases in rail freight rates and help solve seasonal rail traffic congestion. These assumptions gained particular credibility after the outbreak of World War I, a period during which there were significant increases in rail freight rates and in rail congestion. The Federal Government at that point began operating a barge service on the Mississippi, Illinois, Missouri, and Warrior Rivers, thereby initiating the revival of inland water transportation as a competitor to rail. This operation continued for many years and was sold to private interests in 1953.

At the same time the Federal Government was initiating its barge operation, the motor truck and oil pipelines also began to compete for freight. Truck registrations increased from approximately 150,000 in 1915 to 1.1 million in 1920, 2.5 million in 1925, and 3.5 million in 1930. Thus, what had been almost a monopoly by the railroads in the movement of freight from the period of the War Between the States to World War I was subsequently being simultaneously subjected to increased competition from water, motor carriers, and pipelines.

Since 1824, when the Corps of Engineers embarked upon its civil works mission, through fiscal year 1975, slightly over $9 billion had been expended for navigational improvements. The vast majority of these expenditures have occurred in the period since 1920. About 55.5 percent of the total $9 billion has been spent for inland and intracoastal waterways, 37.0 percent for coastal channels, and 7.5 percent for the Great Lakes system. New construction has accounted for 63 percent of these costs, while operations and maintenance have accounted for 37 percent. In addition to this, the U.S. Coast Guard expends at least several hundred million dollars each year in promoting safety and providing pollution control and navigational aids for our inland waterways.

With the exception of the St. Lawrence Seaway and the Panama Canal, virtually no tolls are now collected by which the beneficiaries pay for these services. Instead, the U.S. general taxpayer is bearing these costs which, for fiscal year 1974, were estimated at over $700 million for the U.S. inland, Great Lakes, and coastal waters. One of the arguments offered in favor of Federal waterway development has been that it results in cheaper cost of water carriage compared to rail, and that lower costs to produce a given level of transportation service are to be preferred. For those waterways that are true gifts of nature and require limited investment and maintenance, the cheaper-cost contention may be generally valid. However, when there are relatively large construction and/or maintenance costs associated with developing and maintaining a waterway, the total cost of water transportation to society may actually be higher in certain areas than rail transportation despite the cheaper water rates.

For example, because the users of water transportation do not pay the full costs of operating that system, use of that mode may exceed what would be justified on a purely economic basis. Thus, in order to avail themselves of artificially low-cost, line-haul transportation, shippers of a commodity (e.g., grain) may accept greater auxiliary distribution costs (extra handling, trucking costs to a river terminal, etc.), which are a significant fraction of total transportation costs. In terms of total resource costs to society (public and private) the chosen distribution pattern may be more expensive, even though each private shipper is properly responding to his own private costs. This choice has further impacts on private economic activity, such as investment in transportation equipment, terminals, and even production, which divert the economy from its optimal path.

In addition to distortions of this type, the modal choice decisions may also impact the financial viability of water-competitive modes in such a way as to cause a deterioration in the price and quality of service enjoyed by other traffic. Because water transportation does not pay its full cost, it can charge artificially low rates which are clearly beyond the results of any inherent operating advantage. On the other hand, because rail maintains its own right-of-way and has a higher proportion of fixed costs to variable cost than water, any attempt by railroads to meet the low water rates on water-competitive commodities requires that higher rates be applied on other commodities carried by rail.

Thus, whatever benefits may be pointed to in the form of apparently lower prices to some waterways and some rail users, they do not reflect the true costs to consumers or the taxpayers. The subsidies to the waterways, therefore, result in a less efficient allocation of national resources and a higher cost transportation system, because the allocation of traffic between the competing modes is not based on real cost. Three possible solutions to this problem are a decrease in subsidized services, giving an equal subsidy to competing modes, or the imposition of user charges, whereby the waterway carriers would pay the legitimate costs of providing their right-of-way.

The decision as to which of the three alternatives is preferable should be based on the benefits and costs to the Nation as well as considerations of equity between modes, regions, direct users, and taxpayers in general. If the latter solution—recovery of Federal expenditure—is adopted as national policy, the design of the user-charge scheme still remains an important issue. Should charges reflect the costs of the particular waterways on which each cargo movement occurs, or should a systemwide toll level be adopted under which the least costly waterway subsidizes the most costly? How should new construction costs be amortized so as not to knock out a new waterway before developing its market? Do some alternatives with respect to the timing of implementation make better sense for an orderly policy transition?

Charging on a segment-by-segment basis would appear to be most compatible with the economic arguments presented above. In addition, it would tend to encourage efficiency in Federal investments for navigation, since users promoting each potential investment would know that they would be required to pay their cost, or stand the test of the marketplace. The charges could be levied through such mechanisms as a lockage fee or as a segment tonnage tax upon cargo being carried over a specific waterway segment, or a combination of both.

Those who resist segment charges point out that such a collection system would be very unwieldy. They also suggest that the Nation's navigable waterways should be recognized as a *system* rather than as a number of separate segments.

Under a systemwide scheme, it is argued, it would be possible to collect user charges through a fuel tax. This would be less expensive to collect and more politically acceptable.[1] The major disadvantage of a fuel tax is that the more efficient parts of the system (i.e., low Federal cost relative to ton-miles of traffic) would subsidize the less efficient parts of the system. For example, the Missouri, Arkansas, and Kentucky Rivers received 18.9 percent of Federal operations and maintenance expendi-

[1]There may also be a problem in that ships in U.S. foreign trade would have the opportunity to avoid the tax by bunkering bonded fuels or fueling in foreign ports. It has been proposed that tonnage duties now in existence (one of the Nation's earliest cost-sharing arrangements) should be considered a user charge in lieu of an uncollectable fuel tax on vessels in foreign trade.

Whatever course is chosen, there should be no attempt to recapture expenditures, capital or operations, that were made prior to the time Congress authorizes the change in public policy. Further, any change should be accomplished gradually. The water carriage industry developed on the basis of low cost and on the assumption that there would be no user charges. The transition into full cost recovery should be managed in such a way that it does not force into premature obsolescence the large number of capital investments made by industry along the waterways on the basis of very low costs for water transportation, nor unduly impair the economic health of the water carrier industry, which presently accounts for over 11 percent of the Nation's ton-miles and 16 percent of the total tonnage of intercity freight. Waterway-user charges should be phased in in small increments, observing the impacts on the health of the industry after each increment.

As noted earlier, improving navigation is only one of a number of benefits of some water resource development projects. Without additional data and analysis, the proportion of total costs of these projects that should be allocated to the commercial users of the waterway cannot be determined.

Recognizing that these uncertainties concerning the implementation of waterway-user charges exist, it is nevertheless possible to scale the problem by examining the severest case. If the entire $700 million subsidy were to be allocated to the 557 billion ton-miles moved in 1975, the average cost increase nationwide would be 0.126 cents per ton-mile. The impacts of this increase would vary by toll type. To recover all of the operations, maintenance, and repair outlays for the Mississippi River system, including the Gulf Intracoastal Waterway, a uniform fuel tax would add costs of 0.08 cents, or eight-tenths of a mill per ton-mile. Although it varies by commodity and movement, this would appear to cause a 5- to 15-percent increase over existing barge rates. Under a segment-toll basis, on the other hand, to recover the costs of new construction might increase the rates by 30 to 50 percent.

While it would be of interest to speculate what such increases might imply in the sense of diversion of traffic to the railroads, there are two reasons why this should not be done on the basis of such aggregate input. First, there are substantial differences in transportation costs per ton-mile, depending upon the commodity, region, and season. In addition, depending upon what user-charge mechanism is eventually established, there also may be substantial differences in the allocations of cost, by region and by tonnage.

It is also difficult to anticipate what the reaction of the competing railroads will be. The railroad industry, which also is eligible to receive substantial Federal financial support under the Railroad Revitalization and Regulatory Reform (RRRR) Act of 1976, is discussed in chapter VII. It may be assumed that upon imposition of waterway-user charges, the competing railroads will adjust their tariffs in order to achieve that combination of new volume and higher contribution that will maximize their own overall profitability and thus reduce their need for federally guaranteed loans. Thus, the railroad's competitive reaction to waterway-user charges may not be so much a matter of diverting water traffic as a changing of rail tariffs. This also will vary region by region and commodity by commodity.

In light of the above, it is difficult to determine the extent, if any, to which the subsidy to the water carriers led to the decline of the railroads in the context of the many other railroad problems. One of the Nation's most successful railroads serves routes that involve direct head-to-head competition with water transportation, including connections between cities such as Chicago, St. Louis, Memphis, New Orleans, Omaha, Kansas City, Tulsa, and Galveston. Further, water competition is comparatively limited in the 17-State northeast-midwest quadrant of the Nation, where the viability of the railroads reached acute proportions with the bankruptcy of 8 railroads carrying roughly 45 percent of the region's ton-mile freight volume.

A rudimentary means has been developed for estimating how much diversion would take place, if any, and on what routes. This analytical mechanism has not yet been fully refined, but several tentative estimates have been made using different domestic water transportation user charge alternatives. The estimates of the

1990 impact of waterway user charges incorporated in the estimates shown earlier in table II.2 were based on a 1.4 mill per ton-mile ubiquitous charge. The revenue from such a charge is estimated to be sufficient to cover all the forecast Federal domestic-marine expenditures. In the analysis the tariffs of the competing modes were held constant.

The results indicate that if all the other interstate transportation policies considered in this document, except for waterway user charges were implemented, the following would be the outcome in 1990. Rail revenues would be lower by $33 million per year; truck revenues would be lower by $11 million; and pipeline revenues would be lower by almost $15 million. The domestic marine industry would earn about $21 million more in revenues but the U.S. taxpayer would have to pay approximately $1 billion more in taxes. In summary, other modes would lose $60 million, and the taxpayers more than a billion dollars annually to benefit the marine industry by $21 million. However, those who continued to ship by water would have to pick up the bill. Though these dollar values are large, they are small relative to the total revenues of each of the modes involved. The largest percentage would mean a change of less than 1 percent in domestic-marine industry revenues.

Considerable public debate and a far more detailed study of these impacts may be expected before the final determination of this issue. What is clear, however, is that (a) to the degree that user charges are imposed, waterway improvements and maintenance would properly be paid for by those who receive the benefits and (b) the financial health of the competing railroads may be improved, thereby perhaps reducing the need for additional future Federal financial support. The general taxpayer thus is likely to benefit in two ways.

Users of domestic marine transportation should support such user charges, otherwise it will become increasingly hard for the Congress to vote appropriations for domestic marine developments over the arguments of the competing modes, such as rail, pipelines, and motor carriers.

The situation with respect to waterway user charges and pipelines is somewhat analogous to that of the railroads. However, marine transport and pipeline competition is largely limited to the movement of petroleum and petroleum products. Furthermore, pipelines are almost totally unsubsidized by the Federal Government.

TRAILER-ON-FLAT-CAR MOVEMENT

From the long-range planning perspective, the national freight system will more closely approach its maximum potential when the inherent line-haul efficiencies of the railroads are combined with the inherent collection and distribution potentials of truck and the bulk-cargo carrying capacity of the waterways. The shifting to rail of some portion of the freight now moving by highways also represents a possible solution to both increasingly crowded highways and the underutilization of the national rail system.

This suggests an integrated system of freight transportation in which both railroad companies and motor carriers are partners, each performing that part of the total transportation function for which it is best suited, coupled with their sharing in the rewards that such a system would generate. In such a system, motor carriers would perform pickup and delivery services and short-haul intercity movements. The railroad would be responsible for the line-haul portion of long-distance movements. In popular terms, this has been characterized as the rail mode serving as the wholesaler and the trucking mode serving as the retailer. Intermodal terminals could be operated by the railroads alone, or jointly with the motor carriers, or by a third party.

Since the present concept of intermodal service began in the midfifties, this service has never reached its full fruition; both engineering and institutional explanations have been attempted. The development of intermodal terminals, transfer-handling equipment, and rolling-stock has been, at best, intermittent and sporadic.

Findings from the *National Intermodal Network Feasibility Study* suggest that the present practices typical of trailer-on-flat-car (TOFC) and container-on-flat-car (COFC) operations often are more expensive than highway costs, and are, in the long run, not likely to succeed to improve the present relative market position of railroads in carrying goods suitable for containerization. With few exceptions, most "piggyback" terminals are congested and costly to operate, subject to labor costs and with few mechanized transfer systems. Most intermodel flatcars operate in a nationwide pool; this means they must handle a variety of trailers and containers and also be capable (structurally) of moving as part of conventional freight trains. Many TOFC terminals are still of the "circus-style" drive-on type, which the cars must accommodate, as well as the more modern lift-on/lift-off type. Today's equipment designs make no promise of keeping air drag at a minimum although this one factor alone is believed to be significant in determining total train air resistance, even at relatively low speeds.

Ironically, the revolution of marine-truck (including both roll-on/roll-off and container/chassis) containerization, as exemplified by the sea-land service, received its impetus from the early rail-truck movement. It demonstrates how responsive to shippers' needs a well-designed and executed system based on marine-truck containerization can be; it reduces transfer handling costs, reduces loss and damage costs for the carriers involved, improves process control, significantly reduces packaging costs for the shipper, and permits the reduction of vessel turnaround time from 3–4 days to 12–24 hours, thereby increasing the utilization of high-cost, line-haul equipment.

One explanation of why rail-truck intermodalism has not displayed growth comparable to that of marine-truck is because of the very nature of the two land modes of transport: They compete for the same market. There is no real alternative in the case of maritime transport except perhaps the intracoastal competition with the railroads.

Moreover, only 10 percent of rail intermodal container traffic involves international shipments; therefore, maritime containerization has not had an appreciable effect upon the growth of a land-based container system.

The limited growth of both TOFC and COFC service has also been attributed to poor operating practices, rate schedules, billing practices, and to some extent, competition among the railroads themselves. Consequently, facilities and equipment investments have suffered in this somewhat uncertain environment. More fundamental reasons, perhaps, for why the latent promise of such services has never been realized are that the rail flatcars themselves are often as heavy, if not heavier, than the trailer loads they carry (thereby raising questions of energy efficiency), and that the circuitry and yard delays resulting from present railroad operating practices tend to offset whatever commercial time and cost advantages were expected to result from such integrated service.

With regard to the prospects for the future, it is believed that very large volumes of traffic, which might be handled more efficiently by a highway-rail-highway intermodal operation, move today solely by highway even though they entail higher labor costs per unit of payload, higher fuel consumption, higher highway maintenance costs as truck axle weights increase, delays due to highway congestion, and poorer relative safety. The differences in costs for TOFC/COFC versus the competing services are substantial.

The findings from the *National Intermodal Network Feasibility Study* suggest that solid "unit" trains for TOFC/COFC traffic exclusively could operate profitably, given sufficient volume to justify operation independent of "mixed" freight trains. The circumstances that would encourage higher levels of highway-rail-highway movement are believed to include (a) shorter terminal-to-terminal running times; (b) more frequent service; (c) lighter weight line-haul equipment; (d) consolidated terminals; (e) more adequate management information and operating control systems; and (f) faster, more efficient modal transfer devices.

These are believed realizable only with a sufficient level of traffic to justify the investment and the more costly level of service required. The Department of Transportation is now initiating a demonstration project that will test, over 3 years, the viability of such service in heavy freight corridors using high-speed trains dedicated solely to TOFC service.

TRUCK SIZE AND WEIGHT

For more than a decade, twin 40-foot truck/trailer combinations have operated safely and efficiently on some toll road segments of the Interstate Highway System. A major improvement in the efficiency of motor carrier movement on the Interstate Highway network can be realized through modification of truck size limits without modification to existing axle load limits. Allowing multiple-trailer trucks such as those operating today (e.g., twin 40-foot trailers and triple 27-foot trailers), using specially qualified drivers, would at literally no added expense decrease truck operating costs, traffic congestion, emissions, and energy consumption, while maintaining or improving safety. Allowing such increased sizes to operate on the interstate highways could possibly result in up to 30 percent increased trucking efficiencies for those commodities affected. If axle loadings do not increase, such operations should be safe and should not cause greatly accelerated damage to pavements and bridge structures.

Consideration of such a change would naturally also depend upon public acceptance and environmental impacts. The average motorist in 1990, driving a smaller, lighter, more energy efficient car, is likely to view the larger and heavier trucks with which he shares the highway as a greater menace than the present-day combination. Splash and spray and other aerodynamic effects of large commercial vehicles have been noted as annoyances, and may be perceived as a safety problem for private motorists. The available data, however, from throughways where such tractor trailer combinations have been operating for many years, indicates that they have been operated at least as safely as the conventional models. By handling more cargo in one movement, the accident rate per ton mile, the energy consumption, and the quantity of pollutants emitted is lower. These matters are presented in greater detail in Chapter VI.

Although these benefits appear to be substantial, the decision to allow multiple trailer combinations to operate on the Interstate system should not be made on the basis of economic efficiency alone. It is also important that such a move does not unduly impair the projected growth of the railroads and other competing freight modes. The possible vulnerability of the railroads to price competition is a matter of major concern, and some analysis has been undertaken to assess how the present balances would possibly shift by 1990. The impacts of changes in truck size were examined, employing the same modeling techniques used to investigate rail-waterway competition. For purposes of analysis, it was assumed that half the potential improvement in truck efficiency would be reflected in actual rate decreases to shippers: The remainder would go to profit for carriers, increased taxes to pay for highways, possible increased labor costs, etc. The tariffs of competing modes were held constant. If twin 40's are permitted, the following might be expected in 1990. The maximum annual diversion (worst case) from the railroads would be 7 billion ton-miles and $134 million in revenue. In percentages, these would amount to only about .5 percent lower ton-mileage and .6 percent lower revenues. For domestic interstate marine transportation only a 0.04 percent drop in volume and revenue was indicated. In contrast, air freight showed lower volume and revenues of more than 4.0 percent, although the actual volume change was less than 300 million ton-miles. For the trucking industry, the shift of volume between other modes and trucking involves about 7.7 billion ton-miles a year, for a change in revenue of nearly $0.7 billion yearly. The shift of traffic within the trucking industry requires more detailed analysis. In chapter VI, it is estimated that at least 13 percent of intercity truck freight volume might be amenable to shifts to multiple trailers. If so, then, at best 86 billion ton-miles a year might shift in 1990 at a cost saving to shippers of about $1.3 billion a year.

In summary, use of twin 40-foot trailers on the interstate highways might result in diverting revenues of up to $225 million a year from railroads and air freight to trucks, but it would result in cost savings to the Nation's shippers of up to $800 million a year in 1990.

All of the above figures are nationwide totals. Thus when one considers only particular regions or groups of commodities, the percentage impacts on ton-mileage or revenues may be greater or less.

FUTURE ENERGY MOVEMENT

Future Coal Movement Patterns

Movement of coal in 1990 will differ in magnitude and pattern from the past and from OBERS projection based on pre-1972 trends. Two factors are largely responsible for the change:

(a) the general increase in the use of coal by utilities as they shift away from oil or gas-fire boilers, and (b) the greater use of low-sulfur western coal as utilities move to comply with emission requirements under the Clean Air Act. The eventual market demand for western coal is not yet clear, and will vary depending upon which method of controlling the emissions [the supplemental control system (SCS) or the flue gas desulfurization (FGD) controls] is eventually mandated for utility companies.

Table V.3 compares the 1990 OBERS projection with the same-year forecast by the FEA.[2] Because the shift from oil or gas to coal is occurring both under market pressures as oil and gas prices rise and under pressure from the Government by the Federal Energy Agency (FEA), every area shows an increased demand for coal. The demand areas (census regions and coal supply regions used by the FEA) are shown in figures V.1 and V.2. For the Nation as a whole, the FEA coal-demand forecast is more than half a billion tons a year higher than the OBERS projection for 1990 and more than twice the 1975 consumption.

Coal transportation requirements, however, will increase even more rapidly than the rate of coal tonnage consumption. Although low-sulfur Appalachian coal is available and usable for markets in the Southeast, the changes in shipping patterns emphasize the lower sulfur western coal and longer shipping distances. Coal production in the western part of the northern Great Plains region will increase tenfold over its 1975 level, while the FEA expectation is that production of the northern Appalachian region will remain nearly constant. Low-heating-value gulf lignite not previously exploited will serve nearby Texas utilities.

The coal movement pattern will be determined by a number of considerations, several of which are matters of governmental policy: In general, much eastern coal has high heating value, high sulfur content (3 percent to 4 percent), and a high price at the mine. Western coal tends to possess lower heating value, low sulfur content (0.4 percent), and because it is amenable to large-volume surface mining, low in mine price. However, since nearly three-quarters of the 1990 coal demand will be east of the Mississippi, total shipping and costs favor the use of eastern coal. If there were not requirements for limiting sulfur emissions, the future coal-use pattern would clearly continue to emphasize Appalachian coal.

Given the Environmental Protection Agency (EPA) restrictions on sulfur emissions and the FEA requirement to use coal, each utility company must examine several tradeoffs:

- It may buy western low-sulfur coal at a high shipping cost. For Montana coal delivered to the east coast, more than three-quarters of the delivered price is transportation cost.
- It may buy eastern high-sulfur coal and install the FGD system based on the stack scrubbers to clean up the emissions. Many utilities presently complain that stack scrubbers are unreliable, create their own solid waste disposal problem, and are expensive, adding 4 mills per kilowatt-hour to the operating cost.
- It may buy high-sulfur coal but desulfurize it before use, either at the mine or at its own plant—at present no desulfurization process has been developed for large-scale commercial use although several are in pilot-plant stage.

An added consideration influencing utilities' choice depends on the economics of a regulated utility. Increases in fuel prices including transportation are relatively easy to pass through to electricity rates. Plant modification to install scrubbers, on the other hand, is a capital improvement requiring utility commission action for rate increases.

In view of these considerations and the expected relative price structure, the FEA expects utilities in census districts 4 and 5—between the Mississippi and the Appalachians—to opt strongly for western coal. A major new flow pattern from the northern part of the Great Plains to the east and south is expected to develop. This route is served by the railroads, by the Mississippi/Ohio River system, the Great Lakes system, and by sev-

[2] *1976 National Energy Outlook*, Federal Energy Administration, FEA-N-75/7.3, Feb. 1976. This reference postulates several scenarios; the values used here are for the "reference" case.

Table V.3
1990 Coal Movement, Comparison of FEA Forecast with OBERS Projection[1]
(Millions of Tons/Year)

Coal Supply Region	Demand by Census Region									Export	TOTAL Supplied
	1 North-east	2 Mid-Atlantic	3 South Atlantic	4 East N. Central	5 East S. Central	6 West N. Central	7 West S. Central	8 Mountain	9 Pacific		
1. Northern Appalachia	16.206	130.816	42.413	40.807						12.045	198.998
	2.723	79.546	87.807	88.324							281.678
2. Central Appalachia	.146	38.763	146.548	16.097	3.760					67.890	316.491
		3.470	60.692	34.154	25.377	.151	.750				124.594
3. Southern Appalachia			12.629	2.628	8.687		.219				27.229
			1.613	.892	12.414	.008	.082				16.008
4. Midwest			14.272	65.591	71.577	9.709					161.147
		.030	6.028	90.888	24.325	46.249	6.139				172.632
5. Central-West						10.293					10.293
		.001	.018	.067	.219	4.771	1.141	110			6.327
6. Gulf							20.550				20.550
		.007									.007
7. East-North Great Plains						45.078					45.078
				.023		6.764	.022				6.809
8. West-North Great Plains				212.503	32.011	83.366	60.481	68.657			457.016
				6.539	.032	10.534		4.330	.674		22.109
9. Rockies				14.454	14.856	.548	.548	2.519	1.132		35.624
				.185		.201		8.426	2.655		11.467
A. Southwest							8.687		5.986		14.673
							.124	5.513	.674		6.311
B. Northwest									4.015		4.015
									.235		.235
C. Alaska									.329		.329
TOTAL	16.352	169.579	218.927	352.079	130.889	148.993	90.484	71.175	13.031	79.935	1,211.509
Demanded	2.766	103.104	160.615	240.522	64.305	73.637	8.887	18.555	5.632		678.023

[1]*FEA figures appear above the OBERS projections.*

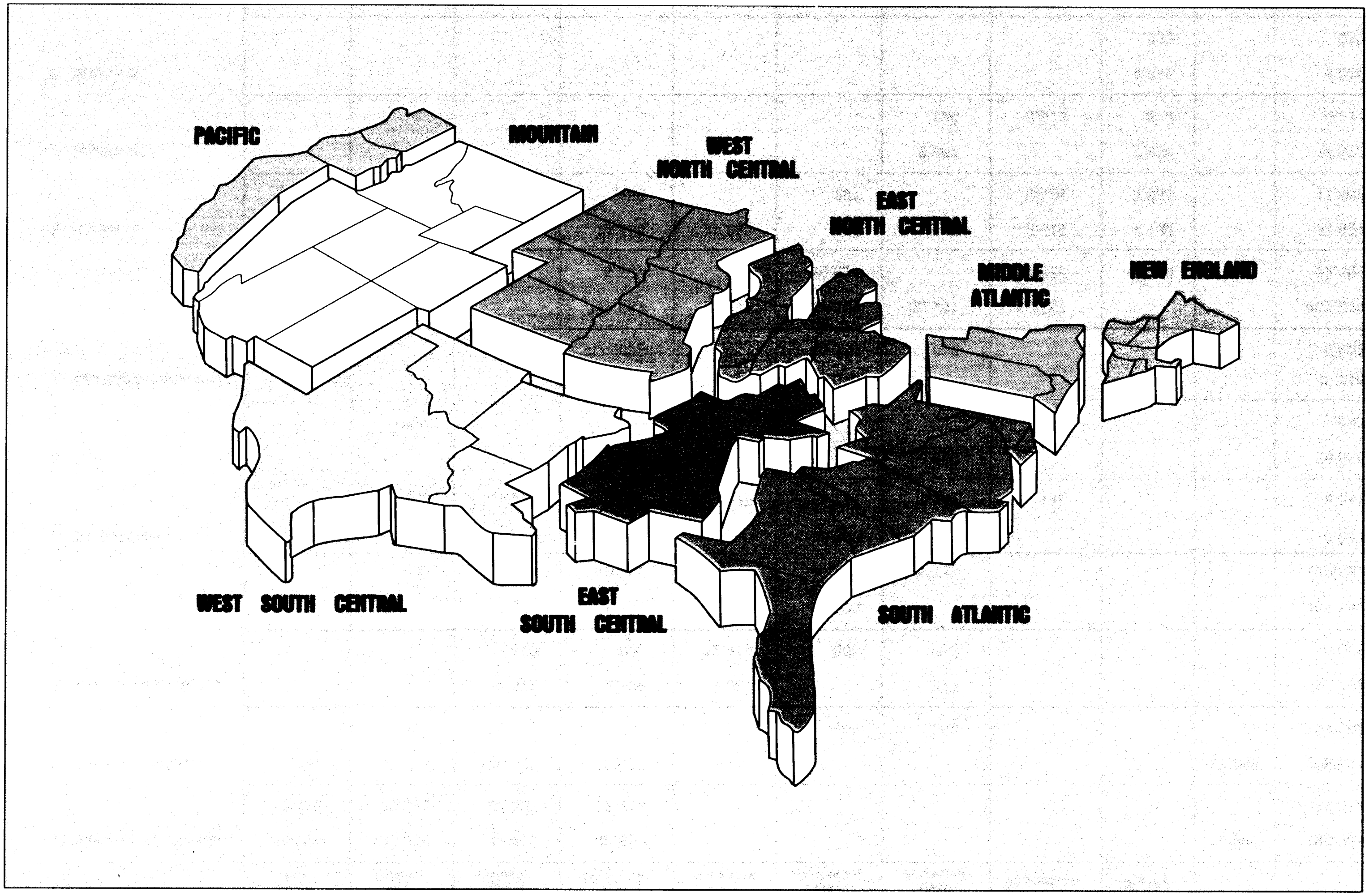
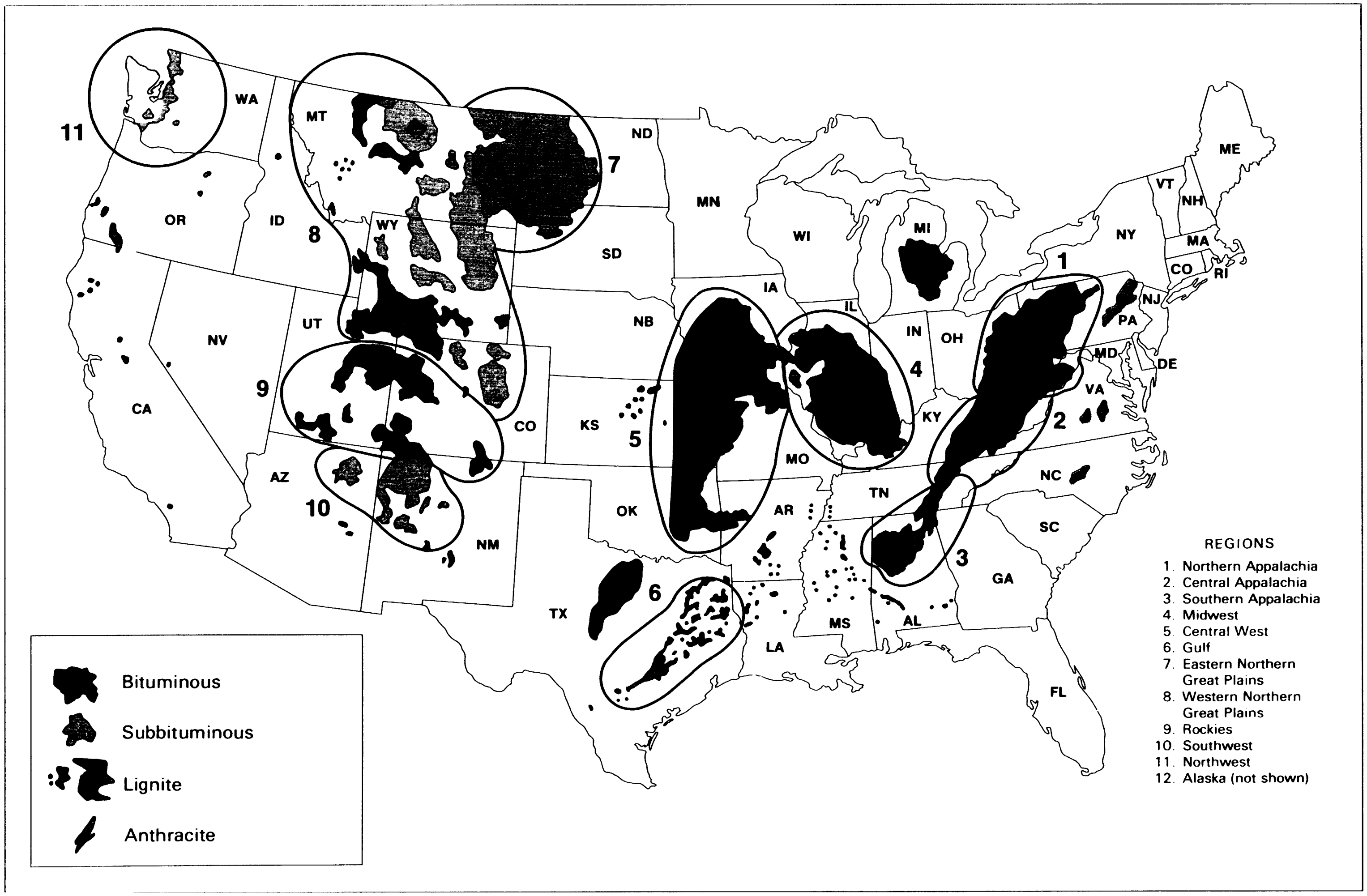


FIGURE V.1. CENSUS REGIONS.



Source: 1976 National Energy Outlook, FEA.

FIGURE V.2. COAL SUPPLY REGIONS.

eral proposed coal slurry pipelines. Serious modal competition for the new traffic may be expected, although rail and water operators are now working on ways to provide low-cost service via multimodal service.

Several intervening developments could, however, work against the above pattern:

- Major increases in the mine price of coal could result from higher wages and fringe benefits for western miners or from a high cost of compliance with strip mining environmental protection requirements.
- Changes in utility commission rulings would either inhibit easy passthrough of transportation cost or permit easy addition of scrubber costs.
- Comparison tests between the SCS and FGD control systems indicate SCS is adequate to meet EPA clean air standards.
- Changes in EPA restrictions might allow normal utility operation with higher emission rates if emergency capability for low-emission operation exists.

Transportation of Western Coal

Both rail and pipeline operators view the planned development of low-sulfur, western coal as a major new market to be served and have announced their intentions to compete for it. How the coal will be transported, or in what proportion its movements will be shared between coal slurry pipelines, rail or other modes depends on Federal and local governmental decisions (granting of national eminent domain and local water rights to slurry pipelines) and regulations as well as market considerations. The final decisions as to how much new investment in coal moving capacity should occur and should rest with the private sector except to the extent there is a conscious public policy that there are public advantages in keeping a large part of the increased freight on the railroads.

From a societal perspective, economists argue that the proper mix of modes is that which would result in the lowest present value of future cost to society of hauling the increased coal flows. The safety, emission, and energy efficiency characteristics of the competing modes appear to be roughly similar. Therefore, the decision as to mix appears to depend primarily on financial considerations. The evaluation of the proposed investment of a slurry pipeline should be based on the incremental cost of the additional capacity to each mode. For rail, this would include, in addition to the operational costs, all new facilities, equipment, etc. required to handle the additional capacity, and for pipelines this would include incremental costs of investment and operation. If the lifetime cost of the pipeline is significantly lower than the additional costs of rail over an equivalent time period, then the investment in a pipeline will lower the total transportation bill.

One coal slurry system, which has been proposed for this market, has a capacity of 25 million tons per year. Prospective pipeline developers estimate that this would entail a capital cost of $750 million. In contrast, the Burlington Northern Railroad estimates that $1.5 billion spent on track and rolling-stock for unit trains on existing rail routes would add 150 million tons per year to rail capacity. Capital charges and amortization comprise about 70 percent of the tariff for a slurry pipeline and 20 to 25 percent of the tariff for a unit train.

Although that proportion of the initial tariff attributable to capital may be higher for a slurry pipeline than a unit train, inflation during a 20- to 30-year amortization period could result in a lower cumulative cost for the pipeline, because the railroad must replace part of its capital stock during the period at inflated prices and is subject to inflation on the 75 percent to 80 percent of its cost that is variable. Where pipeline users can average 20 percent of the equity with 80-percent debt, inflation accounting will always favor pipelines over other methods of transportation.

To be economically feasible in competition with unit trains on existing rail routes, coal slurry pipelines should be at least 1,000 miles long with a throughput of at least 10 million tons per year. Thus, the market at the delivery points has to be 10 million tons or more from initiation of service. A market of this size cannot be created instantaneously, and during its buildup, coal would have to be delivered by rail and by barge east of the Mississippi River. Thus, while the railroads accuse the pipelines of "taking the cream off the market," pipeline proponents argue that pipelines offer competition for the railroads, which would otherwise have a monopoly on coal shipments out of western States.

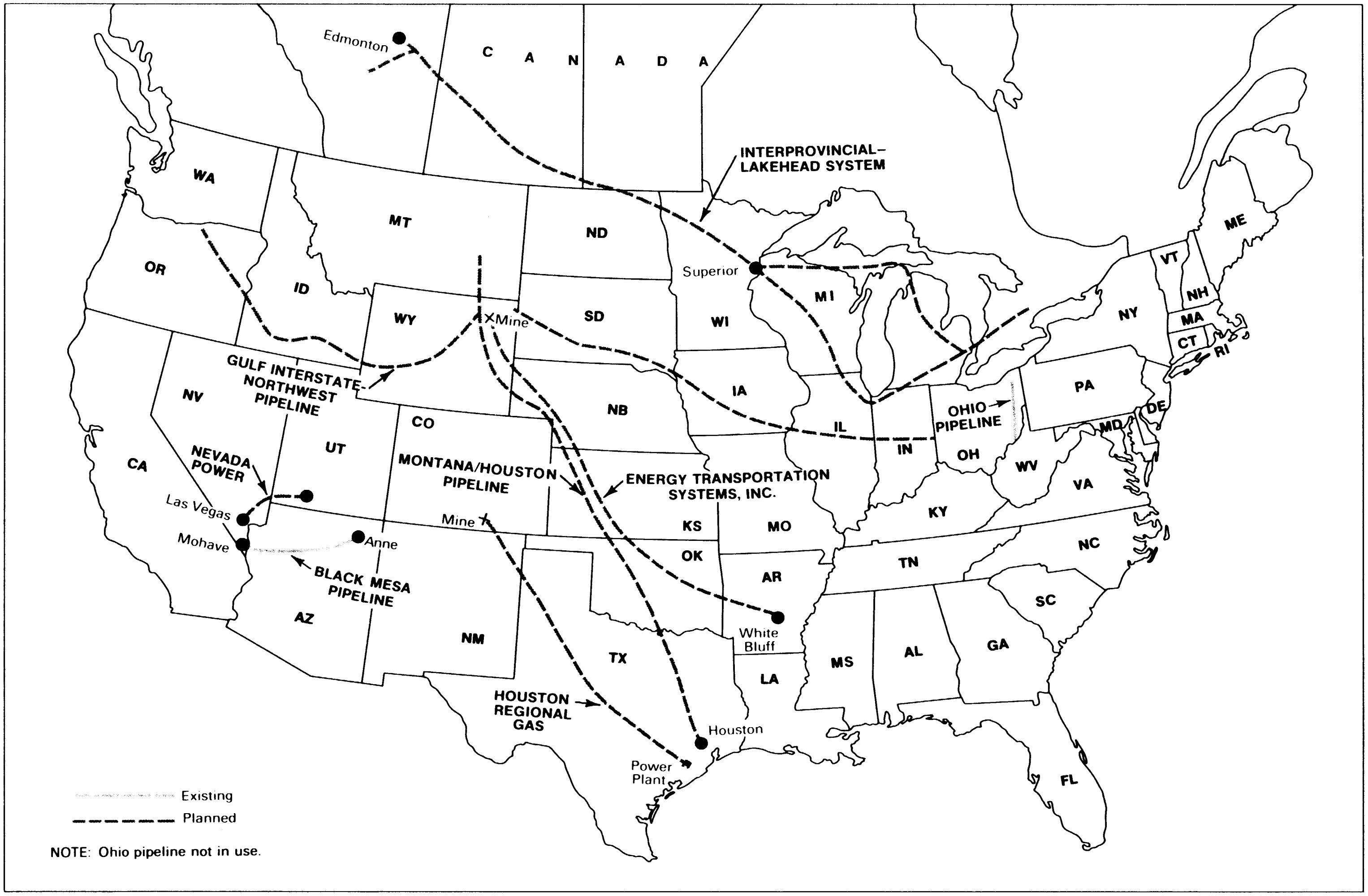


FIGURE V.3. COAL SLURRY PIPELINES.

One of the questions frequently raised about slurry pipelines is the need for massive amounts of water. To move 1 million tons of coal per year as a 50-percent-weight slurry requires 737 acre-feet of water (656,000 gallons per day). Western coal regions lack surface water but have large supplies of underground water. Some of this is too saline and too deep to be pumped for irrigation use, but it can be pumped for use in a coal-slurry line at a cost of about 10 cents per ton of coal. The water used to move coal need not be wasted at the point of delivery. If the consumer is a powerplant, recovered water from the slurry can supply about 12 percent of the powerplant's total water requirement.

For the Wyoming-to-Arkansas pipeline proposed by Energy Transportation Systems, Inc., an agreement has already been made with the State of Wyoming to take 15,000 acre-feet per year from the Madison Formation, subject to rigorous monitoring of water levels. Underground water is also available at the point of origin of other proposed pipelines, but has not yet been committed.

Assuming that the right-of-way problems can be solved,[3] that public policy favors the development of slurry pipelines to the extent possible, and that there is coordination with the railroads in phasing in the service, six pipeline systems could be in operation out of the western coal fields by 1990. These are shown in table X.12. Of the total 157.8 million tons of coal per year to be moved from the region, they would move 79.8 million tons through 4,500 miles of pipe. This 71.5 billion ton-miles per year would require 58,800 acre-feet of water per year.

From the point of view of other measures of performance, there appears to be little difference regarding safety between the two modes. Coal slurry pipelines are perhaps more environmentally sound, running, for the most part, silently and invisibly underground. The energy used by pumping stations is estimated as 200 to 300 Btu per ton-mile, depending on the line diameter. A further 450 Btu per ton of coal are used in preparing and de-watering the slurry. The total energy for a 1,000-mile line is, therefore, 650 to 750 Btu per ton-mile. Similarly, the figure for the railroads is approximately 670 Btu per ton-mile.

The work assumes the 1990 western coal flows forecast by the FEA in its *1976 Energy Outlook*. Considering these flows, four of the above six slurry pipelines were assumed to go into operation. While the railroad system as it exists today would not be able to handle efficiently all the coal traffic predicted for 1990, improvements such as upgraded signal systems, double tracking or long passing sidings in certain areas, and possibly reservation of specific lines for unit train service only, would increase the capacity of the industry tremendously. Some of this work has already begun, and much more is in the planning stage, as is pointed out in the recent DOT report *Rail Transportation Requirements for Coal Movement in 1980*.

Alaska Petroleum Flow Patterns

The pattern of 1990 movements of crude oil and petroleum products will be influenced by the changes in consumption under price pressure and a variety of conservation programs, and the switch of utilities away from petroleum fuel. Likewise, the sources will shift as old domestic oil fields are depleted, new Alaskan and offshore fields come into production, and efforts continue to reduce dependence on imports. Because the present refineries represent a major investment with considerable remaining service life, the major changes in flow patterns are likely to be in crude oil to refineries with the flow of products remaining largely as at present. The new transportation problem thus entails movements from the new sources to the present refinery locations.

The trans-Alaskan oil pipeline from Prudhoe Bay to Valdez, on the Gulf of Alaska, is scheduled for mid-1977 completion. A number of transportation alternatives are under consideration for further movement of 2 million or more barrels per day—the expected North Slope production. Complicating factors regarding the Alaskan oil include:

[3]The proposed Wyoming-to-Arkansas coal slurry pipeline must cross railroad property at 51 points along its route.

- The production is greater than the Pacific region demand or than the west coast refineries can absorb.
- The major regions of demand are New England, which is currently dependent largely on Middle East imports, and the "northern tier" of States currently dependent on imports from Canada, which are scheduled to phase out.
- Oil pipeline capacity does not now exist to move Alaskan crude from the west coast across the Rocky Mountains. However, a solution involving a combination of unit train haulage from the West Coast ports to extant pipelines may be practical until other more economic means are implemented.

The transportation possibilities are illustrated in figure V.4 and enumerated in table V.4.

As of now, the alternatives are still under consideration. Important factors include price, time to become available, environmental impact, security, and reliability. The choice is not limited to a single alternative, although it is unlikely that more than one major new pipeline construction option would be selected.

Table V.4
Alaskan Oil Transport Cost
(dollars/barrel)

Via \ To	Minnesota	Texas	Louisiana	New York
a. Trans-province pipeline [1]	1.67			
b. Northern Tier pipeline [1]	1.34			
c. Southwest pipeline [1]	1.94	1.55 (2)		
d. Trans-Guatemala pipeline [1]		1.66	1.63	1.82
e. Panama Canal [1]		2.95	2.42	2.61
f. Panama pipeline [1]		(3)	(3)	(3)
g. Round the Horn [1]		2.40	2.39	2.65
h. Northwest Passage [4]				.83
i. Tank Car Unit Train [1,5]	3.21			

[1]Add pipeline costs Prudhoe Bay to Valdez $2.00 to 2.60 per barrel.
[2]Cost shown to Midland, Texas, others to Freeport.
[3]Will be lower than canal but higher than Guatemala pipeline.
[4]Add $.25 per barrel for ice breaking but no pipeline costs.
[5]Add also tanker costs to Puget Sound from Valdez, $.30.

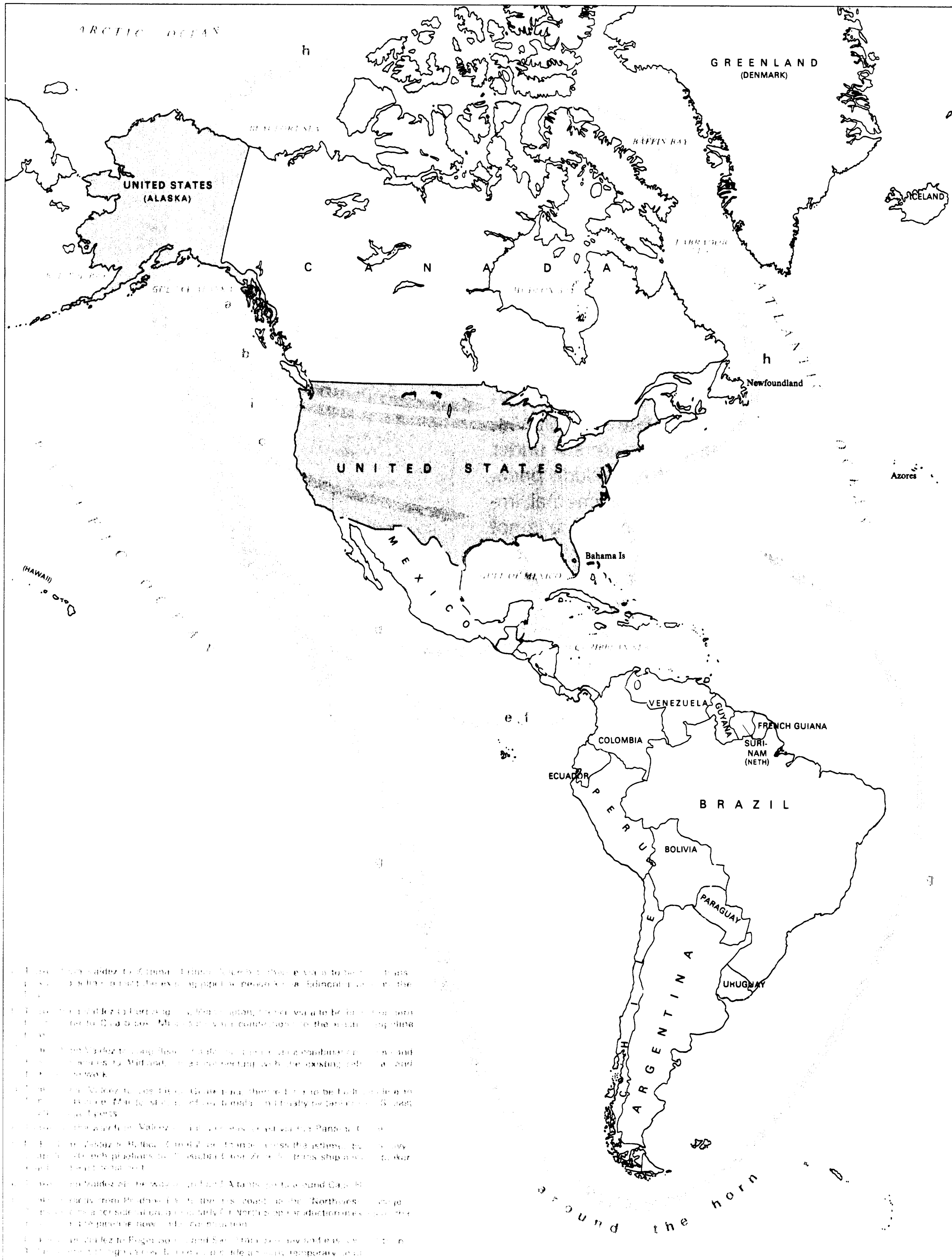
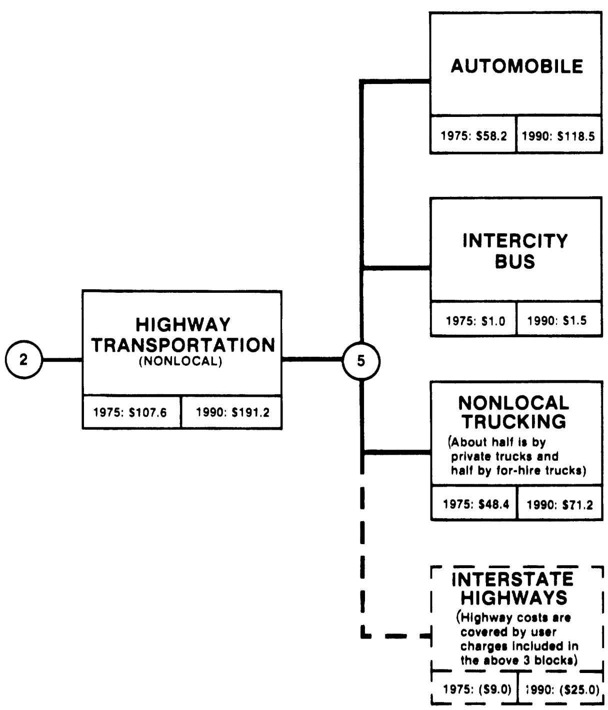


FIGURE V.4. ALTERNATIVE ALASKAN OIL TRANSPORT ROUTES.

CHAPTER VI
Highways

Nearly nine-tenths of the total interstate passenger-miles and almost a fifth of the interstate freight ton-miles move on the Nation's highway system. For discussion, it is useful to separate the fixed facility—the actual concrete on the ground—from the modes that share the use of the facility. As shown in figure VI.1, the following modes are considered: automobile, bus, and trucking. However, since the automobile was the subject of chapters III and IV, this Chapter will cover only bus and trucking modes. The reader must remember that automobiles are the principal users of the highway system and that many of the considerations influencing route locations—such as capacity required—are based on automobile traffic.



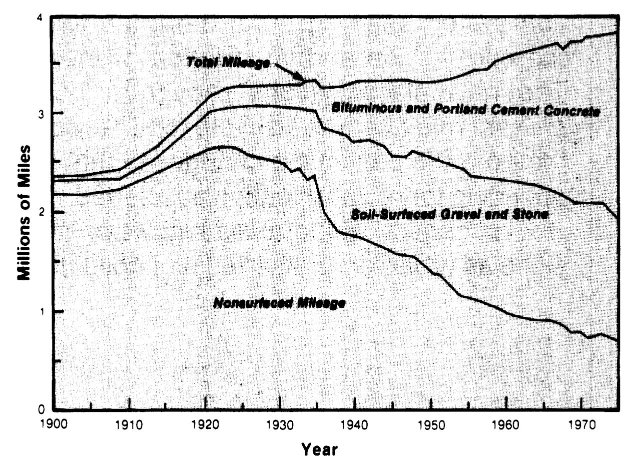
NOTE: The amounts shown are the transportation bills for 1975 and 1990 in billions of 1975 dollars.

Figure VI.1. Transportation Tree.

THE HIGHWAY-FIXED FACILITY

Background

The highway element of the national transportation system consists of roughly 3.8 million miles of public-traveled way ranging from multilane, limited-access freeways through urban streets to rural unsurfaced roads. In terms of route-miles (see fig. VI.2), the roads and highways have increased by 60 percent since 1900 and only roughly 20 percent since the Federal Aid Highway Act of 1921. In contrast, the annual vehicle-miles, a negligible total at the turn of the century, have grown tenfold since the 1920's to more than 1.33 trillion in 1975. A major factor in highway development has been the quality and capacity of mileage. From a network of nonsurfaced ruts—less than 2 percent was hard surfaced in 1900 and almost 90 percent had no surfacing at all—the process has been one of surfacing, widening, grading, and straightening to improve safety, increase convenience, and enlarge the capacity of the system. At times, route straightening has actually resulted in reduced network mileage as older, tortuous roads were abandoned in favor of new more direct routes.



Source: Highway Statistics, *Federal Highway Administration.*

Figure VI.2. Total Road and Street Mileage, By Surface Type.

The growth of the modern highway network kept pace with the vehicle technology, which could yield benefits commensurate with the costs of system improvement. When the system was limited by the strength and speed of the horse, there was little incentive to invest in hard-surfaced roads outside of major urban areas. Only when the innovation of mechanical horsepower multiplied the output of the horse by several orders of magnitude did it become worthwhile to make the investment in the highway facility. In 1975, the total highway expenditures at Federal, State, and local levels came to nearly $27 billion per year. The gross product of that expenditure was 2.3 trillion person-miles of passenger travel and 0.5 trillion ton-miles of intercity freight. In 1975, highway freight revenues totaled more than $100 billion, of which nearly half was intercity movement. Personal expenditures for transportation in 1975 totaled more than $110 billion, of which 96 percent went to highway modes and 92 percent was for user operated transportation (automobiles, light trucks, recreation vehicles, motorcycles, etc.).

Present Classification

The Federal-aid systems provide a national highway network consisting of nearly 927,000 miles of Federal-aid routes including the Interstate System.

As of July 1, 1976, Federal-aid highways are categorized by a new functional classification system (see fig. VI.3) designed to reflect the current use and importance of the roads. The new classifications recognize both the present role of any road in the total network and the possible continuing changes in that role by providing for reclassification as needed.

In general, Federal-aid highways are classified as urban or rural, arterial or collector. The urban designation depends on the population density of the area served and has strong impact on the volume and type of traffic demand. Many Interstate routes in urbanized areas serve rush-hour commuter traffic and general short-haul movement as well as long-haul intercity and interstate movement.

The designation "arterial" indicates a highway intended primarily for mobility. "Minor arterials" and "collectors" combine mobility with access, while "local" roads (not included in the Federal-aid system) are intended primarily for access and short local trips. The definition of arterials and collectors differ between rural and urban areas, with the roads in urban areas expected to operate at lower speeds and higher traffic densities. Local rural or urban roads generally serve every property that abuts them. While it is possible to travel long distances over local roads, travel speeds are low and few people now do so. The "typical" interstate trip is assumed to begin on a local road, move through collectors and minor arterials to the principal arterials where the major long-haul portion is accomplished. At the destination, the process is reversed and the trip ends on a local road.

Table VI.1 summarizes by State the expected future performance and capacity of the highway system. The statewide volume/capacity ratio used in table VI.1 is the expected

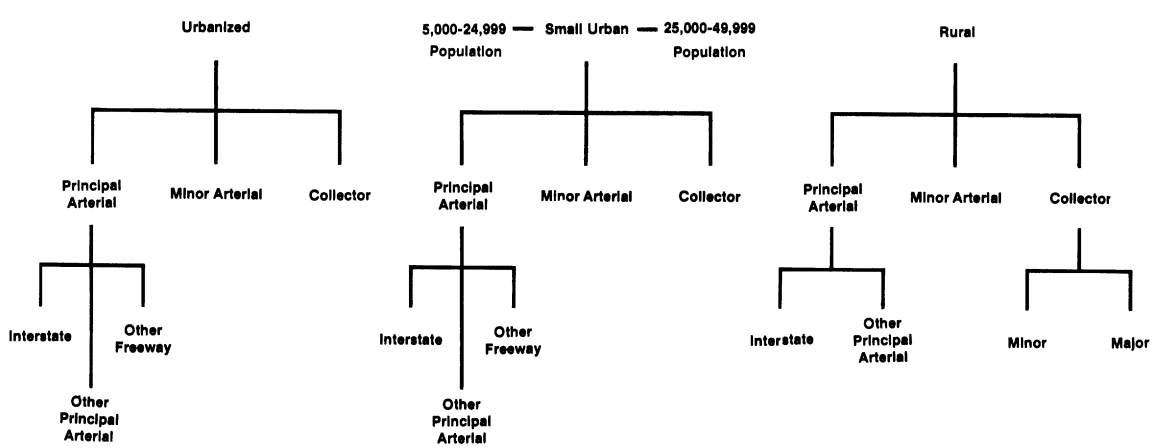


Figure VI.3. July 1976, New Federal-Aid System Class Classifications.

Table VI.1
Expected Traffic on the Highway System

State or Reporting Unit	Vehicle Miles Projected for 1990[1]: Interstate Highway System		Major & Minor Arterials		Collectors & Local		Total		Traffic Load Growth Measure (Volume/Capacity Ratio, 1990) / (Volume/Capacity Ratio, 1972): Interstate System		Arterials	
	Urbanized	Remainder	Urbanized	Remainder	Urbanized	Remainder	Urbanized	Remainder	Urbanized	Remainder	Urbanized	Remainder
Alabama	2,026.0	1,724.4	6,679.1	13,604.8	2,496.3	7,923.4	11,201.4	23,252.6	1.12	1.53	1.43	1.52
Alaska	0	0	696.1	999.0	150.1	441.4	846.2	1,440.4	—	—	.71	.70
Arizona	2,547.7	5,290.1	8,936.9	5,211.1	1,622.5	1,740.4	13,107.1	12,241.6	2.43	1.91	.97	.75
Arkansas[1]	1,074.0	3,022.3	3,890.9	6,734.0	893.7	8,085.2	5,858.6	17,841.4	1.20	1.36	1.42	.80
California[1]	25,506.1	12,294.2	88,294.8	30,749.0	23,790.6	18,660.0	137,591.5	61,703.2	1.16	1.59	1.27	1.58
Colorado[1]	3,146.0	3,922.0	8,530.0	5,428.2	1,297.2	1,451.6	12,973.2	10,801.8	1.15	1.76	1.29	1.81
Connecticut	5,650.7	2,068.2	7,421.9	4,192.3	2,875.5	3,162.4	15,948.1	9,422.9	1.34	1.51	1.21	1.40
Delaware	905.2	0	1,173.9	2,257.5	414.6	530.4	3,093.7	2,787.9	1.20	—	.61	1.51
Florida	5,798.4	8,004.5	28,670.3	19,883.8	8,815.9	11,977.1	43,284.6	39,865.4	4.99	1.60	1.03	1.38
Georgia	6,058.1	9,365.2	15,947.0	16,172.4	6,329.0	7,706.6	28,334.1	33,244.2	1.34	1.88	1.53	.96
Hawaii	734.4	308.9	1,396.0	1,140.7	609.0	636.4	2,739.4	2,386.0	1.40	1.56	.87	.88
Idaho	114.4	1,855.3	307.6	2,820.6	217.4	1,698.2	639.4	6,374.1	1.92	1.47	1.05	1.39
Illinois	9,839.6	8,674.7	30,006.2	16,848.7	10,627.4	9,163.3	50,473.2	34,686.7	1.14	1.78	1.10	1.30
Indiana	4,379.6	5,973.9	11,926.8	16,119.9	3,161.3	7,549.0	19,467.7	29,642.8	1.94	1.43	1.64	1.18
Iowa	1,342.0	4,342.4	4,744.1	10,468.3	1,293.6	5,643.2	7,379.7	20,453.9	1.56	1.52	.88	.57
Kansas[1]	1,828.3	3,216.7	3,309.0	6,197.6	1,036.2	3,657.0	6,173.5	13,071.3	2.38	2.12	1.17	1.17
Kentucky	2,813.7	4,270.4	5,212.9	13,347.1	1,923.9	6,504.9	9,950.5	24,112.4	1.68	1.41	1.53	1.54
Louisiana[1]	2,818.6	5,597.4	6,175.7	8,546.5	1,353.7	5,916.8	10,348.0	20,060.7	2.01	2.83	.93	.93
Maine	154.0	1,569.4	825.6	3,407.9	294.5	3,061.6	1,274.1	8,038.9	1.80	1.74	1.23	1.28
Maryland	6,818.0	2,899.3	21,845.3	10,408.5	3,542.8	3,866.0	32,206.1	17,173.8	1.27	1.78	1.41	1.76
Massachusetts[1]	8,253.9	2,113.9	14,001.1	4,332.2	8,369.2	2,833.9	30,624.2	9,280.0	1.97	1.70	1.87	1.18
Michigan[1]	10,674.5	5,953.0	32,578.9	18,267.8	7,479.9	15,434.9	50,733.3	39,655.7	1.72	1.71	1.25	1.60
Minnesota	4,511.9	2,910.9	8,204.9	10,221.5	3,723.6	6,739.2	16,440.4	19,871.6	1.50	2.39	.63	1.16
Mississippi	1,125.0	4,097.0	2,301.0	8,153.2	545.0	3,867.8	3,971.0	16,118.0	2.13	2.38	1.17	.68
Missouri	5,217.7	5,575.1	9,740.6	9,854.9	3,179.1	4,905.4	18,137.4	20,335.4	1.21	1.44	.93	.60
Montana	53.7	1,720.2	90.7	3,942.6	386.6	2,344.8	1,106.7	8,007.6	1.50	1.78	.25	1.08
Nebraska[1]	629.4	1,959.0	2,315.2	6,674.9	923.2	2,191.2	3,867.8	10,825.1	1.31	1.56	1.14	1.27
Nevada	518.3	2,097.7	1,960.5	1,850.3	843.9	1,156.8	3,322.7	5,104.7	3.79	2.85	1.05	1.61
New Hampshire	180.3	1,069.0	1,069.0	3,561.6	263.4	1,790.5	1,512.6	6,421.4	.99	1.18	1.21	1.44
New Jersey	7,807.1	1,314.0	31,231.4	8,085.3	11,776.9	3,740.7	50,815.4	13,140.0	1.19	2.20	1.13	.95
New Mexico	812.9	3,550.0	1,773.1	5,597.7	677.8	2,436.4	3,263.8	11,584.1	1.96	1.98	1.46	1.24
New York[1]	7,263.1	6,497.1	35,237.5	16,004.3	9,420.4	10,904.2	51,921.0	33,405.6	1.05	1.50	.94	1.22
North Carolina	2,144.0	6,497.0	12,153.1	22,863.1	4,071.0	16,329.0	18,368.1	45,689.1	1.77	2.24	1.26	1.32
North Dakota	74.0	1,305.0	171.0	2,349.0	80.0	1,427.0	325.0	5,081.0	3.90	2.18	.94	.94
Ohio	14,252.7	9,062.3	31,529.6	13,146.4	12,302.9	14,639.7	58,085.2	36,818.4	1.46	1.57	1.40	1.08
Oklahoma	2,325.6	4,420.7	5,735.0	10,329.5	2,334.6	3,216.5	10,395.2	17,966.7	1.66	2.08	.80	1.31
Oregon	1,602.6	3,553.5	4,868.4	9,840.6	785.6	4,156.7	7,256.6	17,550.8	1.35	1.50	1.24	1.51
Pennsylvania	8,015.7	9,545.7	25,420.0	17,749.3	13,295.0	12,281.9	46,730.7	39,576.9	1.54	1.49	1.18	1.10
Rhode Island[1]	1,511.1	187.2	1,898.3	530.3	1,747.3	626.0	5,156.7	1,343.5	1.23	0.50	1.05	1.02
South Carolina	2,031.2	5,003.8	4,690.3	8,410.4	961.0	3,232.1	7,682.5	16,946.3	1.76	1.59	.80	.81
South Dakota	64.0	1,715.0	286.5	3,025.0	85.3	1,538.0	435.8	6,278.0	2.57	1.98	1.01	1.23
Tennessee[1]	5,121.1	4,303.0	7,282.9	12,611.9	3,665.4	6,223.9	16,069.4	23,138.8	1.95	1.32	1.36	.56
Texas	21,457.7	13,825.7	42,894.8	28,181.5	12,117.6	15,565.3	76,470.1	57,572.5	1.84	1.97	1.07	1.33
Utah	2,073.6	2,292.6	2,395.5	1,921.8	1,297.2	1,071.3	5,748.3	5,285.7	1.88	1.43	.98	1.00
Vermont	85.6	861.2	294.0	1,532.0	159.0	1,241.5	538.5	3,634.7	1.65	1.25	.58	.97
Virginia	4,707.8	5,798.7	14,845.4	9,243.9	5,269.3	7,266.0	24,822.5	22,308.6	1.11	1.76	.90	.83
Washington	4,052.4	4,323.5	8,172.7	8,423.5	4,194.4	7,505.7	16,419.5	20,252.7	1.10	1.59	1.15	1.78
West Virginia	573.5	2,107.1	1,264.4	3,708.8	413.5	2,986.8	2,651.4	8,802.7	1.31	1.42	.92	.53
Wisconsin	1,622.3	3,587.9	8,874.0	12,715.5	2,146.7	6,152.9	12,643.0	22,456.3	1.03	1.25	1.09	1.12
Wyoming	45.5	1,867.4	187.8	1,600.1	57.9	628.5	291.2	4,096.0	1.19	2.07	1.54	1.40
District of Columbia	920.2	0	2,097.7	0	709.9	0	3,727.8	0	1.40	—	1.04	—
Puerto Rico	0	0	3,498.2	4,006.6	1,261.8	3,166.1	4,760.0	7,172.7	—	—	1.06	1.52
American Samoa	0	0	0	25.8	0	7.2	0	33.0	—	—	—	1.50
Guam	0	0	0	464.1	0	216.7	0	680.8	—	—	—	—
National Total	203,283.2	205,965.0	576,229.1	461,911.7	186,409.8	274,026.4	962,423.9	937,870.7	1.40	1.67	1.11	1.18
Growth From 1972	1.92	2.23	1.67	1.65	1.38	1.25	1.64	1.59				

[1]*Based on State estimates for the 1974 National Transportation Study, updated in 1976 by States marked.*

total annual vehicle-miles for the particular highway classification divided by total capacity-miles of the same classification in the State. Capacity-miles are obtained by multiplying the rated one-way capacity of each highway segment by the segment length and summing overall segments. The volume/capacity ratio for an entire State is a gross measure of overall traffic load but cannot pinpoint congestion in any single segment. Continued growth of the statewide volume/capacity measure, however, can warn of increasing chances for congestion.

The Interstate Highway System is a designated network of 42,500 miles of high-design, limited-access highways shown in the map located in the envelope inside the back cover of this book. The objectives of the Interstate System are:

- To connect, by as direct routes as practicable, the principal metropolitan areas, cities, and industrial centers;
- To connect at suitable border points with routes of continental importance to Canada and Mexico;
- To serve the national defense.

Routes were selected by joint action of the highway departments of each State and adjoining States, subject to the approval of the Secretary of Transportation. All of the highways included in the Interstate System are also incorporated into the Federal-aid primary system. The Interstate System includes both urban and rural mileage.

The Federal-Aid Highway Act of 1956, as amended, greatly accelerated the authorization of funds to the Interstate System. Initially, funds were authorized through June 30, 1972, and the design year[1] was designated as 1975. Subsequent Acts have extended the completion date to September 30, 1990. In general, it is funded on the basis of 90 percent (or more) Federal and 10 percent (or less) State participation. Federal funding of this program comes from the Highway Trust Fund, which is supported by Federal taxes levied against road users. The annual apportionment to a State is based on the relationship of the estimated cost of completing the system within the State to the cost of completing the system in all States.

Figure VI.4 shows that, in 1974, over 60 percent of highway trust funds went to build the Interstate Highway System. Figure VI.5 shows typical income and outgo at Federal, State, and local levels. About two-thirds of all highway funds came from imposts on users and less than half of the funds went to capital expenditures.

The discussion that follows concentrates largely on the Interstate Highway System because that system has been the focus of much recent construction effort and because it was designed specifically to facilitate interstate travel. The reader should not lose sight of the fact that the earliest U.S. routes, dating from the 1920's, were intended to facilitate interstate travel. Much travel between States still takes place on non-Interstate highways of the Federal-aid system as well as on State and local roads outside the Federal-aid system.

Just as the capital "I" Interstate System has no monopoly on small "i" interstate travel, it also has no monopoly on modern freeway design or on highway problems. Some State routes feature multilane, limited-access highways of freeway standards. The problems of congestion, of wear and maintenance, of safety, and of finances are common to all highways.

A total of 37,392 miles of the Interstate System, or 88 percent of the planned construction, was open to traffic as of December 31, 1975. Figure VI.6 indicates the status of the system. In some places, the incomplete segments may be bypassed on connecting routes that are below freeway standards.

Portions of the Interstate System were opened to traffic as early as 1950. At that time, a total length of 38,548 miles was authorized at an estimated cost of $37.6 billion, a little less than $1 million a mile. As of 1976, the estimated total cost is now about $100 billion, of which about $60 billion has already been spent or obligated. The amount that remains to be spent is more than the original cost estimate. The date for completion has slipped to September

---

[1]The designated design year indicates the date of expected level of traffic for which the segment is designed. All Interstate highways are, or will be, constructed to freeway standards. The freeway standard specifies the safety and mobility design for a multilane divided highway with full control of access. Other high-volume highways, especially other principal arterials, may be constructed as freeways, while minor arterials and collectors providing a substantial degree of access may be four or more lanes but lack full control of access. The great majority of rural highways and streets in small urban areas are constructed with two travel lanes.

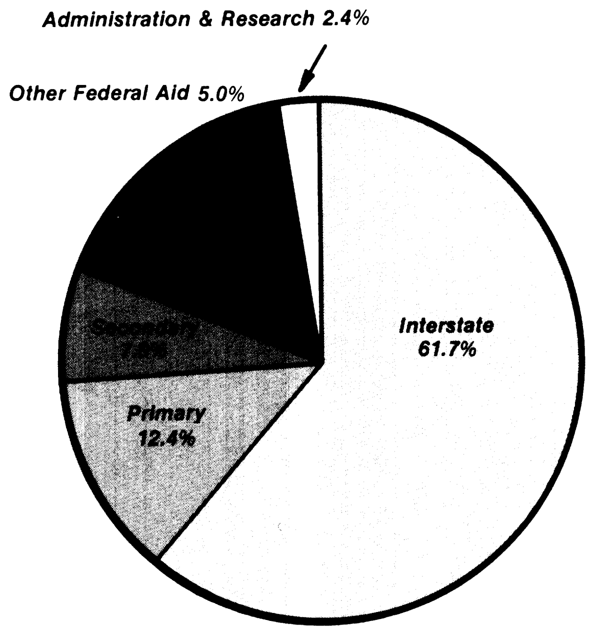
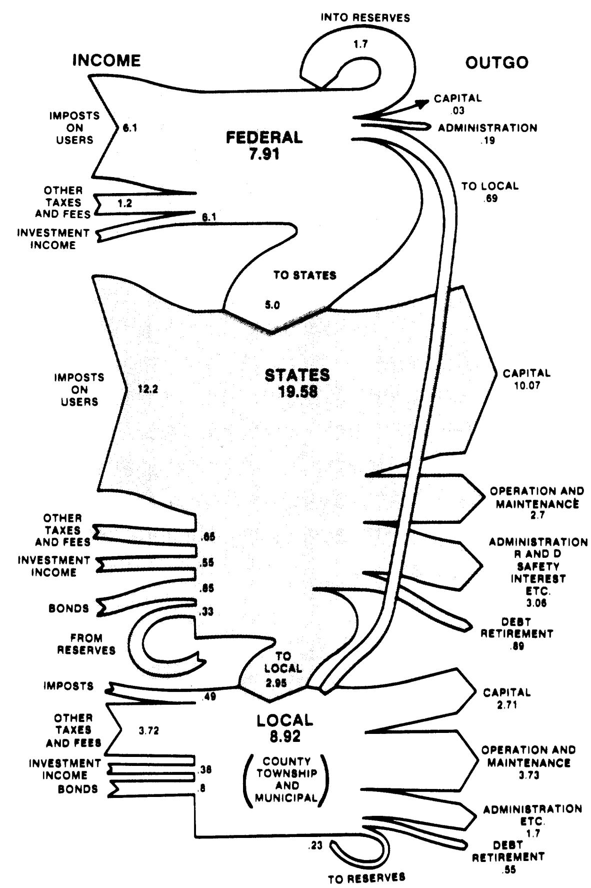


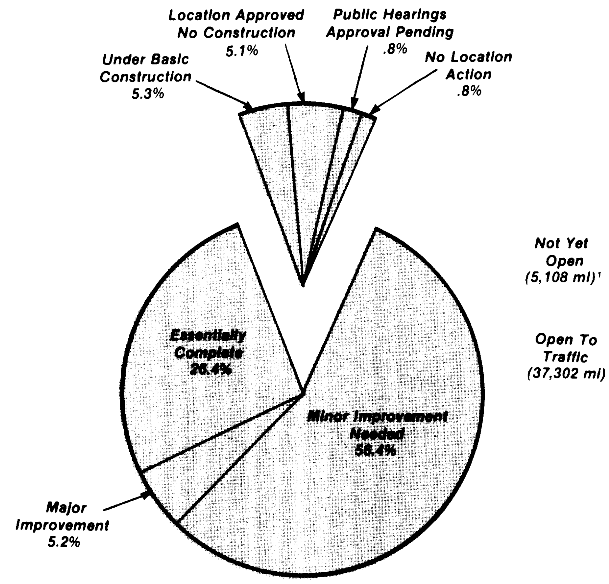
Figure VI.4. 1974 Distribution of Highway Trust Funds.

30, 1990, more than 18 years past the original expected completion date.



Source: Highway Statistics, 1974.

Figure VI.5. 1974 Annual Flow of Highway Funds.
(Billions of dollars)



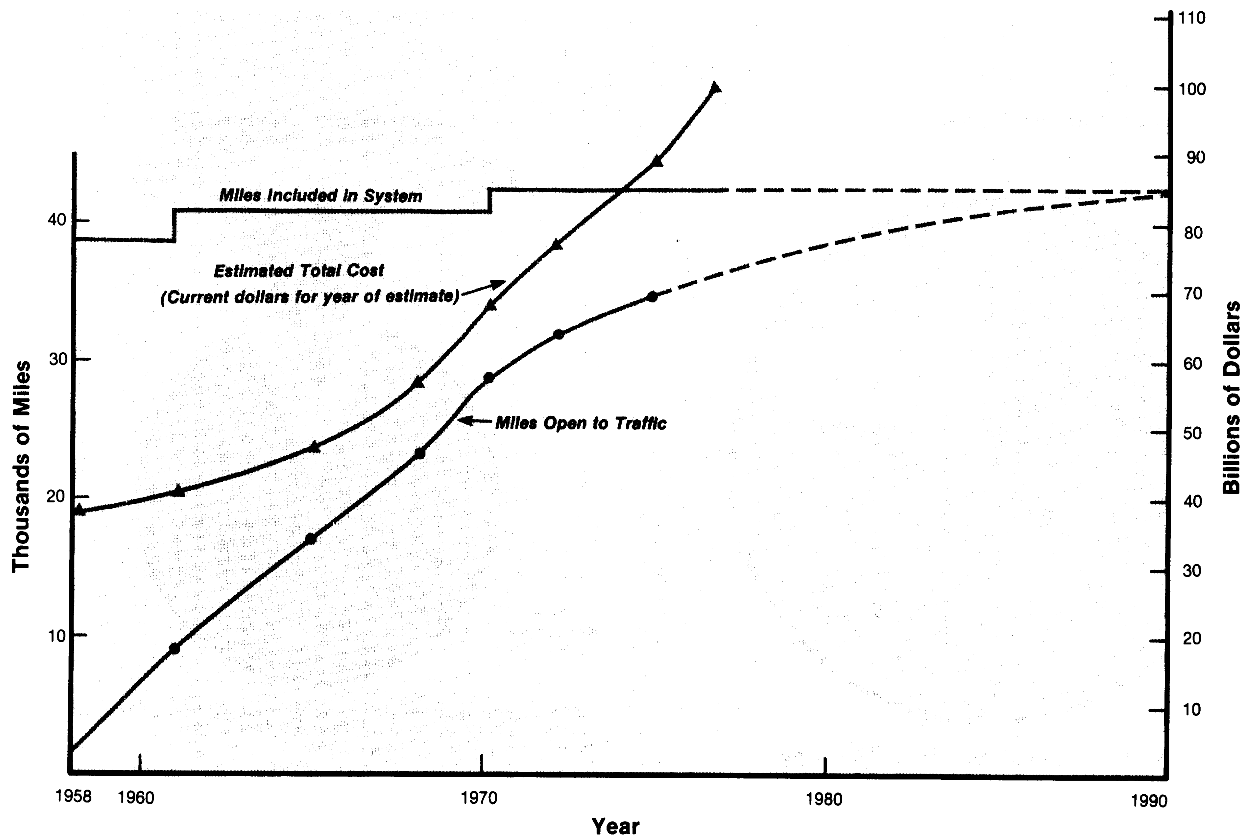
[1]Most unopened segments now routed over existing highway are adequate for present traffic, but not up to Interstate freeway standards.

Source: Federal Highway Administration.

Figure VI.6. December 31 Improvements of the Interstate and Defense Highway Systems

What caused the program slippage and cost escalation which are shown in figure VI.7? A principal factor has been the unprecedented inflation of construction prices. This is discussed more fully later as a highway issue, but it is important to note that inflation in the highway construction sector has been more rapid than for the economy in general. Because Interstate Highway construction is funded principally on a pay-as-you-go basis out of slowly growing tax revenue, rapidly rising prices have meant slower progress, which has subjected the program to still further inflation. Thus some serious consideration including the effect on U.S. fiscal and economic policy should be given to proposals which would permit borrowings to complete the system faster with user charge revenues pledged to pay off such loans. The construction progress has not generally been held up by physical inability to move earth or lay concrete.

Because the program has stretched out, some segments that opened early in the program have already required resurfacing or lane additions to accommodate growing demand. Upgrading standards of safety, environment, and durability has meant design changes in segments still under construction and retrofit to those already in service. Some portions of the system noted as "open to traffic but needing



Source: Federal Highway Administration.

Figure VI.7. Growth in Mileage and Cost of the Interstate System.

improvement" may be early-opened highway subject to this upgrading. It should be noted that even if the entire Interstate System had been completed according to the original schedule, the needs for rehabilitation and capacity increase would still have occurred. Thus a portion of the listed costs to complete the system would have occurred in normal operation.

Finally, it should be noted that those portions of the system yet to be completed tend to be those involving the greatest controversy with respect to route location, environmental impact, etc., and those having the highest cost in land acquisition, relocation, and construction. Thus to some degree, a process of "natural selection" has left to the last those portions most vulnerable to further inflation in prices.

Despite schedule slippage and inflation impacts, most of the Interstate System is in place and operating. In terms of efficiency, the Interstate System has shortened traveling time between most of the Nation's cities.

Prior to the imposition of the nationwide 55-mph speed limit in 1973, the average speed on rural (non-Interstate) arterial roads was 57.1 mph; in the rural portion of the Interstate, average speed was 65 mph. In the urbanized areas, the average speed on principal urban arterials was 35 mph or less; on the urban portion of the Interstate, 52 to 57 mph.

Speed is desirable on highways only if combined with safety, and here the Interstate has been a resounding success. Accident rates, injury rates, and fatality rates on the Interstate are well below the average for all highways. A comparison is made in table VI.2 between the completed segments of the Interstate and the existing conventional roads. Compared to existing roads, the occupant of a car on the Interstate System has a far lower chance of being in an accident, of being killed, or of getting injured.

Table VI.2
Safety Impact of the Interstate System

Rates	Type	Interstate	Existing	Ratio: Interstate/ Existing
Accident Rate[1]	Urban	50.12	137.62	.36
	Rural	25.43	66.28	.38
Injury Rate[1]	Urban	77.21	210.55	.37
	Rural	41.84	114.98	.36
Fatality Rate[1]	Urban	1.32	2.40	.55
	Rural	1.80	5.14	.35

[1]*Occurrence/100 million vehicle-miles traveled.*
Source: "Fatal and Injury Accident Rate." Federal Highway Administration.

Equally important, the Interstate System is being used. Of the 1.33 trillion vehicle-miles on all streets and roads in 1975, more than 19 percent were on the Interstate System which comprises only about 4.6 percent of the Federal-aid highways and only 1.1 percent of the Nation's total street and road network. The average mile of Interstate Highway handled about 17,000 vehicles per day as compared to about 960 for the average of the entire street and road system.

The map shown in figure VI.8 indicates the average annual daily travel (ADT) on segments of the Interstate System in 1975.

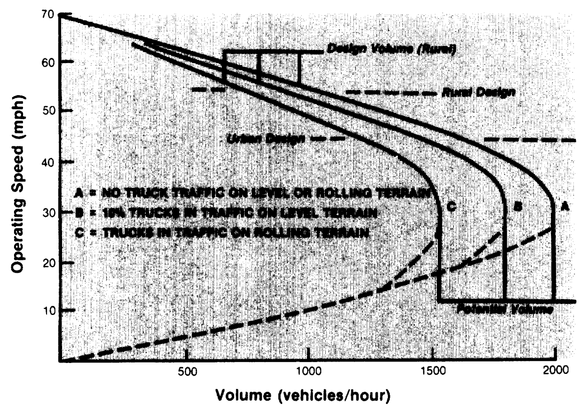
How will use of the Interstate System grow? As total highway vehicle-miles traveled expands to more than 1.8 trillion in 1990, the portion carried by the Interstate System may expand to as much as 26 percent of the total, nearly doubling the present loading of the system to more than 400 billion annual vehicle-miles. Because of differing growth rates, the average vehicles per mile handled will grow more rapidly in some regions than in others.

The map of figure VI.9 presents the forecast average daily traffic on the Interstate for 1990. The growth in volume is evident everywhere with many sections showing more than 60,000 vehicles per day.

Highway Congestion and Capacity

The capacity of a highway is defined as the number of cars (or car equivalents) per hour that can safely pass over the road. The freeway design standards for the Interstate System call for a highway geometry that is safe at speeds well in excess of 70 mph. However, at this speed much of the highway is occupied by the empty safety interval between cars. At lower speeds, although the individual car takes longer to traverse a particular stretch of highway, the safety interval reduces more rapidly so that the total number of cars per hour over the segment actually increases. As illustrated in figure VI.10, this ability to handle increasing volume with decreasing speed continues down to a speed near 30 mph, where the safety interval becomes relatively small and the length of the car itself is a significant part of the total highway occupancy. As speed decreases further, the number of cars per hour that can pass over the highway decreases.

Trucks or buses in the traffic stream take the place of several cars and, if the terrain is hilly, causing the trucks to slow down, the effective space occupied by the truck is even larger. The curve "A" of figure VI.10 becomes a family of curves for various truck (and bus) percentages and terrains.



Source: Highway Design Criteria, *Federal Highway Administration.*

Figure VI.10. The Relation Between Highway-Traffic Volume and Speed.

In determining the number of lanes a highway needs, the first step is to estimate a design hourly volume (DHV) for a design year. Many of the early segments of the Interstate System were designed for the traffic expected about 1975. The practice is to use a DHV near the peak-load condition (the loading expected for the 30th worst condition of the year) and to a speed appropriate to the condition. On the Interstate System, the speed for DHV was 55 mph for the rural sections and 45 mph in urban sections. Given the terrain and expected truck percentage, computations similar to figure VI.10 will yield the volume each lane can handle at the speed. The number of needed lanes is simply the DHV divided by the indicated lane volume, rounded up to full lanes.

The highway designed in this fashion would carry cars moving at the speed limit most of the time and even when loaded to design volume would still move cars at a brisk 45 to 55 mph. For the still higher traffic loads, the highway retains a reserve to slow down still further and handle more cars. The "potential maximum volume" with all lanes loaded up to

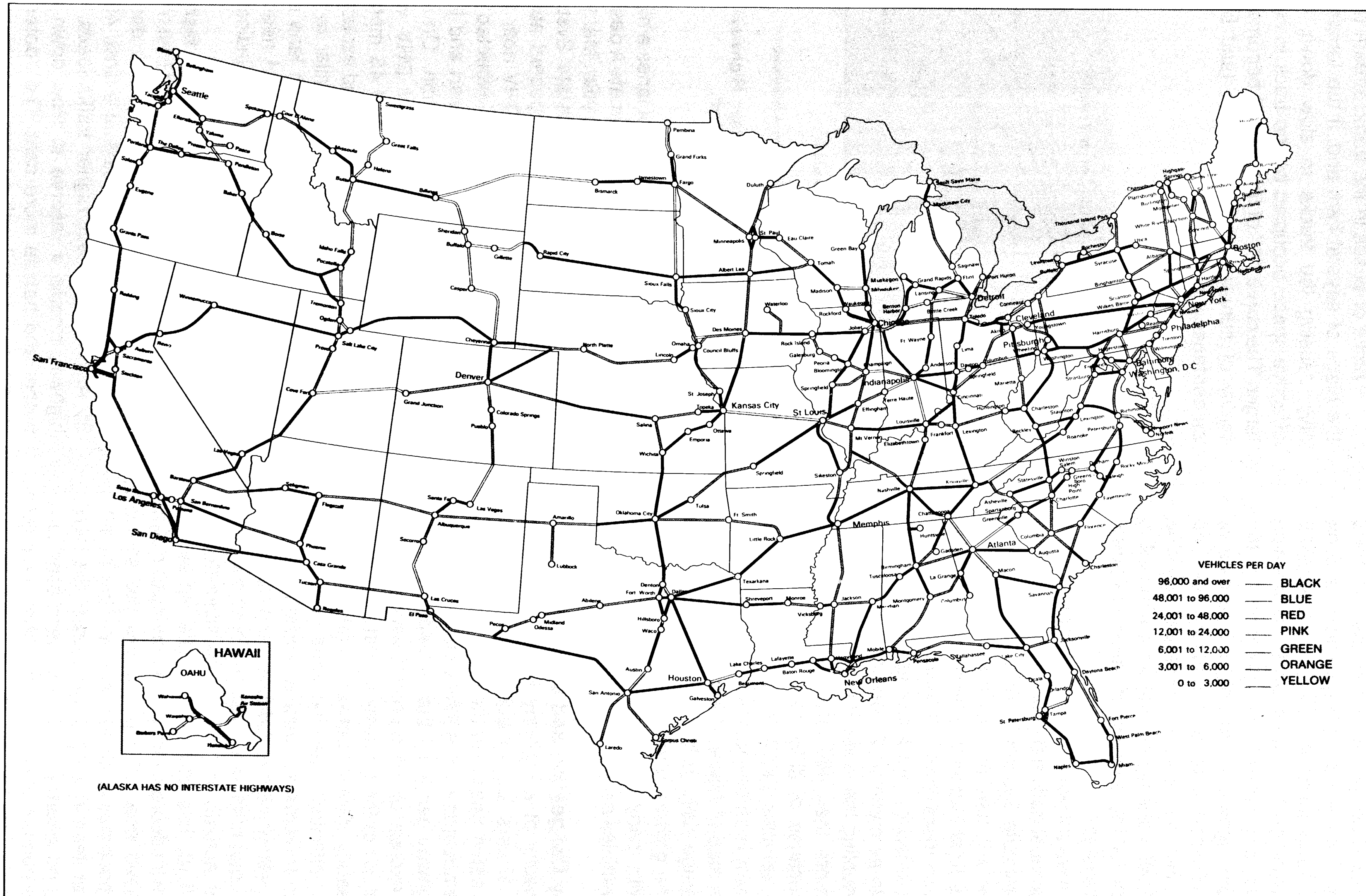


FIGURE VI.8. 1975 DAILY AVERAGE TRAFFIC ON INTERSTATE AND DEFENSE HIGHWAYS.

the appropriate maximum of figure VI.10 indicates the largest load the road can handle safely.[2]

The Interstate System was analyzed to examine how the number of lanes existing or now being constructed in accordance with the specified Interstate System will match the expected 1990 traffic volume.

The analysis indicates that without conscious shifts in public policy resulting in increased use of competing modes, 28 percent of the rural Interstate mileage will experience traffic demand exceeding design volume in 1990; 3 percent will exceed potential maximum volume. For the urban areas, 53 percent will be beyond design and 25 percent beyond potential capacity. Figures VI.11 through VI.14 show these estimates for each State. In considering the data of the maps, several points should be kept in mind: *First*, since the original design date of the Interstate System was 1975, many of the earlier portions were designed for expected traffic volumes considerably below that of 1990. Georgia, for instance, shown with a high percentage of its system loaded beyond capacity in 1990, has some very "old" segments. *Second*, minimum freeway safety design standards require four lanes which may be in excess of that needed just to provide capacity. Many western Mountain States' Interstate Highways are thus "overdesigned" with respect to capacity in order to meet safety standards. *Third*, the urban classification includes segments that were rural when they were designed but, because of urban growth, will be in the urban classification by 1990. Urban highways have a strong impact on land use which, in turn, tends to create increased traffic demand on those highways to fill any unused capacity. *Fourth*, it should be noted that by 1990, several Eastern States will have little or no rural highway. Conversely, some western Mountain States have little urban mileage; the indication of a high *percentage* of overloaded urban highway may involve comparatively little actual mileage. Finally, these projections are based on reports from states which may not always reflect consistent data and on the assumption of no basic change in present automobile usage habits.

Despite the above caveats, the maps present patterns of great interest in planning. It is obvious that considerable additional effort will be needed if the Interstate System is to be kept operating as designed for the next 15 years. Furthermore, while the analysis that produced the maps did not consider it in detail, maintenance costs on the highly loaded segments will increase with traffic. These new capital and maintenance expenditures will be unevenly distributed and probably concentrated heavily in the East. The pattern may differ considerably from the distribution of funds during past Interstate construction.

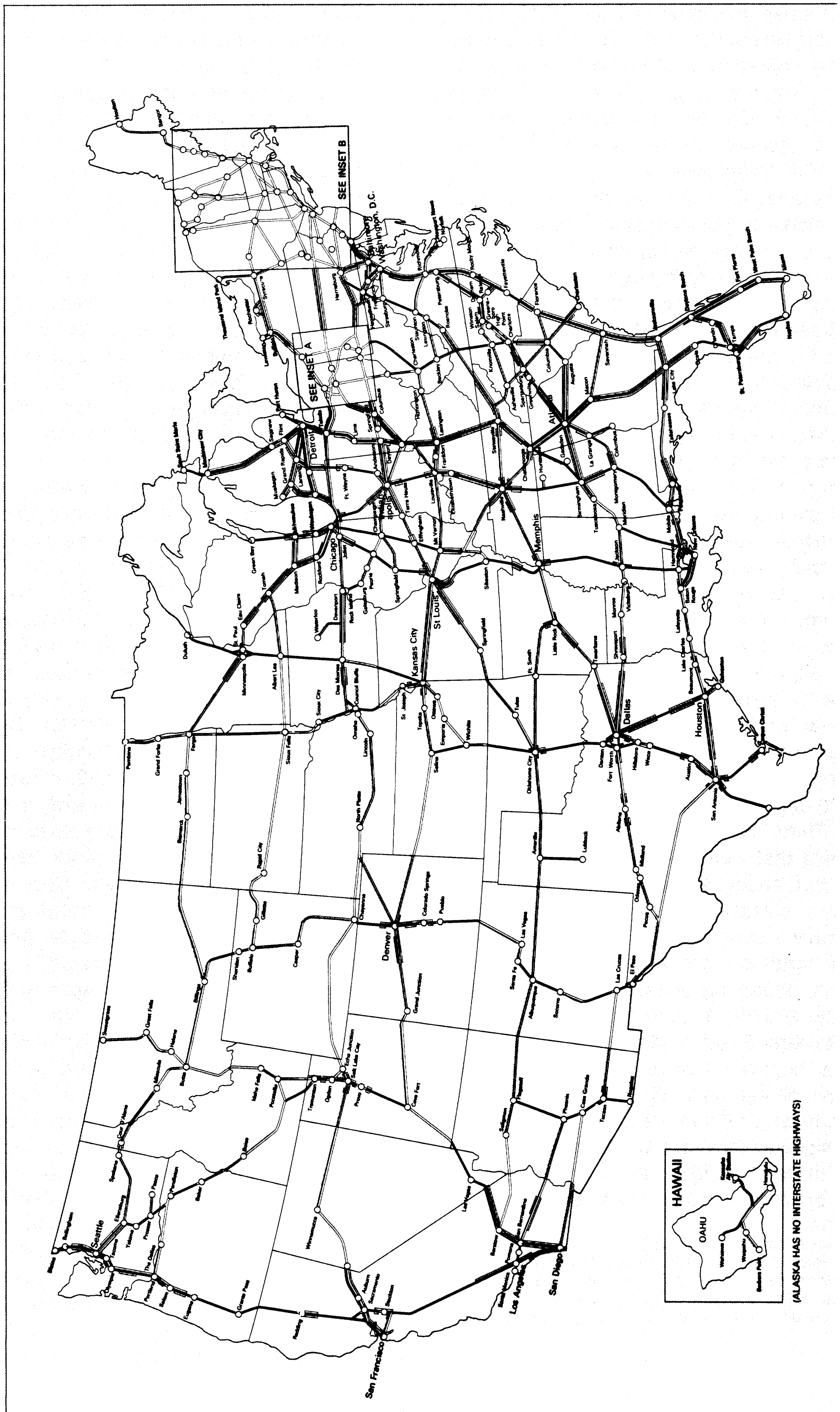
The Highway Congestion Issue

The indication that a significant portion of the Nation's number one highway system can be overloaded before it is completed raises issues both of what to do about it and how to pay for whatever is done. First, for the problem of what to do, the alternatives are essentially these:

- *Do nothing* — If no steps are taken to increase the capacity of the potentially overloaded segments of the Interstate System, the first impact would be a reduction in speed as shown earlier in figure VI.10. However, since the Interstate routes do not exist in a vacuum, traffic would not come to a dead stop at the maximum volume capacity point. Rather, as the Interstate slowed down and became less attractive, traffic would divert to other routes, to other times on the same route, and to other modes. Parallel routes or modes, in turn, would begin to load up and might approach their own capacity limits. Diversion to other destinations might take place so that the entire region would tend toward being congested everywhere at some date considerably further into the future.

The cost of the "do-nothing" stance is the price that everyone pays for the added time, inconvenience, degraded safety, etc., of congestion. Each individual who elects to divert from the preferred Interstate route usage does so because the alternate he diverts to is *marginally* better—lower in overall cost at the time he diverts. If the alternate were *much* better, he would have diverted earlier; if it were worse, he would not divert at all. Thus all of the traffic

[2] The underside of figure VI.10 is an unstable region. When a road is loaded to maximum throughput volume and still more cars try to use it, the interval between cars may drop below the safe distance, sooner or later an accident results, and the flow rate drops catastrophically. Otherwise, drivers simply slow down to "bumper-to-bumper" traffic.


SEE INSET A
SEE INSET B
Washington, D.C.
Seattle
San Francisco
Los Angeles
San Diego
Denver
Kansas City
St Louis
Chicago
Detroit
Memphis
Dallas
Houston
HAWAII
OAHU
(ALASKA HAS NO INTERSTATE HIGHWAYS)

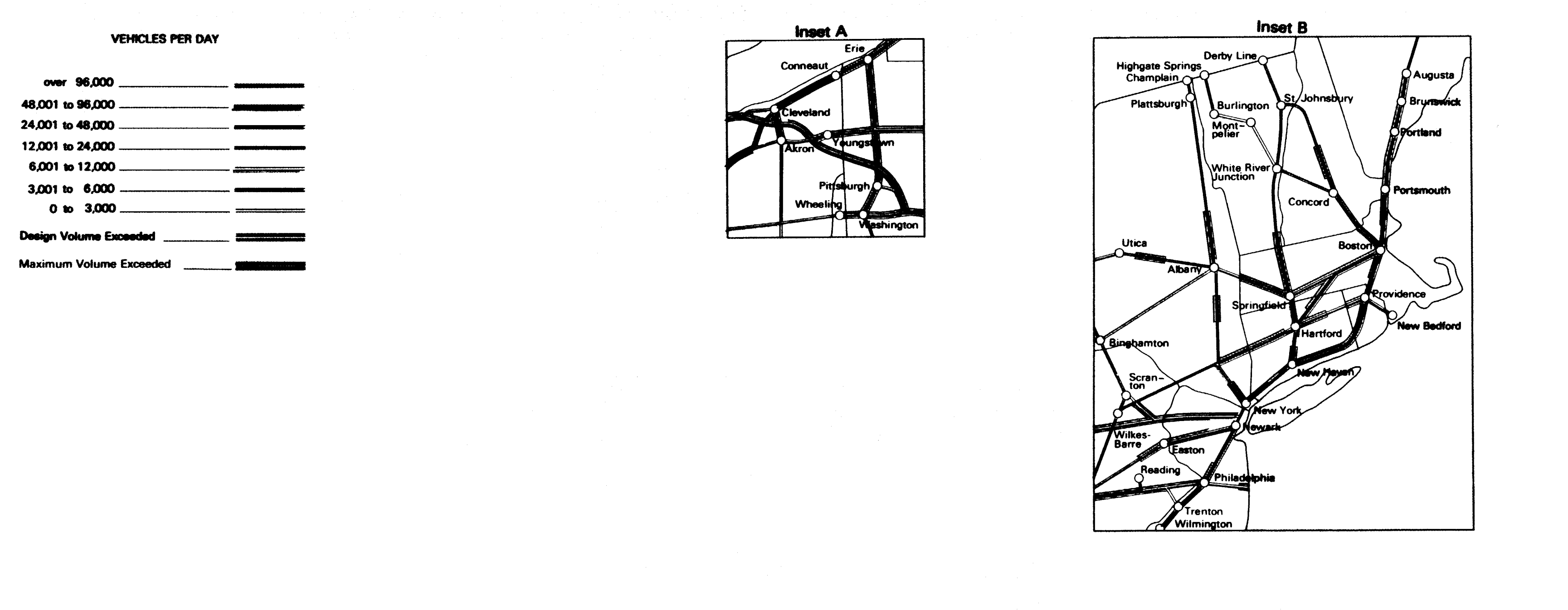


FIGURE VI.9. PROJECTED 1990 DAILY AVERAGE AND OVER CAPACITY TRAFFIC ON INTERSTATE AND DEFENSE HIGHWAYS.

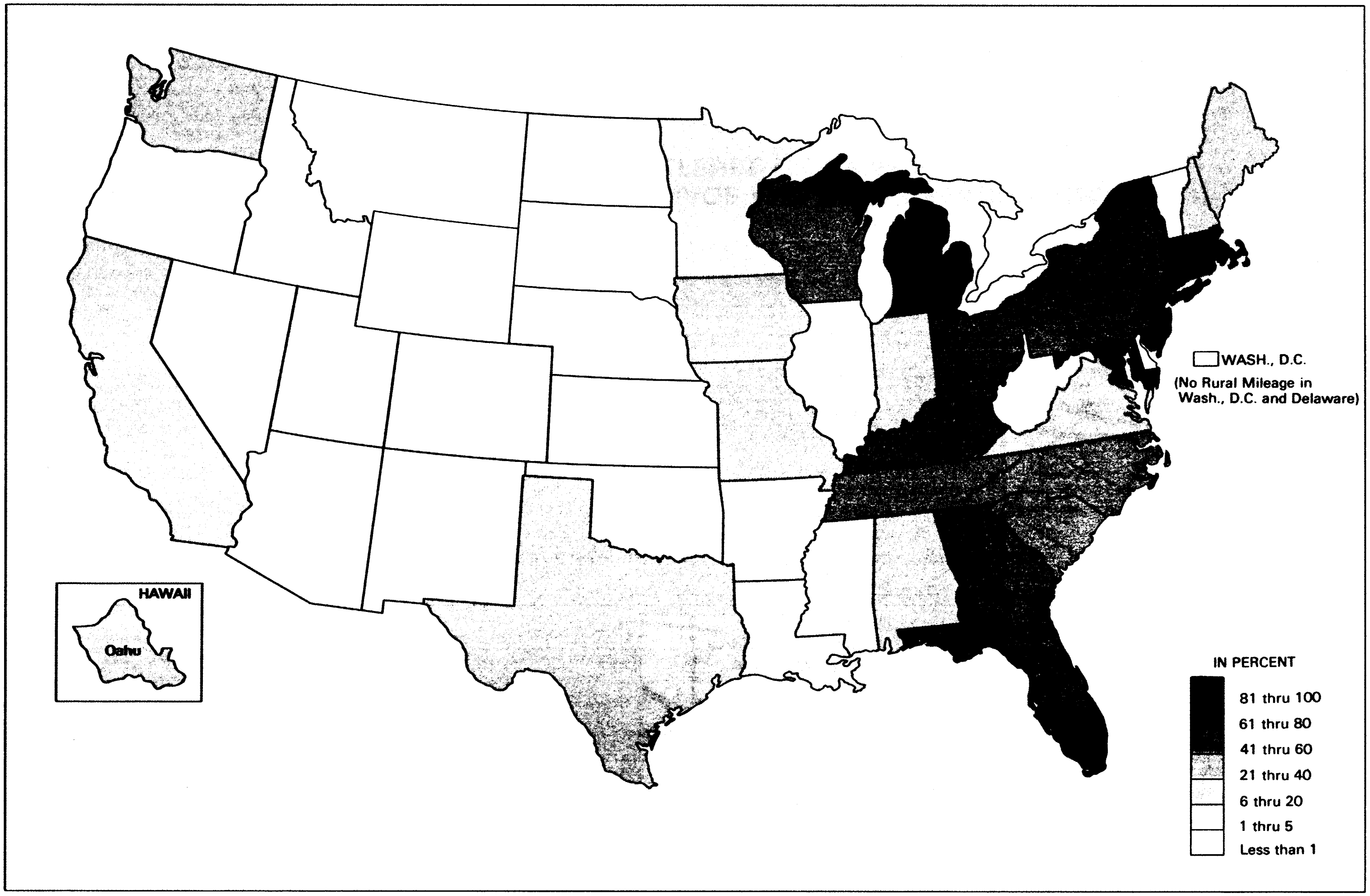


FIGURE VI.11. 1990 RURAL INTERSTATE MILEAGE.
(Percent of traffic exceeding design volume)

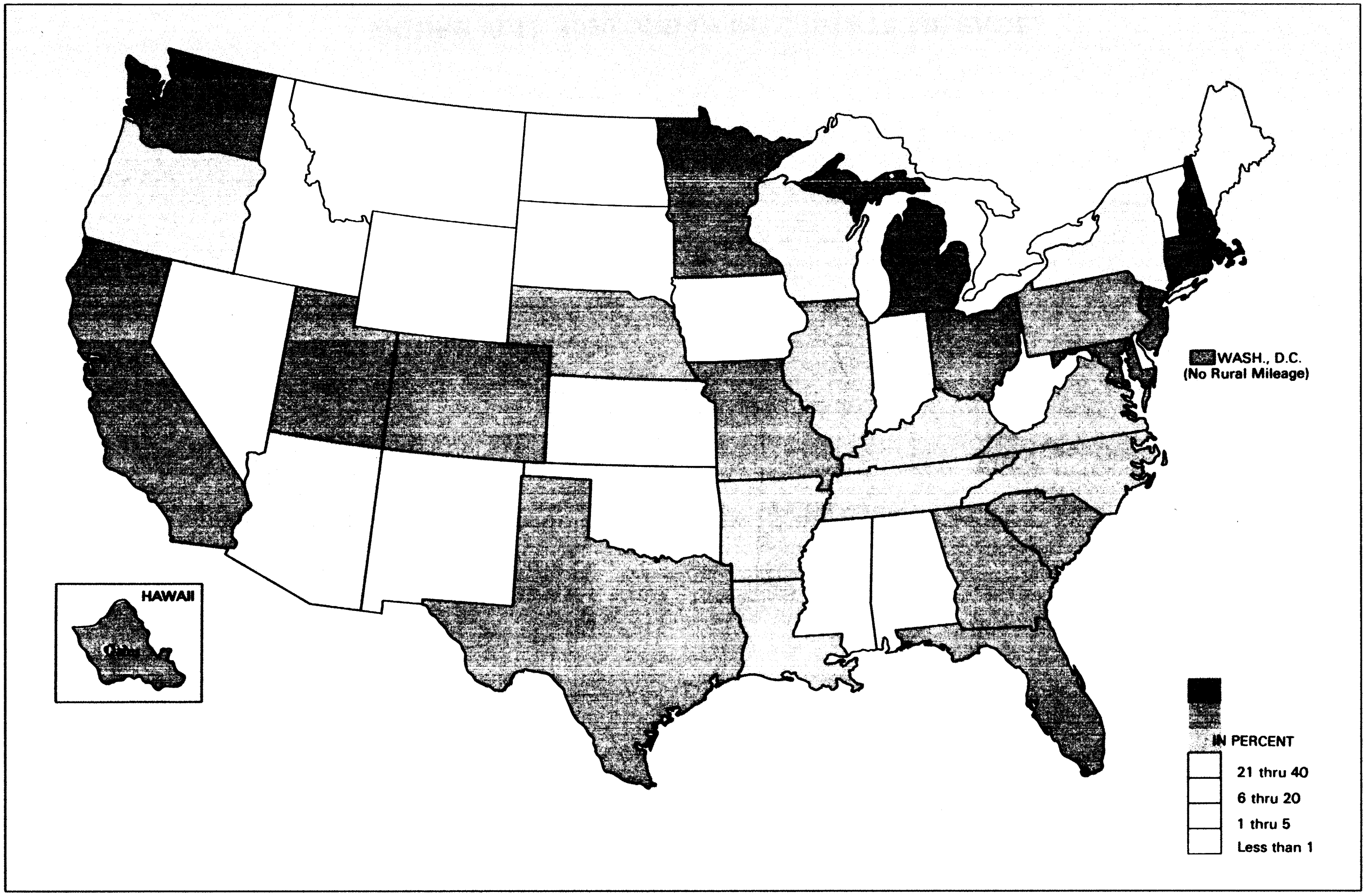


FIGURE VI.12. 1990 RURAL INTERSTATE MILEAGE.
(Percent of traffic exceeding potential volume)

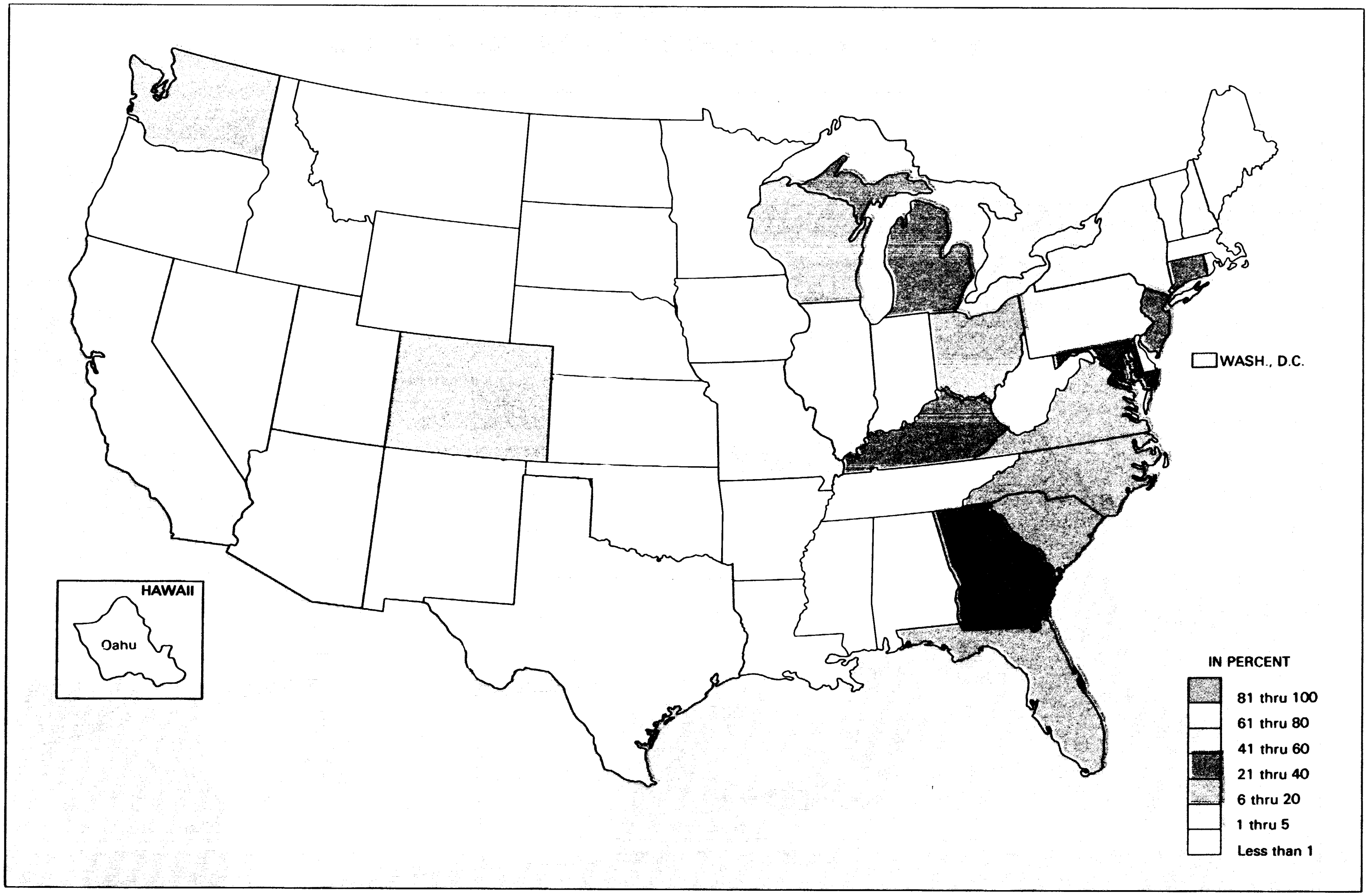


FIGURE VI.13. 1990 URBAN INTERSTATE MILEAGE.
(Percent of traffic exceeding design volume)

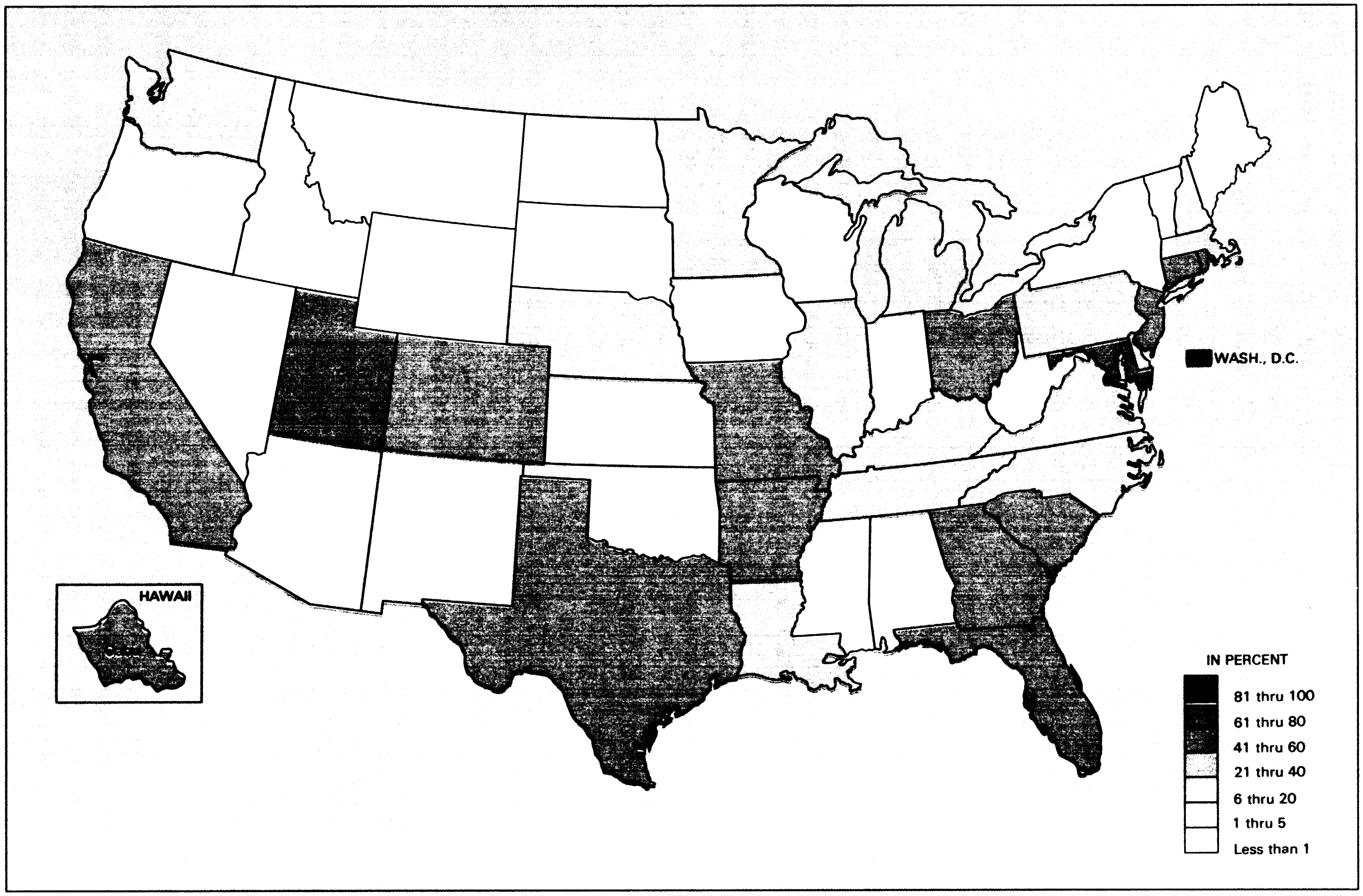


FIGURE VI.14. 1990 URBAN INTERSTATE MILEAGE.
(Percent of traffic exceeding potential volume)

which *would* have flowed over the Interstate segment pays the congestion penalty of the speed loss, inconvenience, and the other price components of the last traveler who diverts. Because the demand total is large, the congestion cost can be very large and a do-nothing stance cannot be tolerated for long.

• *Information assistance* — Some portion of congestion occurs needlessly for lack of knowledge on the part of the travelers. There will be those whose choice of time of day or specific routing for the trip would make very little difference but who got tied up in congestion simply because they did not know it was ahead or how to avoid it. Since the early stages of chronic congestion are characterized by occasional local peak-load jam-ups, inducing some of the traffic to avoid these trouble times and places can avoid or alleviate the flareups and postpone the acute problem. If the cost to those who divert is very low and the cost to provide the information to let them do so is likewise low, then the benefits to all the other travelers who avoid congestion can outweigh these small costs.

Highway information systems are discussed at greater length at the end of this section. Not only are they useful tools to delay the onset of acute congestion, but they can play a significant role in accident prevention, energy conservation, and pollution control. The development and implementation of information systems for the Interstate and other highways is a current Federal effort.

• *Enhancement of alternatives* — Under congestive situations, all the traffic that flows "pays" the same penalty as the last man who diverts. If the service on the alternate can be improved, then all the traffic benefits, and if the cost of that service improvement is low, then such a course may be attractive.

Section 126 of the Federal-Aid Highway Act of 1973 required that each State highway agency, in consultation with appropriate local officials, select Federal-aid primary route candidates for improvement priority. In order to be eligible for status as a priority primary, a route must meet the following criteria: (a) be high-traffic routes or segments, (b) be highways on the Federal-aid primary system, (c) be routes that connect to the Interstate System, (d) supplement the service provided by the Interstate System by furnishing needed adequate traffic collector and distributor facilities. From among the eligible routes, each State selected top priority routes which amounted to 5 percent of the 1972 non-Interstate mileage in the State. If the priority primary system were completed, over 90 percent of the top priority routes would be at least four lanes wide, and 85 percent of these routes would provide some degree of access control.

By virtue of eligibility criteria (c) and (d), the priority primary routes may, in fact, be expected to feed the Interstate and increase the volume of traffic on the rural Interstate System, thus possibly exacerbating congestion. A comparison of priority primary route locations with respect to congested rural Interstate links reveals that the number of routes and the amount of mileage on priority primaries that parallel the rural Interstate routes is almost negligible. There is not now any active Federal program to build up parallel alternates to the Interstate routes, although a general upgrading of the rest of the Federal-aid system is an expressed goal once the Interstate has been completed.

• *Other modes* — The diversion of both passengers and freight to other modes where capacity is underutilized could facilitate the resolution of the Interstate congestion problem. Rail passenger service, which prior to Amtrak had generally been deteriorating with respect to time, cost to user, and frequency, has large unused capacity. Severe congestion on the Interstate System may induce increased train ridership. However, rather than allowing rail passenger service to become a last resort for highway users, the Congress has given Amtrak the mandate to take positive steps to promote ridership by providing fast, reliable, comfortable, and convenient service at a reasonable cost. A car-train operation, such as Auto-Train™, is attractive to many users because they have their own automobiles available at the origin and destination of their trip.

In order for rail *actively* to capture a greater share of the freight market (as opposed to default due to eroded highway service quality), some of the recommendations made in chapter VII should be implemented. Examples are network restructuring and consolidation, performing maintenance functions with respect to rights-of-way and equipment that have hitherto been deferred, and increasing the productivity of equipment and facilities. A particularly attractive type of rail freight service involves the transport of truck trailers-on-flatcars (TOFC). Time and cost of transshipment from truck to boxcar and later from boxcar to truck are saved. Studies of ways to enhance TOFC are in progress.

• *Added highway capacity* — Another highway-oriented alternative would be to increase the capacity of the Interstate System by adding lanes where appropriate, i.e., where economically justified and where environmental and social considerations permit. Social considerations might not prove a major impediment because the primary focus here is on expansion of an existing facility. However, environmental constraints may stem from potential added noise and added vehicle emissions deleterious to air quality. In the case where extra lanes can be constructed on the present median, acquisition of additional right-of-way would be unnecessary; expansion to the present shoulder could eliminate runoff areas and noise barriers thus necessitating some further right-of-way acquisition. Even if environmental impact statements and public hearings are required, completion time for added lanes should be far less than if a wholly new facility were being contemplated.

Although added Interstate lanes would increase capacity, during the construction period existing congestion could be exacerbated. The cost of enlarging tunnels, cuts, fills, or constructing new structures such as bridges could be so large that lane expansion in some locations might not be feasible.

To the extent that congestion is caused by commercial truck and bus traffic, one relief might be to divert this segment of traffic to exclusive lanes or routes. The alternative is discussed more fully in the section on "Segregation" that follows.

The most expensive and time-consuming congestion relief measure is the construction of wholly new freeway-caliber highways. There is not now any plan for any new general post-Interstate network construction, although individual links might be authorized. The possibility of using an abandoned railway right-of-way as an exclusive truck route is also discussed later.

The problem of Interstate congestion and what to do about it has generally been approached on a segment-by-segment basis by the individual States. However, in view of the widespread congestion possible in the future and the potential severe highway funding problem, a concerted national planning effort is required. Such an effort must occur in time for the measures to be implemented and before some of the options, such as railroad diversion, have been lost. It is proposed, therefore, that a multimodal planning study be undertaken in conjunction with the States and appropriate private entities to develop optimum means for insuring adequate capacity for Interstate Highway movement. Such a study should be timed for completion in 1978.

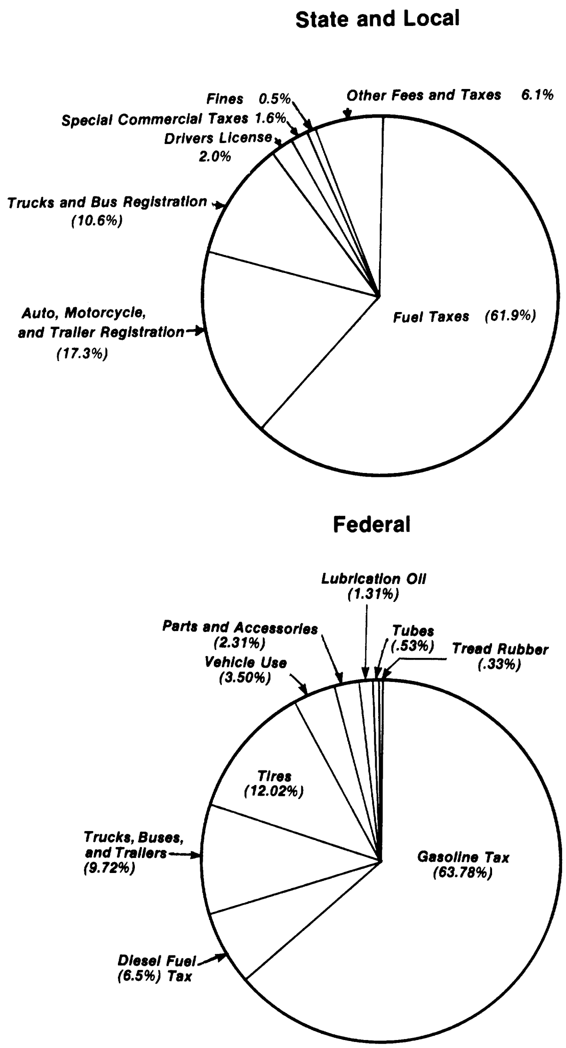
The Highway Funding Issue

The capital-cost estimate for the Interstate System through 1990, in excess of $45 billion, includes both completion of the planned network to freeway standards and the expected level of expenditures needed for improvement and rehabilitation of the existing segments. Over most of the period since World War II, capital cost has comprised roughly half the annual combined disbursements for highways by all levels of government. Maintenance has made up about a quarter of the total, and debt retirement, bond interest, administration, and highway patrol share the remaining quarter. For multilane principal arterials, the maintenance costs vary from $8,000 to $23,000 per mile per year. Over 15 years, maintenance of the 42,500 miles of the Interstate System will add about two-thirds of a billion dollars a year to the cost of the Interstate System. Administration, patrol, debt retirement, and interest will add a similar amount. Thus, the total remaining Interstate System expense to be borne by all levels of government through 1990 will be near $70 billion.

An issue of increasing importance to the Interstate System and to all parts of the national highway system is that of finances. Over the past half century and more, the funding of highway construction, operation, and maintenance has had several important characteristics:

• The source of funds (see fig. VI.15), particularly at State and Federal levels, has been primarily through imposts on the users of the highway system. A variety of taxes has been applied but the mainstay has been fuel taxes.

- The tradition has been for "free" rather than toll highways. About 5 percent of the Interstate System is toll, a fraction far above that for the total road and street system. In general, however, the construction, operation, and maintenance of the Interstate System depends on the same user-impost structure that supports all other streets and roads.

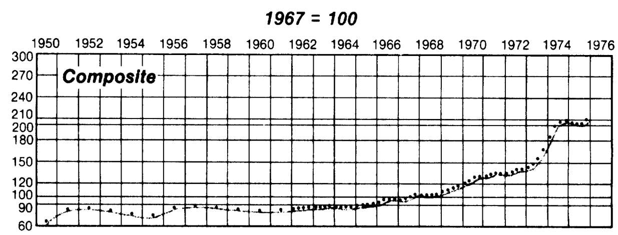


Source: Highway Statistics, *Federal Highway Administration.*

Figure VI.15. Highway Revenue Sources.

- The Federal-aid role has been one of supporting capital outlays. States and localities have supported a matching fraction (50 percent or less) of capital costs on the Federal-aid system, all of the capital costs of the non-Federal-aid remainder of the system, and the operation and maintenance of all of the system. The Federal-Aid Highway Act of 1976 authorizes for the first time additional funds for "... resurfacing, restoring, and rehabilitating those lanes on the Interstate System which have been in use for more than five years and are not on toll roads."

The heart of the issue is that highway costs of all types have been inflating rapidly while revenues have not. Most highway cost indices, as shown in figure VI.16, have been growing more rapidly than the consumer price index but the principal source of revenue, the fuel tax, has been by tradition fixed in current cents per gallon. In real dollars, the revenue has been falling since the late 1960's.



NOTE: All points from 1950 through 1962 reflect mathematical conversions from the 1957-59 base to the 1967 base. Beginning with 1962, the points represent three—quarter moving indices, using 1967 base quantities, and are plotted on the middle quarters of the three-quarter periods.

Figure VI.16. Composite Price Index for Highway Construction.

The impact has been the postponing by States of new highway construction and a shift to capital expenditures for major repairs, capacity expansions, and the safety improvements of the existing network. As financial pressure increased, capacity and safety improvement gave way to repair and resurfacing—simply keeping up with the ravages of time, wear, and weather. As of mid-1976 a total of $7.7 billion in unobligated Federal-aid funds remained undistributed to the States, largely because the States could not find means to raise the matching funds. Half a billion dollars of these unobligated funds were earmarked for safety projects.

A new factor, which will exacerbate the inflation effects, is contained in Federal policy and action on motor vehicle fuel economy. Under the Energy Policy and Conservation Act, new automobiles will be required by 1985 to deliver nearly twice the miles per gallon of 1974 model cars. Fuel economy improvements are expected for the truck and bus fleets as well. Despite a 40-percent increase in the number of annual miles driven, the 1990 total fuel consumed for highway transportation may be less than in 1975. If past inflation rates persist and present cents-per-gallon fuel taxes continue, it is conceivable that by 1990 the total highway revenue to Federal, State, and local jurisdictions would not be sufficient even to operate and maintain the present highway systems.

It is obvious that the highway system now in being must be maintained, repaired and upgraded in safety. Completion of the Interstate Highway System by 1990 is required by law although some controversial sections not essential to the national system may be dropped for social or environmental reasons.

During recent years of rapidly escalating foreign crude oil costs and domestic economic recession, adding new taxes to motor vehicle fuel costs has been an unpopular action for either the Federal or State governments to take. If future foreign crude prices stabilize and the domestic economy grows as in the planning forecast, then it may become feasible to alter fuel taxes to account for both inflation and improved motor vehicle fuel economy. Such a tax increase should not be regarded as a mandate solely for road building or for energy conservation, but rather as a continuation of the "user pays" principle in transportation.

More and more, as the transportation modes come to be regarded as integral parts of a national transportation system by both the public and private sectors, investment decisions will reflect consideration of all the alternatives rather than a modal earmarking of revenues. Some expenditures for added highway construction are likely to be judged advisable; but in other cases, the public interest—including the interest of highway users—may lie with one of the other alternatives discussed above. For the highways, the intent should be to consolidate and improve the system now in being and to concentrate on optimum management of that system in order to realize its full potential for capacity and safety.

Highway Information System

If the potential capacity of the highway system is to be realized, people who drive and use the vehicles that travel that system must have adequate and timely information about the roads. Such information includes "static" information about the system—maps and fixed signs—and variable information about current conditions in the system, both for control and advice. Maps, at various levels of detail, were previously available free from oil companies, as membership items in auto clubs, and for sale by commercial map-makers. By the mid-1970's, however, many oil companies are restricting their free map distribution and the trend is toward State-produced maps and toward retail sales of commercial maps. However produced, an up-to-date road map is essential for effective use of the highway system.

A major change in fixed highway signs has come about during the last few years under the aegis of the DOT. The increased freeway speeds combined with greater levels of interstate and international travel emphasized the need for markers that could be understood rapidly, with minimum ambiguity, and small dependence on written language. The international-type pictorial signs are now familiar to most drivers and are replacing earlier markers. Color and shape coding as well as pictorial symbolism assist the information flow. Highway pavement markings are being standardized nationwide.

Variable highway information has long been used for traffic control in the form of signal lights and lane markers. Increasingly, automatic traffic control devices are being tied in with sensors to make control flexible with conditions rather than fixed to a rigid time schedule. Variable message signs, which began with a two- or three-word vocabulary, now have a broad choice of words that can be displayed under remote control to warn of danger ahead, to change speed limits, to indicate alternate routes, etc.

Maximum real-time information transmission is via voice radio. Many cities have long had helicopter traffic reports via commercial broadcasting stations. Such reports are limited by the inability of the single observer to be all places at once or to anticipate incipient system demands. When the helicopter observer happens on the scene just as the buildup starts, he may be instrumental in averting a major traffic jam; otherwise he may serve only to tell motorists trapped in the jam how big it really is.

Citizens' band (CB) radio jumped to prominence in 1975. A broadly based vehicle intercommunication system has great information potential. At present, the CB channels carry a miscellany of chatter including road condition information, which may be useful if the sender and receiver happen to be in the right place at the right time. As the number of CB sets increases, the chance of having someone in the right places will go up, but the chance of being able to find a clear channel for transmission will go down.

The Federal Communications Commission has recently allocated AM radio bands for official highway information use. The motorist will be able to tune his car radio to these bands and receive voice communication from a low-power local transmitter. Such a system is now in use in some scenic areas as an audio "tour guide" and by at least one State to give real-time highway conditions in mountain passes. "Canned" messages can be repeated at short regular intervals or triggered by roadway sensors. Message length to moving vehicles is limited by the time the vehicle remains in range of the transmitter, but the potential information content for even a few seconds is far beyond the most ambitious variable message sign.

For the future, the Interstate System will see an increase in the use of both variable message signs and highway band AM radio. The latter will be used both for short-message application to moving vehicles and for longer messages to cars parked at highway information centers. Such centers, often at State borders or at entrances to particular regions, will provide all levels of information and direct wire reservation service as well as personal consultation.

INFORMATION KIOSK

INTERSTATE BUSES

Introduction

The interstate and intercity bus industry provides the most ubiquitous service of any of the common carrier passenger modes and connects approximately 15,000 communities of which only about 1,000 are served by other public intercity modes. Ninety-six percent of the small towns with populations between 2,500 and 5,000 and 100 percent of the towns and cities over 5,000 have intercity bus service. Figure VI.17 shows the major intercity bus routes in existence in 1975. In 1975, approximately 60 percent of the passengers using common carriers used intercity buses. However, because intercity buses are used primarily for shorter trips, they log only 15 percent of the passenger-miles. In 1974, the average intercity bus trip was 116 miles in contrast to an average trip length of 689 miles for domestic trunk airlines, 300 miles for local service airlines, and 102 miles for commuter airlines. The bus industry is unique because transportation is provided by private companies which receive neither direct subsidies nor tax exemptions. Intercity buses are, for the most part, profitable. The return on equity for the period from 1960 to 1975 ranged from 11 percent to 18 percent, surpassing the other transportation modes.

The consistent profitability, static but high level of ridership, and output stability in terms of bus-miles, passenger-miles, and passenger-miles per bus-mile of the industry is enigmatic, but may reflect the influence of two opposing forces. On the one hand, the general increase in passengers using public modes would be expected to bolster bus usage, while rising personal income would be expected to decrease bus usage in favor of air and private auto. Yet, as table VI.3 shows, the level of service has remained relatively constant. Thus, these two trends might be offsetting one another.

One factor contributing to bus profitability has been the diversification of service from almost solely regular route service to include charter, special service, and package express, all of which have grown significantly in recent years. In 1974, 26.9 percent of operating revenues stemmed from these nonregular route services. The profitability of charter and special bus service may be partially due to near-capacity loading, a common characteristic of these services.

Table VI.3
Bus Carriers Level of Service

Class 1 Carriers

Year	Companies	Route-Miles Served (thousands)	Buses
1939	165	180	7,263
1950	194	228	14,208
1960	143	207	11,093
1963	147	211	11,036
1968	173	217	12,300
1968[1]	75	192	9,480
1969	70	193	10,003
1970	71	194	10,158
1973	71	199	9,000

Class 1, 2, 3 Carriers

Year	Carriers	Buses	Route-Miles (thousands)	Total Bus-Miles (millions)
1960	1,150	20,944	265,000	1,092
1963	1,100	21,100	260,000	1,155
1968	1,050	22,100	264,000	1,190
1970	1,000	23,100	267,000	1,204
1973	1,000	22,300	271,000	1,175

[1] *On January 1969, the test for Class 1 classification was changed, the data before and after 1968 are not comparable.*

Source: National Association of Motor Bus Owners, Bus Facts, *1975.*

Bus Industry Organization

The lack of growth of the intercity bus industry may be attributable to its structure. Although 677 bus companies regulated by the Interstate Commerce Commission (ICC) were operating in 1974, the disproportionate share of passenger revenues received by Greyhound and Continental makes the industry, effectively, a "duopoly." Together, the two companies account for 65 percent of intercity bus passenger-miles and over 80 percent of class I carrier passenger-miles. (In 1974, 74 companies were classified class I, earning gross annual operating revenues of at least $1 million. Class II carriers earn $200,000 to $1 million annually, while class III carriers have gross annual operating revenues below $200,000.)

The Motor Carrier Act of 1935 placed intercity buses under the purview of the ICC, which has restricted market entry to protect the viability of existing carriers. Applicants for new routes must not only demonstrate financial

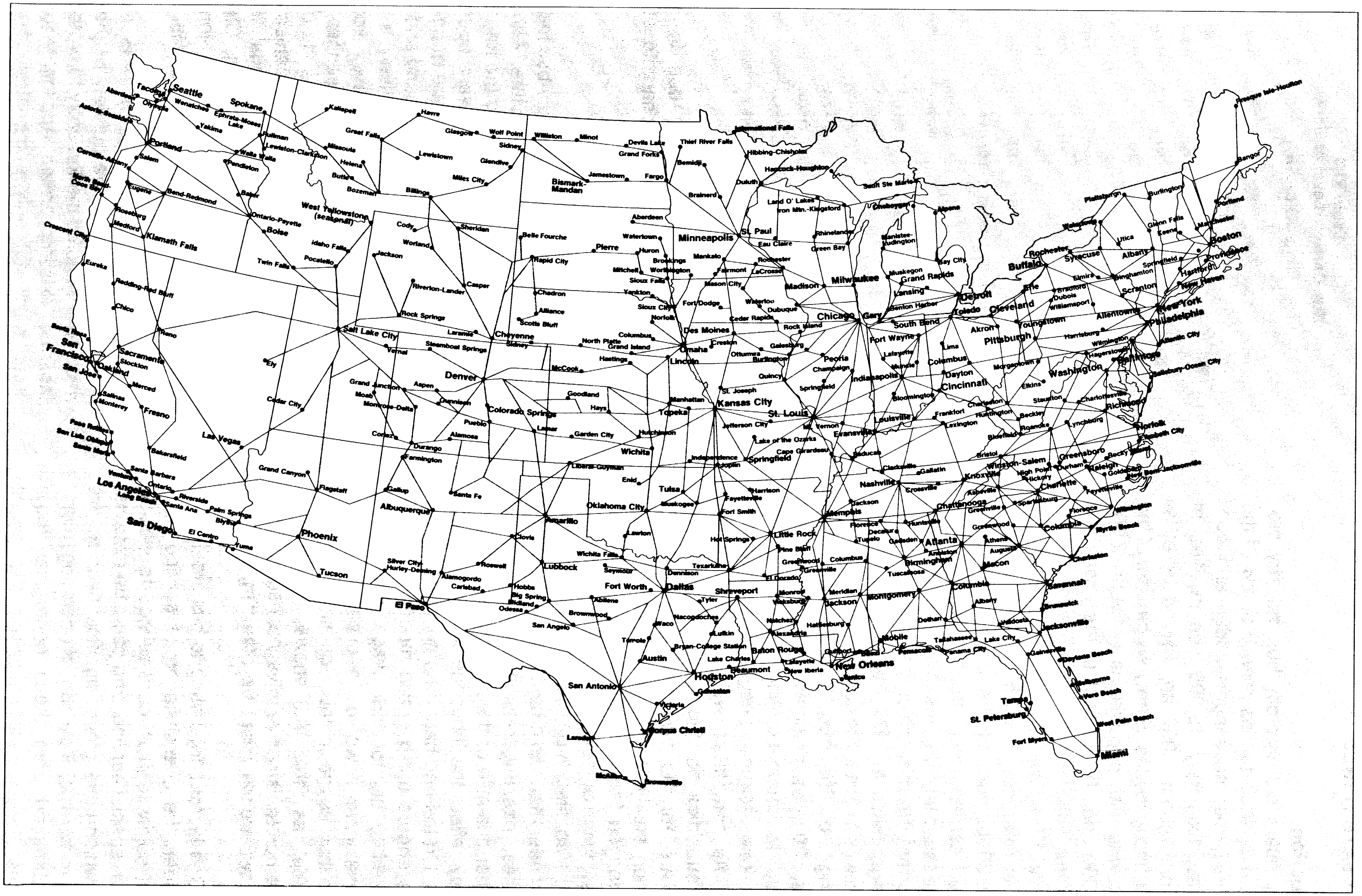


FIGURE VI.17. 1975 MAJOR INTERCITY BUS ROUTES.

soundness, i.e., be "fit, willing, and able," but must also prove public convenience and necessity. Generally, if a proposed operation will overlap significantly with existing routes, an operating certificate will be denied on the grounds that duplication is wasteful and competition destructive. Table VI.4 illustrates the disposition of 130 applications for entry or extension handled by the ICC between 1960 and 1970. Noncontroversial cases are decided by a hearing examiner rather than by the ICC.

Table VI.4
Number of Approvals and Denials of Operating Authority

Applications	Regular–route	Charter	Special	Contract	Limousine
Applications approved	35	15	20	2	8
Applications denied	20	12	13	4	1
Percent denied	36%	44%	39%	67%	11%
Reason for denial: "No Need"	12	10	7	3	1
Percent of those denied for "No Need"	60%	83%	54%	75%	100%

Source: ICC, Motor Carrier Cases.

Although the ICC cannot prohibit the termination of an operation, it can insure that unprofitable lines will be retained (probably at a very low service level) by ruling that a carrier's profitable and unprofitable lines must be terminated concurrently. The ICC also determines whether proposed fare changes should be implemented. Through 1970, virtually all proposed fare changes were assumed to be "just and reasonable." However, since then, the Commission has denied several proposed rate increases. For example, in 1973–74, subsequent to passengers formally protesting increased fares, the Commission granted an interim 3-percent increase rather than the proposed 5 percent. In evaluating the proposed fare increases, the ICC examines the operating ratio—the ratio of operating expenses to operating revenues for the industry as a whole. Comparisons with other modes and industries cannot be made due to the uniqueness of the operating-ratio test while rate of return on investment, the standard by which other industries are evaluated, is ignored because of the low capital investment for intercity buses.

The Reed-Bulwinkle Act of 1948 exempted joint fare decisions by members of the National Bus Traffic Association (NBTA) from antitrust violation proceedings. Approximately 400 intercity bus companies, which together account for 90 percent of intercity bus revenues, belong to the NBTA. While the NBTA performs a valuable function in facilitating the establishment of joint fares and routes, one of the adverse effects of the antitrust exemption enjoyed by the NBTA has been the virtual disappearance of price competition throughout the regular route portion of the intercity bus industry.

State Regulation

In addition to Federal regulation by the ICC, States also have authority over buses traveling within their boundaries. States have focused on safety and the effect of buses on highways. To protect highways from wear and tear, bus size and weight have been restricted. As of 1976, fourteen States had yet to pass enabling legislation permitting increased bus widths. Like the ICC, States have tended to limit entry, perhaps contributing to a lower quality of service than would exist under a more competitive situation.

Vehicle Characteristics

Energy Efficiency. In comparison with other modes, intercity buses are highly energy efficient. Table VI.5 indicates the superiority of intercity buses with respect to passenger-miles per gallon and seat-miles per gallon.

Safety. The intercity bus is one of the safest modes of travel. In 1975, intercity buses had a fatality rate of 0.012 per 100 million passenger-miles; all public modes proved safer than automobiles, which had 1.4 fatalities per 100 million passenger-miles.

Environmental Impact. Most intercity buses are powered by diesel engines, and they compare favorably with other modes in terms of environmental disruption. The worst bus pollution problem is the emission of high amounts of oxides of nitrogen (NO_x). Any increase in bus service may accelerate air quality deterioration unless methods to control this emission are developed. Table VI.6 illustrates the pollutants emitted by buses in 1973 in pounds per 1,000 seat-miles and grams per gallon.

Table VI.5
Energy Efficiency By Mode

Mode	Passenger-Miles Per Gallon								Seat-Miles Per Gallon			
Automobile												
Subcompact									100	100	85	91
Average	48	30	30	32	38	32	25	64				78
Intercity bus	118	110	104	125	82	125	78	215	300	250	270	
Train												
Cross-country	36	50	150+	80	46	80	50	144				
Metroliner								75	210	210		
Commuter						100		200				
Suburban						200		400				
Airplane												
Wide-bodied jet						22		40				
Average	15	16	14	14	16	21	18	34	52	52	22	
Investigator	FEA	DOT/ TSC	DOT/ OTEP	Hirst	Hirst	NCMP	Mooz	Rice	DOT/ OST	Fraize	Lieb	Austen

Source: Boeing Intercity Passenger Transportation Data.

Operating Cost. Buses, with an operating cost of 5.8 cents per revenue passenger-mile (1974), are less costly to operate than other public modes. Whereas fuel, comprising 35 percent of operating costs, is the major expense for airlines, labor is the primary expense for intercity buses. From 1960 to 1974, the ratio of labor costs to total operating costs rose from 47.6 percent to 59.9 percent. Although the number of drivers remained fairly constant between 1960 and 1973 (respectively, 16,786 and 15,574), their average annual earnings, unadjusted for inflation, grew from $6,322 to $12,830. Higher speeds improve both labor and vehicle productivity — passenger-miles per driver and passenger-miles per hour — but at the same time increase fuel costs.

Table VI.6
1973 Intercity Bus Emission Factors

	Seat-Miles (pounds/thousand)	Grams/Gallon
CO	0.67	102.15
HC	0.11	16.79
NO_2	1.12	167.98
SO_2	0.08	12.25
Particulates	0.04	5.90

Traveltime. Although intercity buses appear good in terms of energy efficiency, safety, and pollution, their current service characteristics may make them relatively less attractive, with respect to overall traveltime and convenience. Intercity bus speeds (and, therefore, traveltime) improve as the Interstate Highway System grows. However, the 55-mph restriction has increased traveltime somewhat. Access and egress to terminals, which are predominantly located in downtown areas (often in deteriorated sections), may be time consuming because of traffic congestion. Thus, although line-haul time may be competitive with automobile, the overall traveltime for intercity buses may be much greater. For trips with final destinations in urban areas where public transportation is available, buses (like rail) may be preferred to automobiles, so that parking and maneuvering an automobile through an unfamiliar city may be avoided.

Public Attitude. Large segments of the traveling public view bus travel unfavorably. The groups that rate bus travel as undesirable and the percentages of that group who agree with the negative view are the following: suburbanites, 66 percent; 18- to 29-year-olds, 63 percent; college educated, 64 percent; whites, 57 percent; income over $15,000, 65 percent; frequent business travelers, 73 percent; and frequent pleasure travelers, 65 percent. Perhaps, the belief that buses are the least comfortable mode is one aspect of the negative reaction. Almost 25 percent of the respondents agreed with the statement that bus seats are too small and cramped. Recent legislation permitting the increase of bus widths from 96 inches to 102 inches will improve rider comfort as new buses are phased in.

A factor that may contribute to the negative perception of bus travel is the lack of through ticketing and automatic baggage transfer. Unlike flying, passengers often claim and recheck baggage as well as purchase a new ticket for each leg of a journey. Additionally, information on bus schedules and fares is often difficult to obtain except at a major terminal. Consequently, a passenger may not know in advance the interface between all segments of a trip. Obviously, this can lead to missed connections and long layovers.

Improved information dissemination regarding fares, schedules, and connections for all destinations is recommended at all terminals and ticket counters. Similar information for destinations served solely by other bus companies should also be available. Coordination among bus companies and between modes can facilitate passenger travel by eliminating such inconveniences as the need to transfer baggage and to purchase tickets at each transfer point.

The Future of Intercity Buses

Future Performance. Given the assumptions of this analysis regarding economic growth, population increase, and the availability and price of oil, passenger-miles by intercity buses are forecasted to increase from 25.7 billion in 1975 to 31 billion in 1980 to 38.3 billion in 1990. However, buses will account for only a slightly larger percentage of intercity passenger-miles: 2.2 percent in 1975, 2.3 percent in 1980, and 2.3 percent in 1990. The increase in population countered by the rising personal disposable income affects bus growth. The average length of bus trips is expected to remain approximately the same as patronage stabilizes in the short-haul markets. An unanticipated severe fuel shortage, however, could result in diversion from automobiles as well as airplanes to buses.

Buses may opt to diversify service to attract a higher level of ridership. In addition to being used by persons who cannot afford the cost of other modes, and expansion of charter and special service, discretionary use may be induced if bus companies develop premium service. Unlike regular service characterized by relatively low fares, premium service would command higher fares to cover the cost of refurbished or new terminals featuring the amenities of airports, such as car rental service, attractive restaurants, and new buses with interiors somewhat resembling the inside of an airplane. The presence of hostesses and hosts serving drinks and snacks may also be a feature of premium service.

Regulatory Reform. Probably the most significant impact on the intercity bus industry would result from the adoption of the administration's proposed amendment to the Interstate Commerce Act, the "Motor Carrier Reform Act of 1975" pending before Congress as of June 1976. By lowering barriers to market entry and exit and by increasing management's discretion to set fares and experiment with innovative services, this proposed legislation seeks to improve overall service quality and to restore a measure of competition to the industry. The contention that some routes will be terminated, while wasteful duplication of services will result elsewhere if the status quo is not perpetuated, is most likely invalid. In many cases, small operators provide more cost-effective service on some routes than large-scale operators who must pay high wages and overhead. For example, in 1975, while operating costs for Greyhound amounted to approximately $1.20 per bus-mile, the average for class I carriers was under 90 cents per bus-mile. Class II and class III companies exhibited a wide variation in cost—some as low as 60 cents per bus-mile. Thus, the unprofitable routes, which the ICC is compelling large carriers to retain, could prove profitable for smaller firms.

Although the Federal role in the intercity bus industry is expected to remain minor, and high profitability is expected to continue, State and/or local governments may elect to share in the responsibility for service on particular routes by providing subsidies to the bus companies to insure more frequent service or continued service. For example, Michigan has set a precedent by providing Indian Trails with a subsidy to augment the route between Flint and Chicago. Michigan has also subsidized some endangered Greyhound routes in the Upper Penninsula.

At present, the greatest Federal impact on intercity bus travel is probably through its subsidy of Amtrak operations, and to a lesser extent, subsidies of local service airlines. These subsidies place the bus industry in a very unfair competitive position and unnecessarily jeopardize the Nation's only healthy common carrier mode. This topic was covered more fully in chapter V.

Vehicle Characteristics. Little improvement may be expected before 1990 with respect to the safety, energy consumption, and environmental performance of intercity buses; they already compare favorably with other modes along these lines. The NO_x problem most likely will remain until appropriate new technology is developed and utilized.

Operating costs will continue to increase commensurately with the price of labor, fuel, and vehicles. Fares will undoubtedly be raised to cover costs. More flexibility in setting fares and increased competition from freer market entry can insure greater operating efficiency and reduce fares below their level under the present regulatory system.

Traveltime cannot be expected to change much on the long-haul portion of trips given speed limit restrictions. Improving terminal access and egress times depends on traffic congestion abatement at trip ends. This, in turn, entails diversion from single occupancy automobiles to other modes, or more intensive use of automobiles and taxis. Consequently, significant changes in traveltime are not anticipated. However, the commitment of both Greyhound and Trailways to the construction of suburban terminals may result in shorter intermetropolitan traveltimes because the traffic congestion near a downtown terminal can be avoided for at least one trip end. The Federal-Aid Highway Act of 1976 permits, for the first time, the use of 102-inch-wide buses on Interstate Highways; formerly only 96-inch-wide buses were permitted. Wider buses should mean greater comfort, but bus roominess is still likely to be less than for coach class in a wide-bodied airplane. Furthermore, intercity buses will no longer be at a disadvantage with local transit in providing charter services, because intercity buses will no longer be narrower.

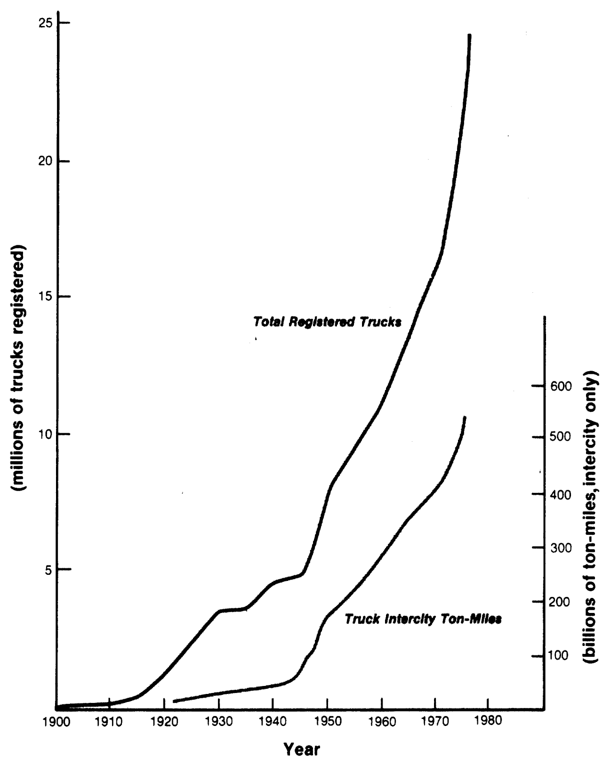
Summary

The lack of growth in the intercity bus industry (despite a growing population) and the failure to decline (despite rising affluence and absence of subsidy) make intercity buses unique. They have maintained a relatively high level of ridership, although they have accounted for only a small percentage of common carrier passenger-miles. The steady performance of the past 25 years is expected to continue in the future. Without critical shortages in fuel for automobiles, buses will continue to be primarily the mode of the less affluent and will serve short-haul trips. Premium service at higher fares is likely to develop between a greater number of major city pairs separated by relatively short distances.

TRUCK FREIGHT

Intercity trucking carries about one-fifth of the U.S. intercity freight in ton-miles of movement. In so doing, trucking accounts for about two-thirds of intercity freight revenue, a disparity rooted in the nature and evolution of the trucking industry.

The present-day truck is the 20th-century descendant of the 19th-century horse and wagon. The lineage still shows in the name of the Teamster's Union, but otherwise the evolutionary change has been complete. At the turn of the century, when the infant automobile was just beginning to crawl around a few urban streets, intercity freight was being carried competently by a vigorous railroad industry. Horse-drawn wagons filled the pickup and delivery role. Except for some private haulage and the movement of agricultural products to nearby market, there was no intercity highway freight mode to compete with rail. The first commercial penetration of the truck was in the displacement of the horse for urban hauling. As shown in figure VI.18, the Nation's truck population reached a million just after the close of World War I, grew to about 3.5 million by 1930, and to 5.0 million by the 1940's.

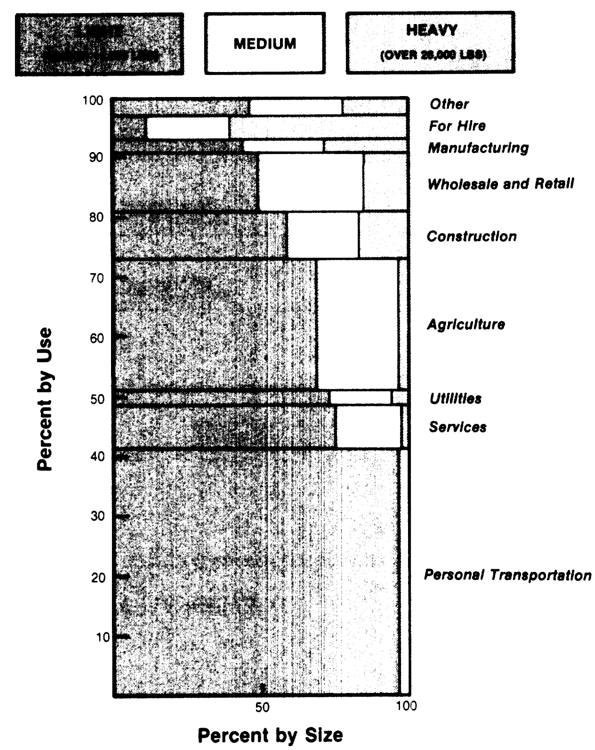


Source: Highway Statistics, *Federal Highway Administration.*

Figure VI.18. Growth of Truck Registrations and Ton-Miles.

The truck population has grown by a factor of five since World War II. Of the 25 million trucks now registered, only a little over 8 percent are the heavy types usually associated with over-the-road intercity freight. About three-quarters of all the vehicles registered as "trucks" (shown in fig. VI.19) are less than 10,000 pounds gross vehicle weight (GVW), and more than half of these are used for personal transportation. Vans, mobile homes, campers, and recreational vehicles are registered as trucks in most States. About 1 truck in 5 is used in agriculture, and about 1 in 10 is used by utilities or service industries to haul personnel and tools rather than cargo. Personal truck ownership varies regionally, and while 1 family in 3 owns a truck in the Mountain States, only 1 family in 24 owns a truck in the Middle Atlantic States.

Trucks are manufactured by the major U.S. auto manufacturers but, unlike automobiles, at least a dozen other manufacturers produce and sell significant numbers of trucks. Special sizes and configurations exist in a wide variety, and to a considerable degree, particularly for large-size trucks, the combination of components is specified by the buyer. Trucks are classified according to gross vehicle weight, and only the two highest weight classes (class VII, 26,001–33,000 lb.; class VIII, 33,001 lb. and above) are significant in intercity freight. Class VIII includes the large diesel-powered tractor-trailer combinations plus still larger multiple-trailer rigs covered in figure VI.20.

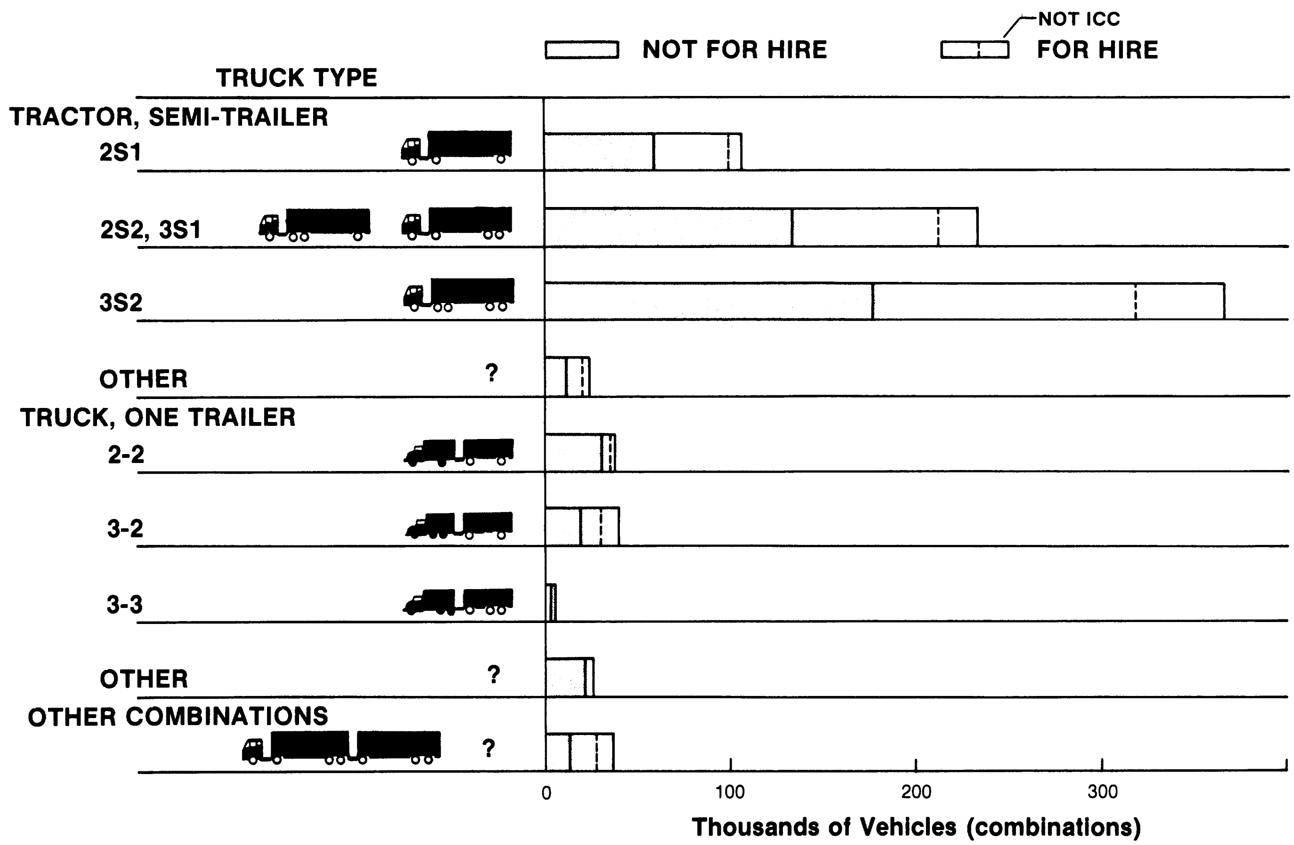


Source: 1972 Truck Inventory and Use Survey, *Census of Transportation, U.S. Bureau of the Census.*

Figure VI.19. Truck Distribution by Size and Use.

Regulation

The size and shape of the large trucks engaged in interstate freight movement reflects to a large degree the bewildering array of State regulations governing trucks. Maximum truck height, width, length, gross weight, weight per axle, number of axles, and distance between first and last axles are all regulated by one or more States, but the regulations may differ from State to State and between the Interstate System and other highways in the State. Such a familiar feature as the cab-over-engine design is the result of maximizing the allowable payload space within fixed overall length dimension. The development of a simplified, single national size and weight code would materially assist the flow of interstate commerce by motor vehicle.



Source: Nationwide Truck Commodity Flow Study: 1972-1973, *Federal Highway Administration.*

Figure VI.20. Distribution of Combination Trucks.

State size and weight regulations of trucks (summarized in table VI.7) are aimed at safety, at standardization of facilities such as underpass clearance, and at controlling the effect of excessively high axle loading on the highway pavement, bridges, etc. Historically, these regulations grew up within individual States without great need to coordinate with regulations of neighboring States. Gross vehicle weight limitations range from a low of 73,000 pounds in Connecticut and Wisconsin to a high of 129,000 pounds in Nevada. Twenty-three States have a limit of 80,000 pounds GVW but not all these allow the same axle loads or lengths. Thus a truck configured legally and loaded to the limit in one State may be illegally overloaded in the next, and underloaded in still another State on the same route.

Interstate truckers have essentially four options:

- Load and configure for the most restrictive State en route,
- Shift loads and/or reconfigure at State lines,
- Route circuitously to avoid restrictive States,
- Run illegally in restrictive States, avoiding weighing stations and police.

The indications are that all four are used at different times by many truckers.

States also levy special taxes on trucks, principally to cover the added cost which these large, heavy vehicles impose on their highway system. As with size and weight regulation, the tax rate and method of taxation differ widely among the States as illustrated in table VI.8. All States impose fuel taxes, but since these are inadequate to cover highway cost of the large, fuel-efficient vehicles, and since trucks could traverse States by some routes without ever buying fuel, a variety of other taxation schemes have evolved. Many States reinforce fuel taxes by requiring trucks passing through either to buy fuel or else pay a tax equivalent to that which would have been paid on fuel consumed for mileage driven within the State, and many

Table VI.7
Truck Size and Weight Limits By State

State	Height (Ft., Ins.)	Width (In.)	Length, Ft.				Weight, Lbs. Single Axle		Tandem Axle		Gross Combination		Tolerance (GCW[1]/GAW[2])
Alabama	13 6	96	NS	55	NP	NP	20,000 (22,000)[F1]	20,000	40,000 (44,000)[F1]	36,000 (39,600)[F1]	92,400	80,000	10%
Alaska**	13 6	96[B4]	45	65	65	70	20,000	20,000	34,000	34,000	105,500	No interstate	None
Arizona	13 6 (14)[A3]	96	NS 40	65	65	65	20,000	20,000	34,000	34,000	80,000	80,000	None
Arkansas	13 6	96	NS	55	65	65	18,000	18,000	32,000	32,000	64,000 (73,280)[A1]	73,280	None
California	13 6 (14)[F1]	96[B2]	40[C2]	60	65	65	20,000	20,000	34,000	34,000	80,000	80,000	500 lb /
Colorado	13 (13 6)[A1]	96[B3]	NS	65	65	65	18,000	20,000	36,000	36,000	85,000	60,000	None
Connecticut	13 6	102	NS	55	55	NP	22,400	22,400	36,000	36,000	73,000	73,000 (73,280)[E1]	2%
Delaware	13 6	96	40[C5]	55	55	65	20,000	20,000	36,000	36,000	73,280	73,280	None
Washington D.C.	12 6	96	NS	55	55	NP	21,000 (22,000)[E1 F2]	21,000 (22,000)[E1]	37,000 (38,000)[E1]	37,000 (38,000)[E1]	72,280 (73,280)[E1]	72,280 (73,280)[E1]	1,000 lb
Florida	13 6	96	NS[D1]	55	55	NP	20,000 (22,000)[E1]	20,000 (22,000)[E1]	40,000 (44,000)[E1]	40,000 (44,000)[E1]	85,500	80,000	10%
Georgia	13 6	96	NS	55	55	55	18,000 (20,340)[E1]	18,000 (20,340)[E1]	36,000 (40,680)[E1]	36,000 (40,680)[E1]	80,000	80,000	None - 13%
Hawaii	13 6	108	NS	55	65	65	24,000	24,000	32,000	32,000	80,800	80,800	None
Idaho	14	102 96	NS	65[C1]	65	75 (98)[A1]	20,000	20,000	34,000	34,000	105,500	80,000 (105,500)[A3]	None
Illinois	13 6	96	45 42	55	60	60 (65)[A1]	18,000	18,000	32,000	32,000	73,280	73,280	None
Indiana	13 6	96	NS	55	55	65	18,000	18,000	32,000	32,000	73,280	73,280	1,000 lb
Iowa	13 6	96	NS	55	55	60	18,000	18,000 (18,540)[E1]	32,000	32,000 (32,960)[E1]	72,634 (73,280)[E1]	73,280	8% - 3%
Kansas	13 6	96[B3]	NS 42 5	60	65	65	20,000	20,000	34,000	34,000	85,000	80,000	None
Kentucky	11 6 (13 6)[A1]	96	NS	30 (55)[A1]	55 (65)[A1]	55 (65)[A1]	(21,000)[A1 E1]	20,000	(35,700)[A1 E1]	34,000	***30,000 (82,000)[A1]	80,000	5%
Louisiana	13 6	96	NS	60	65	(65)[A1]	20,000	20,000	34,000	34,000	80,000	80,000	None
Maine	13 6 (14)[E1]	102 96	45	56 5	56 5	NP	22,000	22,000	38,000	34,000	80,000	80,000	5%
Maryland	13 6	96	NS	55	55 (65)[A1]	(65)[A1]	22,400	22,400	40,000	40,000	73,280	73,280	1000 lb
Massachusetts	13 6	96[B3]	NS	55	NP	NP	22,400	22,400	36,000	36,000	80,000	80,000	None
Michigan	13 6	96	NS	55	55	(65)[A1]	18,000 (20,000)[A1]	18,000 (20,000)[A1]	26,000 (34,000)[A1]	26,000 (34,000)[A1]	G4	G4	None
Minnesota	13 6	96	NS	55	55	(65)[A1]	18,000	18,000	32,000	32,000	73,280	73,280	2,000 lb axle 4,000 lb max
Mississippi	13 6	96	NS	55	55	55	18,000	18,000	28,650 (32,000)[A1]	32,000	57,650 (73,280)[A1]	73,280	7500 lb
Missouri	13 6	96	NS	55	55	55 (65)[A1]	18,000	18,000	32,000	32,000	64,650 (73,280)[A1]	73,280	None
Montana	13 6	102 96	NS	60 (65)[A3]	60 (65)[A1]	60 (65)[A3]	18,000 (20,000)[A1]	18,000 (20,000)[A1]	32,000 (34,000)[A1]	32,000 (34,000)[A1]	76,800 (105,500)[A3]	76,800 (105,500)[A3]	None
Nebraska	13 6	96	NS 40	60	65	65	20,000	18,000 (18,900)[E1] (20,000)[A1]	34,000	32,000 (33,600)[E1] (34,000)[A3]	95,000	71,146 (73,280)[E1] (95,000)[A3]	3% - 5%
Nevada	14	96[B3]	NS	70	70	70	20,000	20,000	34,000	34,000	G5 (129,000)[A1]	80,000 (129,000)[A3]	None
New Hampshire	13 6	96	NS	55	55	NP	22,400	22,400	36,000	36,000	73,280	73,280	None
New Jersey	13 6	96	NS 35	55	55	55	22,400	22,400	34,000	34,000	80,000	80,000	5%
New Mexico	13 6	96 (102)[A1]	NS	65	65	65	21,600	21,600	34,320	34,320	86,400	86,400	None
New York	13 6	96	NS 35	55	55	55[C4]	22,400	22,400	36,000	36,000	71,000 (80,000)[A3]	71,000 (80,000)[A3]	None
North Carolina	13 6	96	NS	55	55	NP	19,000 (20,000)[E1]	19,000 (20,000)[E1]	36,000 (38,000)[E1]	36,000 (38,000)[E1]	76,000 (79,800)[E1]	76,000 (79,800)[E1]	5% 1,000 lb single 2,000 lb tandem
North Dakota	13 6	96 (102)[A1]	NS	60 (65)[H1]	60 (65)[H1]	(65)[A1]	18,000 (20,000)[A1]	20,000	32,000 (34,000)[A1]	34,000	G6 (105,500)[A1]	80,000	None
Ohio	13 6	96	45	60	65	65	20,000	20,000	34,000	34,000	80,000	80,000	1,000 lb
Oklahoma	13 6	96 (102)[A1]	NS	65	65	65	20,000	20,000	34,000	34,000	90,000	80,000	None
Oregon	13 6	96[B2]	40	60	65 (75)[A1]	65 (75)[A1]	20,000	20,000	34,000	34,000	76,000 (105,500)[A4]	76,000 (105,500)[A4]	4,000 lb 1,000 lb
Pennsylvania	13 6	96	NS	55	55	NP	22,400	22,400	36,000	36,000	73,280	73,280	3% if under 73,280
Rhode Island	13 6	102	NS 40	55	55	NP	22,400	22,400	36,000	36,000	80,000	80,000 (88,000)[G2]	None
South Carolina	13 6	96	NS	55	55	NP	20,000 (22,000)[E1]	20,000	36,000 (39,600)[E1]	32,000 (35,200)[E1]	73,280 (80,600)[E1]	80,000	10%
South Dakota	13 6	96	NS	65	65	65	20,000	20,000	34,000	34,000	95,000	80,000	1,000 lb
Tennessee	13 6	96	NS	55	55	NP	18,000	18,000	32,000	32,000	73,280	73,280	None
Texas	13 6	96	NS	65	65	65	20,000	20,000	34,000	34,000	80,000	80,000	(Use 5%)
Utah	14	96	45	65	65	65	20,000	20,000	34,000	34,000	80,000 (105,000)[A3]	80,000 (105,000)[A1]	None
Vermont	13 6	102 96	NS	55	55	NP	22,400	22,400	36,000	36,000	73,280	73,280	5%
Virginia	13 6	96	NS	55	55	NP	20,000 (21,000)[E1]	20,000	34,000 (35,700)[E1]	34,000	76,000 (79,800)[E1]	76,000 (79,800)[E1]	(Use 5%)
Washington	13 6	96	45	65	65	65 (70)[H1]	18,000 (20,000)[A3]	18,000 (20,000)[A3]	32,000 (34,000)[A3]	32,000 (34,000)[A3]	72,000 (105,500)[A3]	72,000 (105,500)[A3]	2,000 lb 500 lb
West Virginia	12 6 (13 6)[A1]	96	NS	50 (55)[A1]	50 (55)[A1]	NP	20,000	20,000	34,000	34,000	65,000 (80,000)[A1]	80,000	5%
Wisconsin	13 6	96	35[C1]	55	55	NP	11,700 (19,500)[A1 E1]	11,700 (19,500)[E1]	19,200 (32,000)[E1]	19,200 (32,000)[E1]	43,800 (73,000)[A1 E1]	69,350 (73,000)[E1]	3,650 lb 1,500 lb
Wyoming	14	96 (102)[A1]	NS	75	75	75	20,000	20,000	36,000	36,000	101,000	80,000	None

LEGEND

A1 – On designated highways.
A2 – During designated seasons.
A3 – With regular permit.
A4 – By fuel crisis proclamation.
NS – Not specified or not restricted.
NP – Not permited.
** – Alaska has no interstate highways.
*** – Class B highways.
B2 – 100 inch across tires.
B3 – 102 inch across tires.
B4 – 102 inch including safety items.
C1 – Semitrailer length measured from extreme rear of tractor chassis to rear of semitrailer.
C2 – Semitrailers in excess of 40 feet permitted if kingpin to rear axles of semitrailer does not exceed 38 feet.
C3 – Combination of 65 feet allowed provided kingpin to rearmost axle of semitrailer does not exceed 39 feet.
C4 – Except NYC and Suffolk and Nassau Counties.
C5 – Not restricted to 40 ft. if overall length limit of combination not exceeded.
D1 – 35 if 2-axle, 40 if 3-axle.
E1 – Numerical value includes tolerance.
F1 – With load.
F2 – 4 tires per axle.
G1 – One tandem axle load of 32,000 lbs. per combination less than 5 axles. Two tandem axle loads of 32,000 lbs. each per combination with 5-axles provided GCW not over 73,280 lbs.
G2 – 3-Axle truck plus 3-axle full trailer within 50 feet overall length.
G3 – 64,000 lbs + steering axle wt. (assumed 9,000 lbs.)
G4 – Limited by axles – 139,000 lb. max. calculated 80,000 lb. max. for 5-axle combination.
G5 – Formula yields 106,000 lbs. for 8-axle combination.
G6 – W = 750 (L + 40)
L = ⩾ 18 ft
H1 – Stinger.

[1] Gross combination weight. [2] Gross axle weight.
Source: Truck Trailer Manufacturers Association.

require a bond to insure payment. Most States have some form of registration fee, some impose property and other taxes on motor carriers and/or miscellaneous fees. Not only does the amount paid vary from State to State but the recordkeeping and paperwork proliferate for the operator.

Federal taxes include user-charge taxes on fuel, lubricating oil, vehicle use, new trucks and trailers, parts and accessories, tires, tubes,

Table VI.8
Partial Tabulation of State Taxes, Fees, and Regulations

State	Registration: Basis			Compact Participation	Fuel Tax				Third Structure			Utilities Commission	
	Tractor	Trailer	Cost Typical Combination		Report Req'd of	Rate ¢/Gal	Bond Req'd. $	Filing Reg.	Nature	Applies To	Carriers Filing	Insurance Req'd	Resident Agent Req'd.
Alabama	GVW	FF	$ 800	MSR	>2 AX	8	1,000	Q			R	25/100/10	–
Arizona	FF + GVW	FF + GVW	523	WSP	D	7	500	M	GR	For-Hire	R E	25/100/10	Y
Arkansas	GVW	FF	802	–	>30 G	9.5	500	M			R E	25/100/10	Y
California	FF + GVW	FF + GVW	474	WSP	All	7	Yes	M			R E	100/300/50	Y
Colorado	EW	FF	56	WSP	>20 G	7	100/v	M	Mile	All	R E P	25/50/5	Y
Connecticut	GVW	FF	555	–	>2 AX	10	1,000	Q			R E	25/50/5	Y
Delaware	GVW	GVW	362	–	>2 AX	8	1,000	Q			–	10/20/5	–
Florida	GVW	FF	472	MSR	>50 G	8	–	–			R	10/20/5	–
Georgia	GVW	FF	700	MSR	>2 AX	7.5	–	Q	Retal	Versus	R E	25/100/5	Y
Idaho	GVW	FF	102	WSP	>20 G	8.5	500	Q	Mile	All	R E	–	–
Illinois	FF + GVW	–	1,492	WSP	>20 G	7.5	Bulk	Bulk	–		R E	20/40/5	Y
Indiana	GVW	–	486	WSP	>2 AX	8	1,000	Q	–		R	25/100/10	–
Iowa	GVW	GVW	1,220	WSP	>30 G	8	500	M	–		R E	25/50/10	Y
Kansas	GVW	GVW	1,070	WSP	>2 AX	8	1,000	Q	–		R E P	Evidence	Y
Kentucky	GVW	FF	771	MSR, IRP	>2 AX	9	1,000	Q	–		R E	10/30/5	–
Louisiana	GW/AX	FF	570	MSR	>30 G	8	500	M	–		R E	25/10/10	Y
Maine	GVW	FF	605	–	>2 KGW	9	–	Q	–		R E	20/40/10	Y
Maryland	GVW	EW	455	MSR	>2 AX	9	–	M/Q	–		–	–	–
Massachusetts	GVW	FF	390	–	>20 G	7.5	–	Q	–		R E	–	Y
Michigan	GVW, AG	EW	590	MSR	>25 GC	7	–	M	–		R	100/300/50	–
Minnesota	GVW	FF	1,063	WSP	>2 AX	7	3,000	M	–		R E	50/200/15	Y
Mississippi	T + GVW	T + FF	832	MSR	>24 KGW	10	1,000	Q			R	100/300/25	–
Missouri	GVW	FF	1,008	MSR, WSP, IRP	>30 G	7	500	M			R E	50/100/10	–
Montana	FF + GVW	FF + GVW	771	WSP	D	9	500	M	GR	For Hire	R	25/100/10	–
Nebraska	GVW	FF	812	WSP	>30 GC	8.5	1,000	M	Retal	Versus	R E P	Evidence	Y
Nevada	EW	EW	132	WSP	D	6	500	Q	EW	All	R P	25/100/10	Y
New Hampshire		–	432	–	D	9	–	Q	–		R	15/30/5	
New Jersey	GVW	FF	544	MSR	>18 KGW	8	–	Q	–		–	–	–
New Mexico	GVW	FF	76	WSP	D	7	1,000	Q	Mile	All	R E	10/20/5	Y
New York	GVW	FF	519	–	>18 KGW	10	–	Q	T-Mile	All	–	25/100/10	–
North Carolina	GVW	FF	724	MSR	>2 AX	9	200	Q	–		R E	25/100/10	–
North Dakota	GVW	FF	971	WSP	All	7	< 20,000	M	–		R	20/5	Y
Ohio	EW	EW	605	–	–	7	–	–	Mile	All	R	25/100/10	–
Oklahoma	GVW, AG	FF	634	–	All	6.5	500	Q	–		R E	10/25/10	Y
Oregon	GVW	GVW	185	WSP	–	7.5	–	–	Mile	All	R E P	10/20/10	–
Pennsylvania	GVW	FF	560	–	>2 AX	9	–	Q			–	–	–
Rhode Island	GVW	FF	410	–	–	8	–	–	–		R E	25/100/10	–
South Carolina	CAP	FF	514	MSR	D	8	–	Q	–		R E	10/20/5	Y
South Dakota	EW, AG	EW, AG	707	WSP	>40 G	7	Yes	M	–		R E	–	Y
Tennessee	GVW	FF	878	MSR, IRP	>26 KGW	8	500	Q	–		R E	10/20/5	–
Texas	GVW	FF	737	IRP	D	6.5	500	M	–		R E	25/100/10	Y
Utah	GVW	FF	465	–	D	7	100	M	–		R E	25/100/10	Y
Vermont	GVW	FF	1,659	–	–	–	–	–	Retal	Versus	–	–	–
Virginia	FF + GVW	FF	662	MSR	>2 AX	9	–	Q	–		R E P	20/40/5	–
Washington	FF + GVW	FF	742	WSP	D	9	500	M	–		R E	25/100/10	–
West Virginia	GVW	FF	590	MSR	>2 AX	8.5	–	Q	–		R E	10/20/5	Y
Wisconsin	GVW	FF	962	–	>20 G	7	–	–	Retal	Versus	R E	15/30/10	–
Wyoming	EW	EW	60	–	–	7	–	–	Comp	All	R E	25/50/5	Y

LEGEND:

GVW – Gross vehicle weight
EW – Empty weight
FF – Flat fee
GW/AX – Gross weight/axle
AG – Age
T – Tag
CAP – Load capacity
MSR – Multistate reciprocity
WSP – Western states proration
IRP – International registration

Q – Quarterly compensatory
M – Monthly
GR – Gross receipts or operating revenues
Mile – Mileage tax
T-Mile – Ton-miles tax
Retal – Retaliatory versus States Taxing own trucks
>2 AX – All with more than 2 axles
>XX G – All with more than XX gal in tank entering
>XX GC – All with more than XX gal capacity
>XX KGW – All over XX thousand lb. GVW

R – Regulated (ICC)
E – Exempt
P – Private
Y – Yes
10/20/5 – Liability Single person/ Multiple person/ Property $ x 1,000 Plan

G – Gross
D – Double tire vehicles
Comp. – Compensatory

Source: Report No. FHWA-RD-75-40, "Effect of Current State Licensing, Permit and Fee Requirements," Federal Highway Administration.

and tread rubber. In many cases Federal regulations differ from the States', and in most cases the reporting paperwork is additive to the State-imposed workload.

Trucks and trucking are regulated on a national basis by agencies that include but are not limited to the DOT for safety (National Highway Transportation Safety Administration, Bureau of Motor Carrier Safety, and Materials Transportation Bureau); the Environmental Protection Agency (EPA) for emission and noise; Occupational Safety and Health Administration for worker conditions; and the Interstate Commerce Commission (ICC) for entry, exit, rates, and other economic matters.

The ICC regulates common and contract "for hire" motor carriers with the exception of (a) those operating entirely within one State, (b) carriers of exempt agricultural products, and (c) carriers operating in defined commercial zones of intense trade activity. The nearly 15,000 carriers regulated by the ICC haul approximately 42 percent of the total freight ton-miles. Private carriers—those owned by a company and hauling the goods of that company—are not ICC regulated. Regulated motor carriers are further classified by size (class I, over $3 million annual revenues; class II, $0.5 million to $3 million; class III, less than $0.5 million), by commodities carried (general or special), and by route (regular or irregular).

The ICC controls entry into the market, merger within the market, exit from the market, commodities carried, and rates charged. The ICC does not set freight rates but acts to approve or reject rate proposals made by individual firms or by rate bureaus. Under the Reed-Bulwinkle Act of 1948, rate bureaus are granted immunity from antitrust laws, allowing them to set rates collectively.

The stated goals of rate regulation are that rates must be just and reasonable, compensatory, and neither unduly discriminatory nor preferential. Although ICC regulation of motor carriers dates back only to the Motor Carrier Act of 1935, truck freight rates follow the earlier precedent of rail freight rates in being commodity-by-commodity specific, and are based on a value-of-service philosophy. "Value of service" follows the principle that the value of the commodity shipped and the rate shippers are willing to pay to move that commodity under specific conditions are controlling in rate setting.

In any transaction, two limiting prices may be identified: the minimum price the seller will take for his goods or services and the maximum price the buyer is willing to pay to get them. Under competitive conditions, the actual transaction price usually settles near the minimum related to the seller's costs; without competition the seller may charge the maximum—what the traffic will bear. For high-value goods, the shipper (the buyer) finds that the price of transportation is generally low compared with overall product value and that a major additional transportation cost is the inventory cost of his goods tied up en route or placed at risk if the transportation is unreliable. As a result, the shipper of high-value goods may be willing to pay extra for fast, reliable service. Conversely, a shipper of low-value goods finds that transportation price is a large part of the final price of his product and may be less sensitive to other service factors.

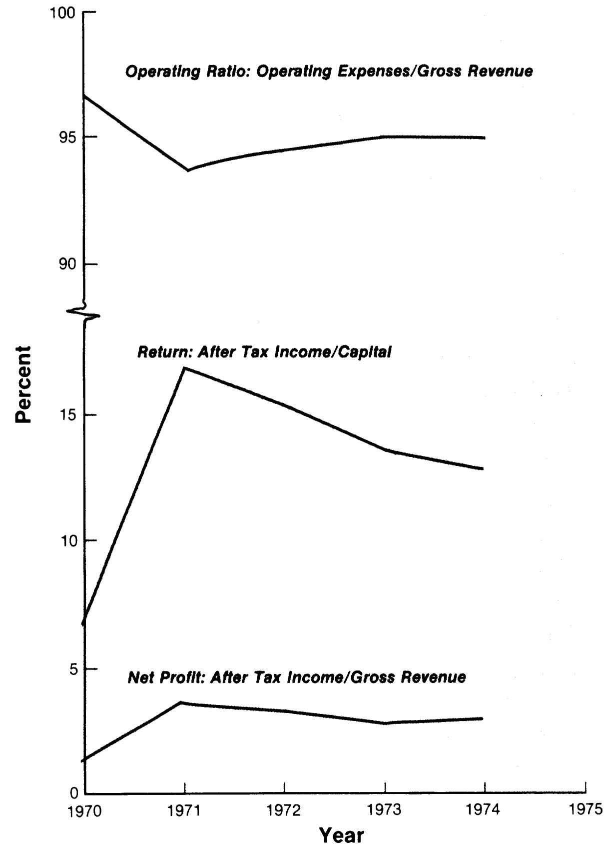
Value-of-service rate-setting makes official and perpetuates on a commodity-by-commodity basis the type of price that would result from a transaction between a monopoly-like seller (carriers represented by the rate bureau) and the shipper. Because commodities are defined—and subdefined—in great detail and because tariffs are set on a point-to-point basis, the collected truck freight tariffs are extremely voluminous and intricate, so much so as to have reportedly resisted computerization. A movement away from value-of-service pricing and toward cost-based pricing would greatly simplify the rate structure and have substantial benefits. One way this could be done (and this has been recommended by the Department of Transportation) would be to prevent carriers from agreeing on rate levels, thus leading to price competition.

Another aspect of the current highly complex rate structure is cross-subsidization. While, in total, the truck freight industry revenues have been adequate to cover costs with a fair return on investments, there is no assurance that the revenue from any particular shipment will cover all its costs or that revenue from another shipment may not be compensating for losses (cross-subsidizing) of the first. One form in which cross-subsidization takes place is between different sizes of shipment. Currently, small shipments are regarded as less profitable and larger shipments may be highly profitable.

One result of the regulated for-hire truck freight rate structure has been the diversion of substantial amounts of traffic away from common carriage to private carriage. This loss of highly profitable traffic is now recognized as a principal problem faced by the common carrier sector.

In many cases, the threat of competition from private carriage provides a practical "cap" to regulated tariffs. However, unless the shipper is very large, his private trucks sit idle much of the time and make many empty backhauls so that the private hauling costs per ton-mile actually moved are significantly higher than costs per ton-mile of a large common carrier. Value-of-service pricing tends to discriminate against shippers both by commodity and by size.

Agricultural products are exempt from ICC regulation and many farm-to-market cargoes move in farmer-owned trucks. Owner-operated trucks, some "gypsies" who virtually live in their trucks, conduct a lively business in exempt commodities and strike individual bargains with shippers for each cargo in the classical free-market tradition.



Source: 1975 Financial Analysis of the Motor Carrier Industry, *First National Bank of Boston.*

Figure VI.21. Trucking Industry Performance. (General Freight Carriers with Revenues over $500,000)

Industry Performance

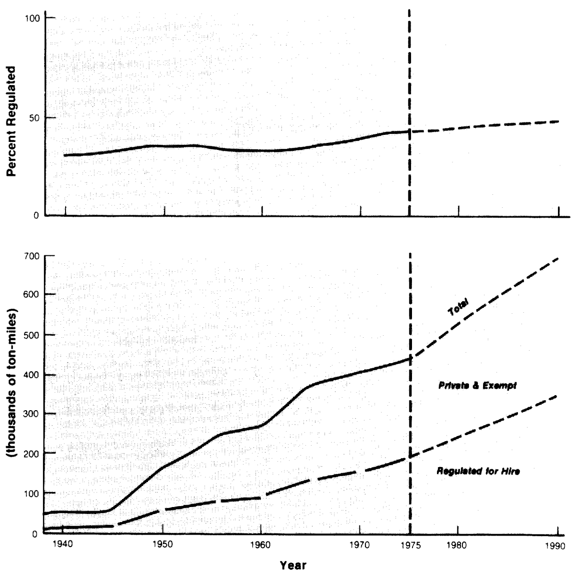
Since the major capital investment in the highway system is made by the Government and much of the user charges thereon are paid by non-truckers, no complete indicator of trucking industry financial performance is available. Return on direct trucking investment, shown in figure VI.21, and operating ratio—the ratio of operating expenses to gross revenue—are frequently used indicators.

The industry operating ratio has tended to be in the mid-90's for a thin margin of profit sensitive to small variations in expenses or general economic conditions. The trucking industry did relatively well in 1971 through 1974, but 1975 was a difficult year.

Class I and class II carriers (about 15 percent of the total number of regulated carriers) generate nearly 90 percent of the industry revenue. Independent truckers—often single-truck owner-operators—operate with the thinnest profit margins and may remain viable only by dint of long hours spent in maintenance and administration beyond actual driving time. The independent operator may contract directly with shippers to haul exempt agricultural commodities or haul under lease for regulated firms. In the latter capacity, the independent truckers serve to limit the investment required for the class I and II carriers—in good times they can lease additional independent equipment which in poorer times they need not be burdened with. The independent trucker lives a precarious economic life.

More than half of all intercity truck ton-miles shown in figure VI.22 are not ICC regulated, being either haulage by private carriers or the carriage of exempt livestock, fish, agricultural, and horticultural products.

As noted earlier, private trucking operations tend to be more costly than for-hire operations. Figure VI.23 shows results of one loadmeter study in which trucks stopped were characterized by regulatory class and either as empty



Source: Transportation Facts and Trends, 1975, *Transportation Association of America.*

Figure VI.22. Intercity Truck Regulations.

or loaded. Despite some possible data limitations,[3] the results indicate that private, not-for-hire trucks move without payload more often than for-hire trucks. Despite the higher costs of private trucking, many shippers and manufacturers have opted for it. When asked why they have become private carriers, shippers overwhelmingly responded that the reasons were a combination of price and/or quality of service which they could not get from regulated carriers.

A survey of large industrial shippers located in major metropolitan areas is a source of information on why shippers use trucks. This study indicates that this type of shipper is relatively satisfied with the quality of truck freight haulage in the aggregate (private and for-hire combined), as shown in figure VI.24. The high level of satisfaction is not surprising since trucks usually provide more rapid and reliable service than the other surface modes. Overnight service for distances up to roughly 400 miles is possible on truckload (TL) shipments where terminal delays are very small. Ontime reliability is also higher (especially for private carriers), and en route losses, through damage or theft, are lower than on other surface modes. Less is known about shipper satisfaction with less-than-truckload (LTL) service. It is generally believed that LTL service to major metropolitan areas is satisfactory, but that service to small or isolated communities is less satisfactory.

LTL shipments are usually handled by the larger regular-route motor carriers who make regularly scheduled trips to a number of points. The carrier may provide local pickup and delivery service at either end and will have terminal facilities for sorting and consolidation at major origin and destination points. The LTL shipment thus carries an "overhead" of two pickup-and-delivery operations, two or more terminal handling operations, and a considerable volume of bookkeeping to keep track of the shipment piled on top of the line-haul cost. For the average LTL shipment, this overhead amounts to about 40 percent of the total cost but for short distances and very small lot size, the overhead may comprise most of the cost, accounting for the sharp rise at short distance on figure VI.25.

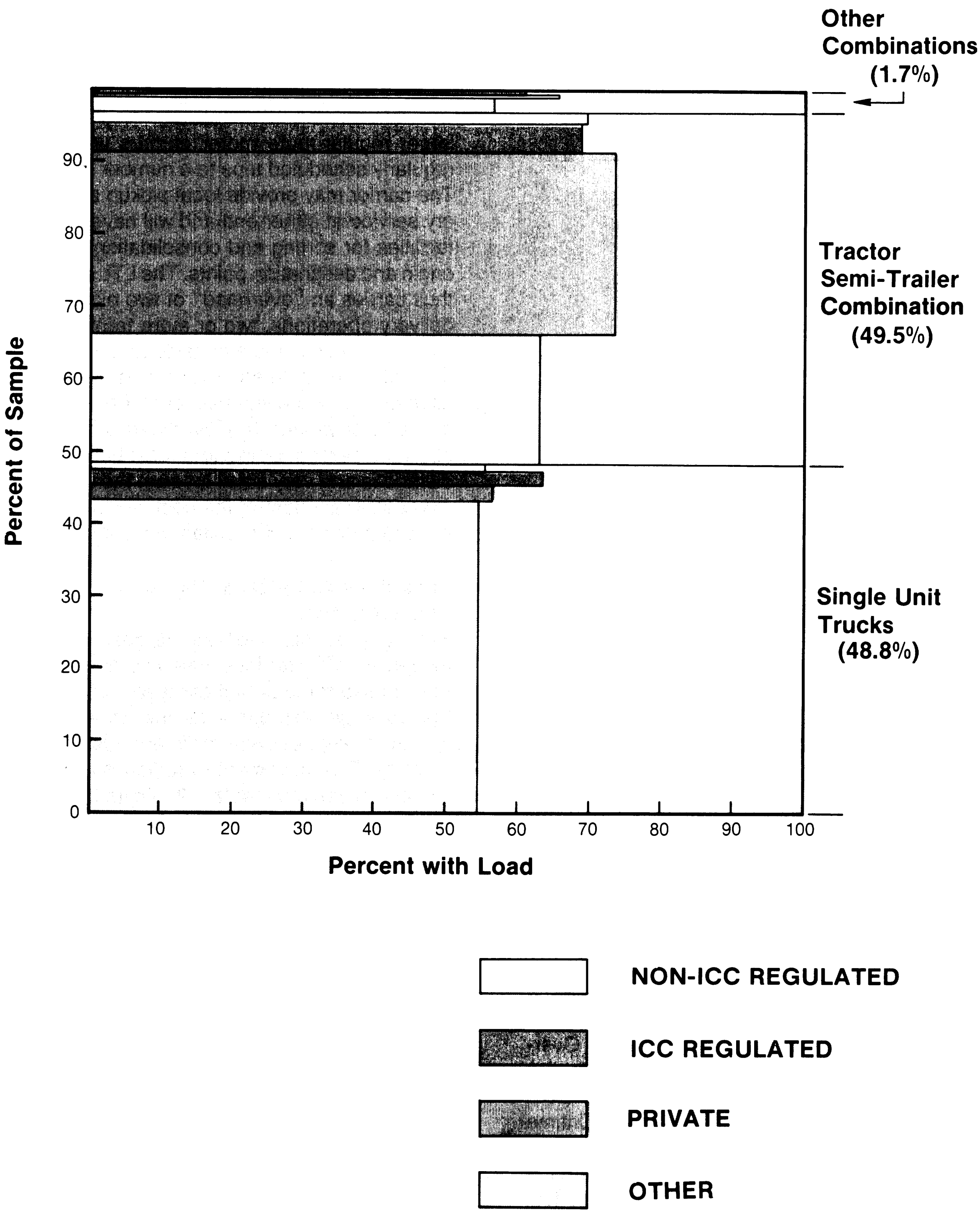
Hazardous Materials in Highway Transportation

Highways account for the largest vehicular movement of hazardous materials. Not only are trucks used for line-haul carriage, but many of the package shipments by the other modes involve pickup, delivery, or intermodal transfer by truck. The movement of radioactive materials shown earlier in table II.21 omits this short-haul truck leg.

While urban truck speeds are usually low, the chance for accident during the pickup or delivery of radioactive or other hazardous material involves danger to surrounding traffic and to the residential population. On the Interstate System or other freeways, the road is usually well separated from the residential population, although the danger to other traffic remains. Trucks hauling bulk hazardous material in tanks or pressurized containers are a familiar highway sight and are placarded to indicate the type of material being carried. These placards are intended to provide information to handling crews and more particularly to emergency personnel who might have to deal with the truck in an accident.

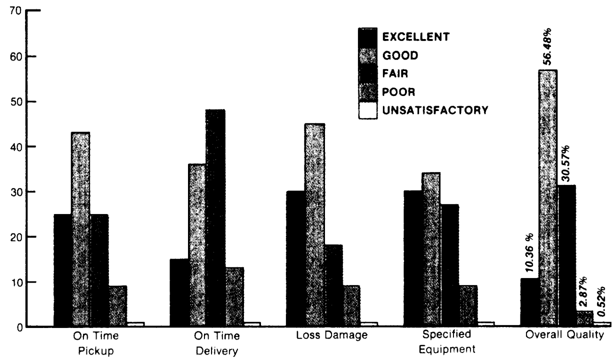
Individual packages of hazardous material carried as part of an LTL-consolidated shipment may be labeled, and their contents will be indicated on a shipping paper. However, when

[3]The data do not show how much load the "loaded" truck carried. No indication is available as to why the truck was traveling unloaded. The sample may have been preselected by excluding lighter trucks and others obviously not requiring weighing.



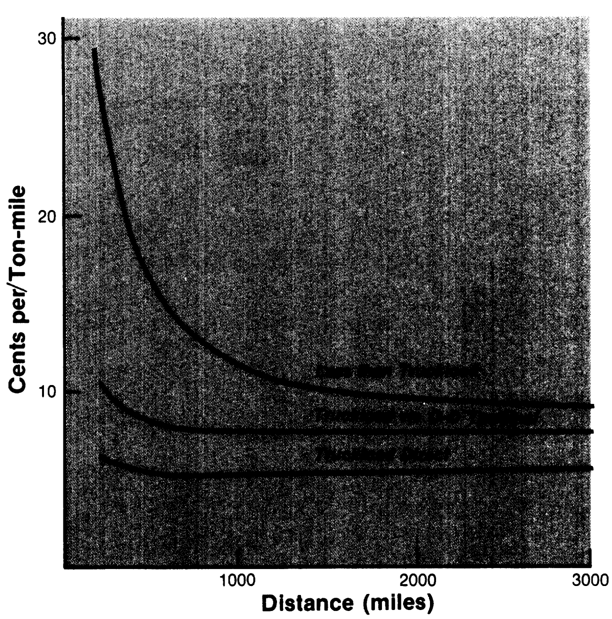
Source: 1972 Loadmeter Studies, *Federal Highway Administration.*

Figure VI.23. Portion of Trucks Carrying Load (1972 Loadometer Study)



Source: Industrial Shipper Survey 1975, *Department of Transportation.*

Figure VI.24. Shipper Satisfaction with Trucking.



Source: U.S. Cargo Transportation Systems Cost and Service Characteristics, *Transportation System Center, Department of Transportation.*

Figure VI.25. Comparison of Trucking Costs.

small quantities are carried, the van itself is not likely to be placarded, and the driver may not be specifically aware of the materials involved except for the notations on the shipping papers he carries. Such situations pose special dangers in the event of an accident since emergency personnel may not be aware of special precautions required.

Measures to improve the overall safety of trucking will enhance the safety of transporting hazardous material. As the volume of hazardous-material movement doubles by 1990, the Department of Transportation will press its program to add to safety in the highway transportation of these materials. The Department will continue to support State adoption of Federal regulations in the interest of efficiency and uniformity. It will increase its efforts to educate shippers, carriers, and emergency-response personnel as well as the general public via the available media. It is anticipated that motor carriers of hazardous materials will be required to formulate and initiate "contingency cleanup" plans analogous to those now required of water carriers.

Truck Issues

The following section discusses several truck-connected problem areas involved in planning for the future, first presenting the set of issues and then the planning recommendations or assumptions that deal with them.

Less-Than-Truckload Shipments. The LTL issue is two sided. The LTL shipper or receiver generally gets poorer service at higher prices than he would get at TL size. If he is located in a small community, he may get infrequent service with choice limited to a single carrier. His problem is compounded by the Byzantine intricacy of the rate structure if the route involves more than one carrier and if the destination is also a small community.

On the other hand, for the carrier, the small, short-distance LTL shipment may be a money loser. One study has indicated that for shipments under 500 pounds, which made up two-thirds of the shipments, the cost-to-revenue operating ratio was 125 percent—costs 25 percent above revenues—while the overall operating ratio for all size shipments was 94.6 percent. Thus, the carrier was cross-subsidizing his small shipments from the large and had an incentive to improve his profit position by cutting back on small shipment service.

There appears to be a movement away from cross-subsidization in the motor carrier rate structure. Actions by the ICC, as well as recommendations by critics of the existing regulatory environment, all point to a reduction, if not an elimination, of this cross-subsidy via some form of rate restructuring.

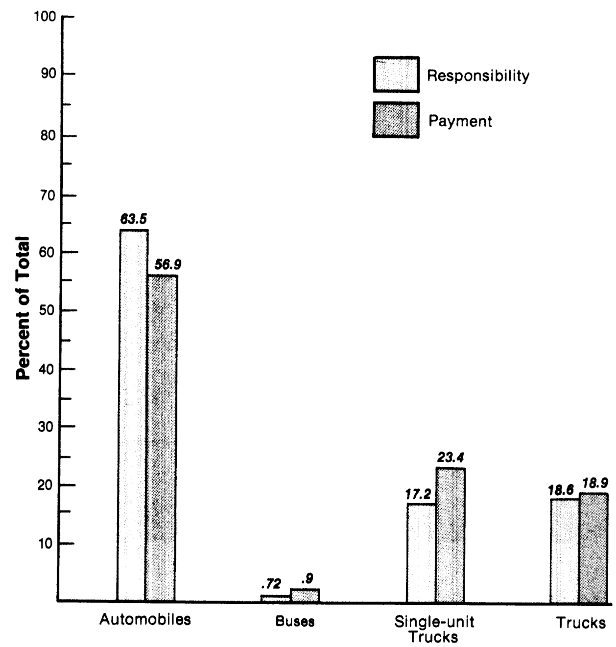
Another current cross-subsidization is between shipments of different value, with high-value shipments cross-subsidizing low-value shipments through value-of-service ratemaking. The loss of high-value shipments to private carriage has reduced the efficacy of value-of-service pricing to motor carriers, and some movement away from it is probably occurring. Under regulatory reform, this movement would be accelerated.

The Cost-Share Issue. A second recurring truck/highway issue is whether trucking pays its share of highway costs. Of course, even if they do, they still enjoy a competitive advantage over rail since (1) there are joint users of the highway who pay part of the total cost of the highway, and (2) trucks pay as they use the facilities, whereas railroads have to make the entire investment prior to using the facility and must continue with repairs and modernization even when traffic is limited.

The cost of construction and maintenance of highways used in interstate truck freight movement comes almost entirely from taxes and fees levied on the various highway users and earmarked for such purposes. Trucks do pay such taxes, on fuel and in a variety of other forms as noted earlier. The issue, then, is whether the share of taxes from trucking compensates for the share of highway costs for which the truck is responsible.

The process of determining cost responsibility is an intricate one. To determine capital cost responsibility of various vehicles on Federal-aid highways, the Federal Highway Administration (FHWA) follows a procedure that in effect "peels back" the incremental costs imposed by vehicles of different weight classes. For six classes of axle weights, the process repeatedly asks how much less it would cost to build the highway if the highest weight class were not present; the cost differences indicate the fraction of the total cost assignable to each weight increment. The heaviest trucks thus take a share of cost responsibility in all six classes, automobiles only in the lightest. The cost responsibility of a specific truck type depends on the number of vehicle-miles assignable to that type under various loading conditions. In addition to axle-load costs, trucks are assessed for the whole cost of facilities required by their presence, such as truck hill-climbing lanes. One foot of the 12-foot freeway lane is charged to all wide (dual-tire) vehicles.

Such cost-allocation studies were made by FHWA in 1961, 1965, and 1970. In 1975, a short study was made with a more complete analysis due later. The 1975 study indicates, as did the earlier studies, that a rough balance among the highway modes does exist for the Highway Trust Fund. It appears from figure VI.26 that trucks, in fact, pay slightly more than their share of the total, and autos, slightly less. In greater detail, it appears that some heavy diesel-powered trucks may be underpaying while some lighter, gasoline-powered units are heavily overpaying. The current studies, as have the previous studies, will result in recommendations for changes in the Federal tax and fee structure to better match payment to cost responsibility.



Source: Cost Allocation Study, 1975, *Federal Highway Administration.*

Figure VI.26. Cost Responsibility and Payment for Federal-Aid Highways, By Vehicle and Type

Cost-responsibility studies are also made by States and likewise result in recommendations for change in the tax and fee structure at the State level. Again a rough balance is assumed to exist, but undoubtedly each analysis indicates some need for change resulting from some detail unbalance. Two points should be noted, however. First, that a nationwide study, as done for the Federal-aid system, does not preclude imbalances among regions, lot sizes, or commodities. Second, that the timelag involved in making cost-allocation studies and eventually legislating rate changes means that any disequilibrium may persist several years and that remedies, when they come, may treat an earlier condition. The private enterprise system, which seeks to maximize return on investment, will tend to concentrate activities where the tax and fee structure are most favorable. Thus, if a particular truck configuration or usage is able to take advantage of a peculiarity of the regulatory or tax structure, it may be exploited heavily before the situation is corrected. Such behavior is, of course, not restricted to trucks or to transportation but is a normal characteristic of any "living" system to grow most where conditions are most favorable.

It appears that, on the whole, the highway tax and fee system is not intended to be tilted strongly in favor of subsidization of truck freight. The correction mechanisms, however slow, do operate to correct imbalances. As stated above, public ownership of the right-of-way, and sharing of that right-of-way with a much larger body of private automobile users, does present an advantage to trucks as compared to private right-of-way ownership by railroads. Truck freight gets the use of a system which it could not afford to build alone, and it pays for the system only as it uses it. The truck operator is not burdened with time-accumulating costs for the highway system. If business slumps and his usage declines, the system does not fall into massive decay because truck contributions to maintenance decline in bad business times. The public sector takes the investment risk and the cushion of automobile-user tax revenues provides stability.

The Truck Size and Weight Issue. Because larger trucks can generally operate at lower cost per ton-mile to the operator, there is a continuing question whether current size and weight restrictions ought to be modified to permit these more economical sizes. Larger truck sizes, however, pose questions of safety, of damage to existing roads, of emissions and other environmental impacts, and of economic impacts including those on competing modes.

The Federal-Aid Highway Act of 1975 authorized States to increase their maximum vehicle weights on Interstate Highways to 20,000 pounds for single axles, 34,000 pounds for tandem axles, and 80,000 pounds (or the so-called bridge formula,[4] whichever is less) for the overall maximum gross weight. However, under grandfather clauses, States may retain their previous regulations. Thus, for those that permitted larger trucks on other roads, the size and weight regulations for the Interstate move up to the new values of the Act. States with more restrictive limits may retain them on the Interstate and elsewhere.

There are several options which various people have proposed for further increase in truck size and weight:

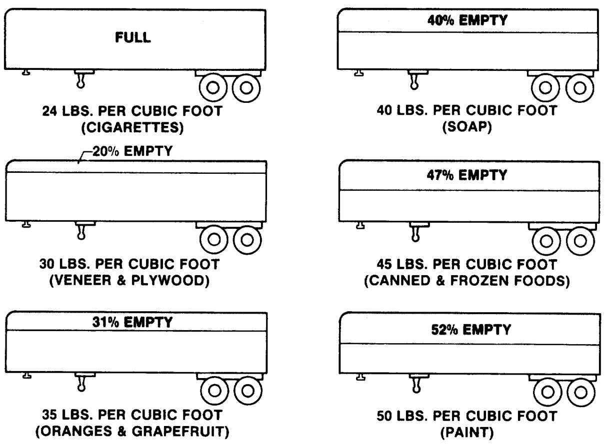
- Increasing length and width without changing maximum gross vehicle weight,
- Increasing maximum gross vehicle weight but retaining maximum tandem axle loads (implying multiple trailers),
- Increasing tandem axle load.

The capacity of a truck may be constrained by either the volume limit of the cargo-carrying space or the weight restrictions on gross weight or axle load. The empty curb weight of a semitrailer rig is generally in the neighborhood of 20,000 to 25,000 pounds, and approximately 4,000 pounds must be added for refrigerated trailers that move perishables. Thus, approximately one-third to one-fourth of the permissible gross weight is tare or non-revenue-producing dead vehicle weight. Depending upon the size of the trailer and the density of the cargo carried, trucks may bulk out (reach the limits of space of the container) before they weigh out (reach the limits of GVW or axle load) or vice versa.

Figure VI.27 indicates how the space and weight limits balance for six cargoes ranging from 24 to 50 pounds per cubic foot using a 35-foot semitrailer with 2,000-cubic-foot capacity under a 73,000-pound GVW limit. It may be seen that for a trailer of that particular length, a cargo of cigarettes will bulk out, whereas a cargo of paint will weigh out. It may also be shown that the 30-pound-per-foot cargo of veneer and plywood will continue to weigh out before it bulks out even when the weight limit is changed from 73,000 to 80,000 pounds, but that more cargo can be carried. Alternatively, while more cigarettes could be carried in a 40-foot van than in the 35-foot one used for illustration, the added length would be of little use

[4] $W = 500\ ((LN/N\text{-}1) + 12N + 36)$, where W = overall gross weight of any group of two or more consecutive axles, L = distance in feet between the extreme of any group of two or more consecutive axles, N = number of axles in the group under consideration.

for other cargoes that have already reached their weight limit. Therefore, the utility of either of the two options for increasing trailer productivity, higher axle-weight limits or larger trailer volume is very dependent upon what cargoes are being carried.



[1]*These ratios will be somewhat changed because of the increased axle weights allowed. Double trailers generate more unused capacity than single trailers.*

Source: Malcolm F. Kent, "The Freight's the Weight," Highway Research Board Proceedings *Thirty-seventh Annual meeting, Jan. 1958, p.35.*

Figure VI.27. 73,000-Pound Gross Weight Loadings in 35-Foot Semitrailers of 2,000 Cubic Foot Capacity[1].
(Tare weight — tractor 14,000 lbs, trailer 11,000 lbs)

The average density of general freight shipment is about 12–1/2 pounds per cubic foot as packaged for transportation. A large segment of vehicle-mile truck traffic could thus benefit from increased volume. However, the dimensions and shape of the existing highway system limit the payoff from larger trailers. Increased height encounters obvious clearance problems with underpasses. Increased length encounters problems in turning radius and in overhang on freeway interchanges and off-freeway intersections. Increased width has limitations in the locked-in-concrete lane widths of the highway system. However, a 6-inch increase from 96 to 102 inches appears to have payoff beyond the simple volume increase. By allowing for slightly more than 8 feet of *internal* dimension, the stacking efficiency of pallets and other packages of standardized 2-, 4-, or 8-foot dimension would be greatly improved. On freeways with 12-foot lane widths, the increase of 6 inches in truck width may be tolerable. Some urban buses now use a 102-inch width. Older streets and highways, especially narrow secondary roads might not be as able to tolerate wider trucks.

All States apply overall length restrictions to trucks. Particularly on two-lane roads, truck overall length is meaningful for safety in passing; on multilane freeways, length up to as much as 100 feet appears to be reasonably safe (see below in discussion of multiple trailers). The limitation of overall length was a prime factor in the evolution of the cab-over-engine tractor design which minimizes nonpayload length. Unfortunately, the design has poor aerodynamics, leading to fuel economy loss; creates problems in weight distribution between steering and pulling wheels; and leads to higher driver fatigue from cramped space. Special wind deflectors are now being added to truck cabs to correct poor aerodynamics of the gap between tractor cab and trailer. The basic blunt shape of the cab-over-engine design is difficult to correct without adding to truck length.

About 30 States, mostly in the West, now permit length up to 65 feet for twin-trailer combinations. The usual rig consists of a standard short tractor with a 27-foot trailer, a towing dolly hooked to the lead trailer, and a second 27-foot trailer mounted to the "fifth wheel"[5] of the dolly. The "twin 27" combination has about a third more cargo space than the conventional 55-foot overall length tractor-semitrailer combination but has better weight distribution and a tighter turning radius.

A few States, including Utah, permit triple 27-foot combinations to operate on designated highways. Table VI.9 summarizes the payload capacity of various configurations of 27- and 40-foot trailers.

Twin 40-foot trailer combinations may operate under special permit on Interstate toll roads in Massachusetts, New York, Ohio, Indiana, and Illinois, forming a nearly continuous east-west route from Boston and New York City to Chicago. The twin 40's do have turning radius problems and are assembled and disassembled in special yard areas adjacent to the freeways. Their use on toll roads gives State authorities ready control over the twin 40-foot traffic. With two 40-foot trailers, the twin 40-foot

[5]"Fifth wheel" is the pivot and circular-bearing plate to which the semitrailer attaches.

Table VI.9
Payload Capacity for Trailer Sizes and Configurations.

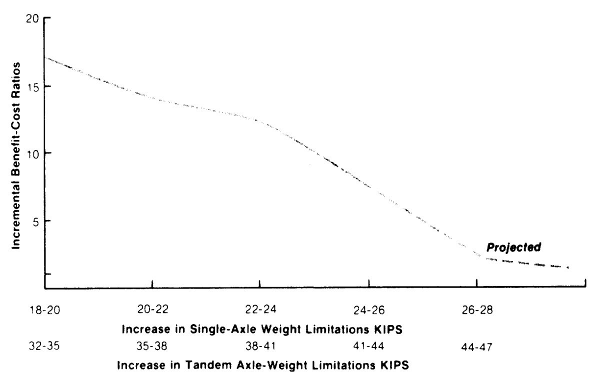
Vehicle Description	Trailer: Length Outside	Trailer: Length Inside	Trailer: Height Inside	Trailer: Width Inside	Combination: Ullage[1]	Combination: Net Cube	Cargo: Tons[2] @ 12 lb/ft[3]	Cargo: Tons[3] @ 18 lb/ft[3]	Cargo: Tons[4] @ 24 lb/ft[3]	Cargo: Tons @ 50 lb/ft[3]
	(feet)				cubic feet					
Semi-Combination[5]	27	26.3	8	7.6	160	1,439	8.7	13.0	17.3	36.2
Semi-Combination[5]	30	29.3	8	7.6	178	1,603	9.6	14.4	19.2	40.1
Semi-Combination[5]	40	39.3	8	7.6	239	2,150	12.9	19.4	25.8	53.8
Semi-Combination[5]	45	44.3	8	7.6	269	2,424	14.6	21.9	29.2	60.7
Doubles-Combination[6]	27	26.3	8	7.6	320	2,878	17.3	25.9	34.5	71.9
Doubles-Combination[7]	40	39.3	8	7.6	478	4,300	25.8	38.7	51.6	107.5
Triples-Combination[8]	27	26.3	8	7.6	480	4,317	25.9	38.9	51.9	108.0
Semi-Combination[9]	45	44.3	8	8.1	165	2,630	15.8	23.7	31.5	65.7

[1]Ullage is unused space in packing due to package shape. [2]"Low Density" according to American Trucking Association [3]"High Density" according to American Trucking Association. [4]Density to match cube and weighout of 40' trailer. [5]The existing "workhorse" of the system. [6]Western doubles. [7]Eastern doubles (turnpike). [8]Utah only. [9]Change to 102" width, ullage computed for 40"x48" pallets.

Source: U.S. Cargo Transportation Systems Cost and Service Characteristics, Transportation System Center, Department of Transportation.

obviously has twice the volume of the single 40, an advantage that may not be usable for all cargoes unless GVW may also increase. The ability to run doubles also allows empty trailers to be repositioned without the dead loss of a completely empty backhaul if the empty can be hooked to a loaded single rig.

Increasing truck weight would benefit those shipments of denser goods, which make up less than half of general freight shipments, but include liquids, steel, machinery, etc., of relatively high value. Increased weight has safety implications in terms of truck handling and bridge structure. The principal factor, however, is not gross weight but the weight per axle or closely spaced pair of tandem axles. Increased axle load directly affects highway surface wear and, for very heavy loads applied over a small area, could actually crush the surface. For the most part, however, a moderately greater load per axle results in an accelerated need for surface repair and bridge reinforcement. A 1967 study by the FHWA examined the cost and benefits of increasing highway axle loads and concluded that the benefits would significantly outweigh the costs. Figure VI.28, taken from that study, indicates a favorable benefit-cost ratio for tandem axle loads up to 44,000 pounds. However, since the time of the study, highway construction costs have inflated, the 55-mph speed limit has altered the benefit value, and other factors may have altered the relationships. FHWA is now actively reexamining the truck size and weight benefit-cost picture and the results of the earlier study are shown here only to indicate that a net benefit in higher axle load *might* exist.

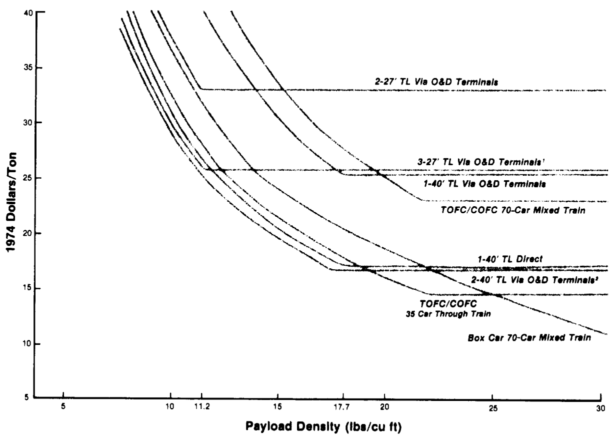


Source: Summary and Assessment of Sizes and Weights Report, *Federal Highway Administration.*

Figure VI.28. Incremental Benefit-Cost Ratios For Increased Truck Axle Weight.

Bridge replacement, because of age and increased traffic loads, is a serious problem for most State highway systems. For the most part, however, this replacement of older bridges is a need associated with older streets and roads, not with the Interstate System or newer non-Interstate freeways. Possible bridge problems associated with increasing truck axle loads on these newer highways would more likely be those of accelerated maintenance or reinforcement rather than replacement. Nevertheless, the potential cost of bridge work needs case-by-case evaluation, and the cost would have to be allocated fully to the trucks, which benefit from the weight increase.

Estimates for the reduced operating cost of various combinations are given in figure VI.29. It may be seen that for a second 40-foot trailer, the costs are reduced by 31 percent. Projecting these potential cost reductions to savings on a national scale will require estimating that portion of the traffic that would take advantage of this expanded cargo capacity.



[1]*One 27' trailer added to 2-27-foot rig.*
[2]*One 40' trailer added to 1-40-foot rig.*
Source: U.S. Cargo Transportation Systems, Cost and Service Characteristics, *Transportation System Center, Department of Transportation.*

Figure VI.29. Preliminary Estimates of Door-to-Door System Costs.

While savings on unit costs are significant, even an immediate legalization of larger sizes and doubles everywhere would not result in an overnight change by truckers or shippers.

Any change requiring new equipment would be unlikely to phase in much faster than the normal industry purchasing cycle. Wider trailers or more powerful tractors to pull higher gross weights would enter the fleet relatively slowly. New truck purchases have averaged about 10 percent of the fleet a year, and equipment retirement has been at about 5 percent a year as the fleet has expanded. Truck life is relatively long and about 40 percent of trucks registered 15 years ago are still on the road.

Conversion to doubles at little or no weight increase might require only the towing dolly as the major equipment purchase and could proceed rapidly from a technical standpoint. However, despite the lower cost per ton-mile, not all shippers would find an advantage in larger volume per shipment. Certainly the shipper who regularly dispatches two trucks a day to a specific destination would readily shift to two trailers in a single combination. But the shipper who now ships single truckloads needs to worry about his and his customers' inventory costs if he doubles the shipment size *and* the time between shipments. If a shipper now sends one truckload directly to the customer, he will see no cost advantage in a double if his shipment must be routed via terminals at the origin and destination ends for consolidation. Figure VI.29 shows nearly identical cost curves for the direct single 40-foot and the twin 40-foot routed via origin-destination terminals.

Roughly 41 percent of truck ton-miles now move on the Interstate System, about 87 percent now move in combinations, and about 37 percent in trucks of weight over 50,000 pounds. Some of this movement is already in doubles. If the above percentages applied simultaneously to indicate prime candidates for a shift to doubles, then something less than 13 percent of all truck ton-miles would be eligible to shift.

Some shift of traffic from rail or waterborne modes to truck might be expected if larger trucks or doubles reduced trucking costs. Because trucks, in certain cases, offer better service at higher cost, the past decisions of shippers to use rail or waterway must be assumed to have been on a cost basis. Therefore, if truck cost is reduced, some shippers would reevaluate that decision. It should be noted, however, that figure VI.29 shows that even twin 40's in direct origin to destination (O-D) service are still more costly than conventional rail boxcar. Any shift would thus be limited to those borderline cases of moderately high-value goods where speed and service are important considerations. In actual cases, however, value-of-service pricing may have so distorted rail, waterway, and truck tariffs that short-term, individual O-D link shifts would be difficult to predict. In the longer term, however, with cost-based pricing in all modes, the lowering of truck costs would be expected to divert some rail or waterway traffic with impacts on fuel consumption, emission, safety, and investment needs as well as direct dollar cost. Thus, resolution of some of the above issues requires a conscious review of public policy to weigh the effect on the rail and water barge modes.

Safety of Larger Trucks. The prospect of increased truck size and weight also raises questions of safety. Larger trucks are generally *perceived* as safety hazards by the motoring public. The facts, as illustrated in figure VI.30, appear to be these: The damage that occurs in a truck accident generally *does* increase with truck weight. Fatalities are slightly higher *per* accident for trucks over 73,000 pounds GVW than for trucks under 73,000 pounds. However, the experience has been that the *number* of accidents per vehicle-mile is lower for double and heavy trucks than the average for all combination trucks (possibly because of greater driver experience as noted above, and possibly because doubles are usually permitted only on the freeways that can safely accommodate them). Because of the larger load per truck, the accident rate and the fatality rate per ton-mile are significantly *lower* for doubles than for trucks in general.

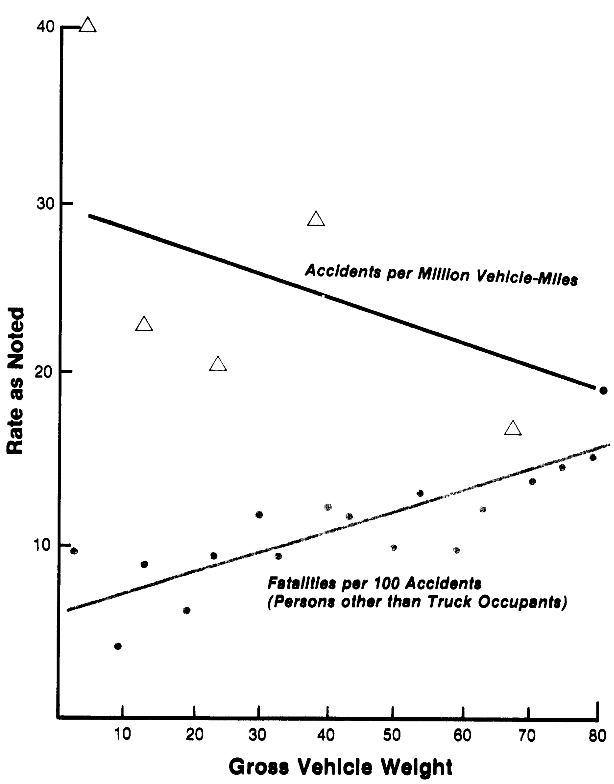


Figure VI.30. Trucking Accident and Fatality Rates.

Splash and spray, and other aerodynamic effects of large commercial vehicles, have been mentioned as annoyances, and perhaps safety problems to private motorists. The common tractor-semitrailer generates two bow waves in the air, one each from the nose of the tractor and from the trailer, and three splash or spray fronts, one from each set of wheels; a double 27-foot combination will have three bow waves and five splash fronts. Such effects are highly sensitive to speed variations and to the shape and configurations of the vehicles involved, but are materially reduced below 50-mph speeds. They are almost totally insensitive to the weights of the vehicles, either as an absolute or a relative matter.

As to the problems of passing a longer vehicle, the safety effect will depend upon what highway is involved. On the Interstate System any reduction in climbing and acceleration ability due to greater weight should make only a small difference because of multiple lanes. In contrast, on an older two-lane road, a heavier and, therefore, slower truck will build up a greater backlog of traffic. On the level, the heavier truck needs more room to build passing speed. For those attempting to pass the truck, the added exposure time to pass and distance traveled in the opposing lane at 50 mph increases from 7 seconds and 610 feet for a 70-foot truck to 8.5 seconds and 740 feet for a 96-foot one.

All other factors being equal, increased axle weights should increase stopping distance, brake component wear, and potential for brake fade. Stopping distances ordinarily increase in a non-linear manner with increasing vehicle weight, in the absence of wheel lock or stability problems. On those trucks where such problems have been the limiting factor in braking effectiveness, similar problems can be expected at higher weights. While the effects of this problem may be reduced somewhat under NHTSA Standard 121, which became effective in January 1975, it should be recognized that it will take many years before the total fleet consists of vehicles conforming to this standard. Larger tires, properly rated for the new maximum weight allowances would of course also be required. Those motor carriers subject to the Federal Motor Safety Regulations have to meet specific safety performance and equipment requirements for braking, tires, and accessories regardless of size or weight.

The empirical data available to date from States where higher size and weight limits are in effect indicate that double and triple combinations have been operating at least as safely as the conventional tractor-semitrailers. The data are limited to over-the-road operations, and not city streets. They tend to bear out the view that it is the quality of a motor carrier's operation rather than the weight or configuration of its vehicles that is the more significant determinant of its safety record.

On balance, it appears that a shift to larger truck sizes need not result in poorer safety but rather could improve safety if high standards of driver proficiency and equipment maintenance were maintained. Nevertheless, the average motorist in 1990, driving a smaller, lighter car for energy conservation, is likely to view the larger and heavier trucks with which he shares the highway as a greater menace than does his present-day counterpart.

In 1976, some truckers fail to obey the 55-mph speed limit and these large vehicles in the high-speed lanes create both a real hazard and a perceived resentment among motorists who do obey the law. Any change to permit larger trucks must be based on strict compliance of truckers with the law.

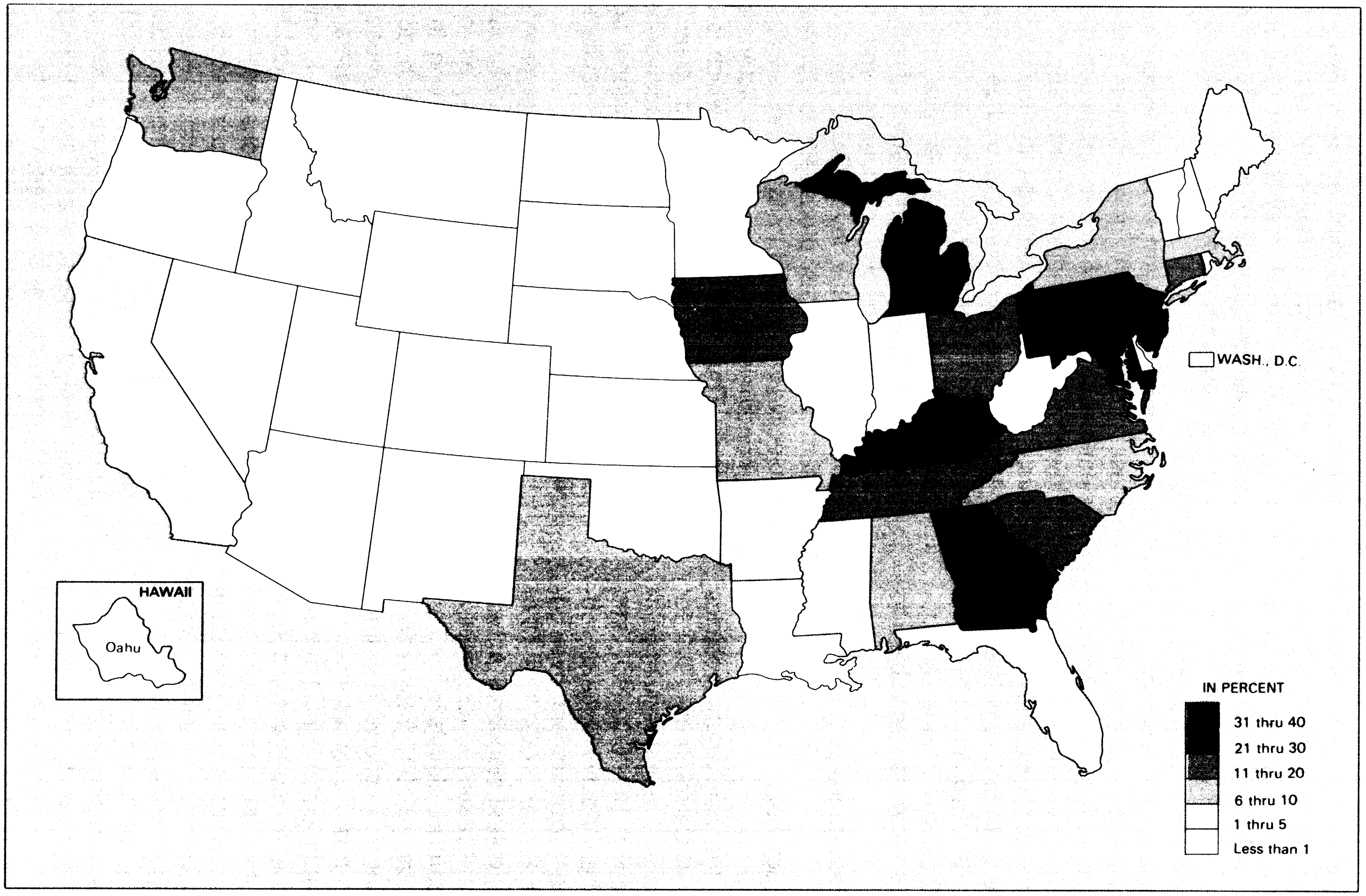
Highway safety is a major consideration in highway capacity. As noted earlier in this chapter, an increasing ratio of trucks to automobiles results in a decreased volume the highway can handle. Capacity-design estimates of the Interstate Highway System include an expected concentration of trucks in the traffic mix. If the proportion of trucks or size of the trucks in the future traffic mix differs significantly from the expected design mix, then the overload problems already discussed may be exacerbated. Figure VI.31 illustrates the impact of doubling the effective truck concentration in terms of the additional miles of Interstate route pushed beyond design volume.

It is necessary then, in considering actions that may enhance the attractiveness of truck relative to other modes, to reevaluate the capacity of the highway system. Those segments indicated as potential overloaded links constitute an additional cost chargeable to the truck-freight mode to the extent that truck traffic causes the overload.

The motorists' perception of capacity may also prove a critical factor to be considered in truck-freight expansion. Since the financial success of the trucking industry is in part a result of its shared use of the right-of-way, the willingness of the private motorist to participate in such a sharing becomes a crucial factor. If the concentration of trucks becomes too high and/or the trucks themselves become too menacing, the motoring public may be unwilling to continue to share.

Segregation. If the perceived truck menace becomes too severe, it may be necessary to consider segregation of truck traffic. Several possibilities appear:

- *Lane Segregation* — Designated truck lanes on existing highways could separate the bulk of truck traffic from automobile traffic. However, since passing capability is needed for both trucks and cars, only an eight-lane design (four each way) would give separation at all times, and extensive redesign of interchanges would be needed to avoid mixing at entry and exit. A six-lane highway now often exhibits "de facto" truck segregation with interaction only for truck passing. No segregation is feasible for a four-lane highway.
- *Timesharing* — A day-night segregation of trucks and autos might take advantage of the strong market for overnight delivery the truck mode enjoys. While it might not be practical to exclude all trucks by day (or all autos by night) from most highways, traffic regulations might strongly favor one or the other and change the rules by time of day. A six-lane highway might designate only the single outer lanes for trucks by day with no truck passing, and by night give trucks the outer two lanes with autos on the single inner lane. Again, interchanges would pose a problem. Exclusive-use lane designation is now limited mainly to urban area bus and carpool lanes for encouragement of such multirider travel. Time-variable lanes are now used mainly to shift direction of traffic flow. Improved highway communication systems will extend the capability for selective lane control.
- *Exclusive routes* — Completely separate truck highways could be built and designated. One suggestion has been to pave over abandoned rail right-of-ways for truck use. To do so would deprive commercial trucking of the cost advantages of shared highway use. Nevertheless, if truck freight were to increase very greatly it might be necessary to adopt such measures on very congested routes. Multi-trailer truck "trains" on exclusive right-of-way



[1]Additional interstate rural highway miles loaded beyond design volume by hypothetical doubling truck traffic.

FIGURE VI.31. IMPACT OF HYPOTHETICAL INCREASED TRUCK TRAFFIC[1]

would exhibit many of the characteristics of rail freight and might be considered as a new mode, intermediate between present truck and rail. It does not appear that such a "mode" could compete with trailer-on-flat-car (TOFC) or container-on-flat-car (COFC) over longer distances while a viable nationwide rail system exists. In 1990, any exclusive truck routes are likely to be relatively short, local bypasses.

Pollution. Trucks have a general reputation of being noisy and producing objectionable smoke and odors. The diesel engine, which is more efficient than the gasoline engine for fuel economy, tends to be considerably noisier and emits, in addition to the hydrocarbons (HC), carbon monoxide (CO), and NO_x currently regulated, other substances that may be subject to future regulation:

- Airborne particulates (smoke),
- Sulfate aerosols,
- Polynuclear aromatics, and
- Aldehydes (odor).

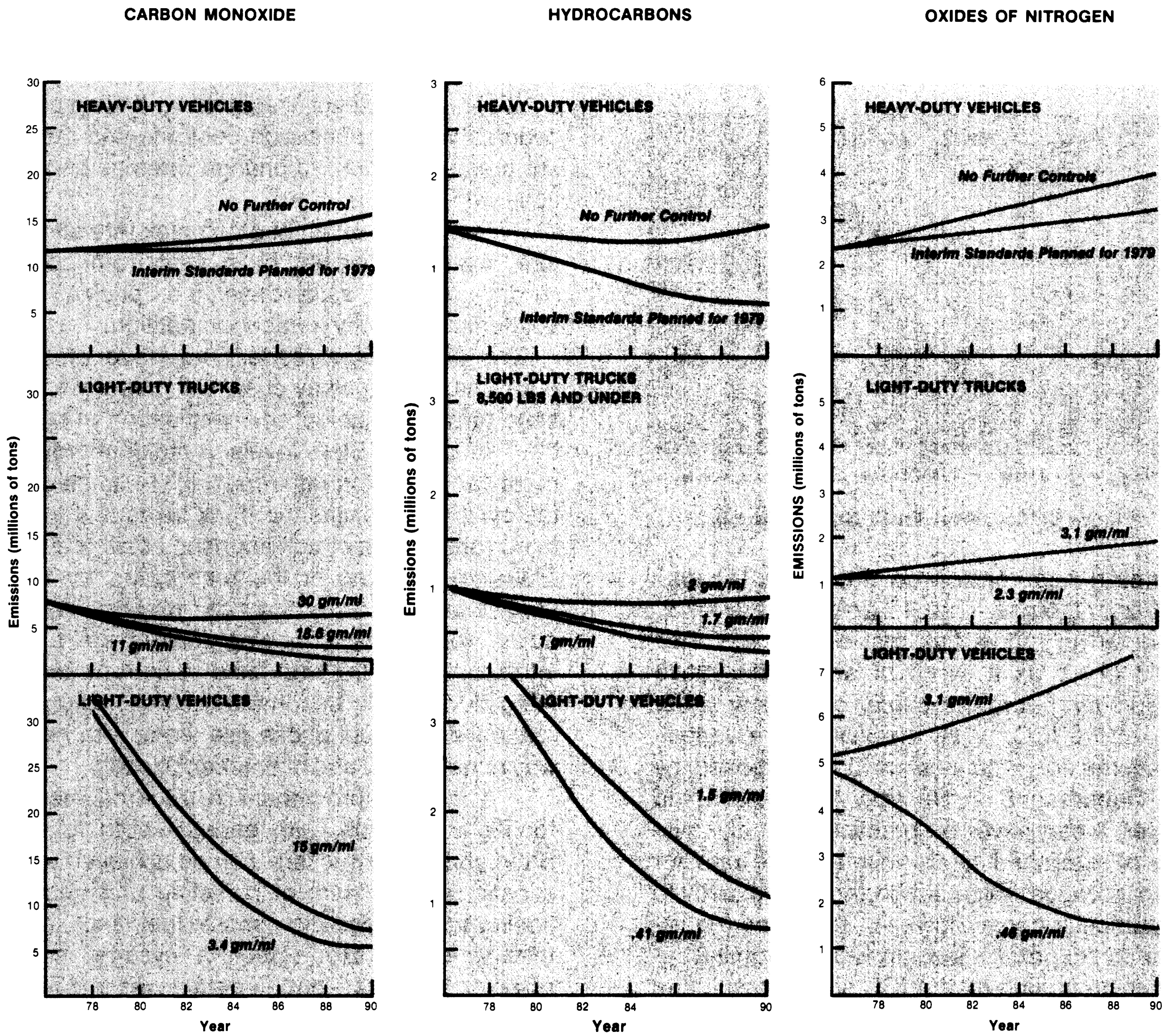
Exhaust emissions for heavy-duty vehicles were first regulated in California in 1969 for gasoline engines and by Federal regulation in 1970. Regulations cover HC, CO, NO_x, and smoke. The original heavy-duty standards represented a very small improvement over uncontrolled levels for HC and CO. The 1974 California and 1975 Federal standards at best represent a 53-percent reduction for gasoline engines and 25 percent for diesels in contrast to 80 percent or better for 1975 interim light-duty standards. Figure VI.32 shows that, if the 1975 standards for heavy-duty vehicles remained unchanged and the statutory standards for light-duty vehicles went into effect as scheduled, we would find by 1990 that trucks (and buses) were contributing more total pollutants than automobiles, despite more than five times the vehicle-miles clocked by automobiles.

Vehicle-miles are not, however, a reasonable basis for comparison among trucks since vehicle gross weight may vary by a factor of 30 or more between the smallest and largest trucks, and engine horsepower may vary over similarly wide ranges. Heavy-duty truck emission standards, therefore, are set in terms of grams emitted per brake horsepower-hour for the engine alone rather than for the complete vehicle. Because final assembly of trucks is done by many smaller manufacturers, often to buyers' specifications, control at the engine-production stage is more practical from an administrative standpoint as well. Nevertheless, engine-based emission standards mean that the heavy truck may legally emit many more times the quantity of pollutants per mile than the automobile with which it shares the road.

The high temperature and pressure in the diesel cylinder tends to give complete and efficient fuel combustion under design conditions. However, these conditions, particularly in relatively lean mixtures, enhance the formation of nitrogen oxide compounds as well as complex hydrocarbon compounds and sulfur compounds from the fuel. Diesel fuel, less "refined" than gasoline, may contain a variety of complex heavier hydrocarbon compounds and may have a higher sulfur level. Odor, largely the result of aldehydes produced, is somewhat subjective with regard to its offensiveness, but is, nonetheless, a recognized characteristic of diesels. Thus, the diesel engine, which is efficient in terms of fuel economy and "clean" as far as CO, HC, and NO_x per horsepower-hour, has its own distinctive set of additional pollutants and tends to be used in installations requiring high horsepower.

Smoke production by diesel engines is a sign of incomplete combustion, usually caused by an overly rich mixture of fuel to air in the cylinder. In some cases, poor mixing in the cylinder leaves rich "pockets" which do not burn fully—a matter of cylinder and head design. A frequent offender with all diesels, and especially with turbocharged diesels, is smoke due to rich mixture during acceleration. Measures to limit acceleration smoke may reduce acceleration—reduce smoke per second but require more seconds to reach speed—and hamper "drivability." A final smoke-producing condition is simply hard pulling as on steep inclines where the engine may be putting out a great deal of exhaust over a limited distance, and the mixture may be somewhat rich.

Highway conditions that require acceleration and/or hard pulling, such as entrance or exit ramps, underpasses, and traffic lights on inclines, often cause every truck in the traffic stream to emit heavy smoke and other pollutants and then tend to trap these emissions in high-pollution pockets. It may not be feasible



Source: Interagency Study of Post-1980 Goals for Commercial Motor Vehicles.

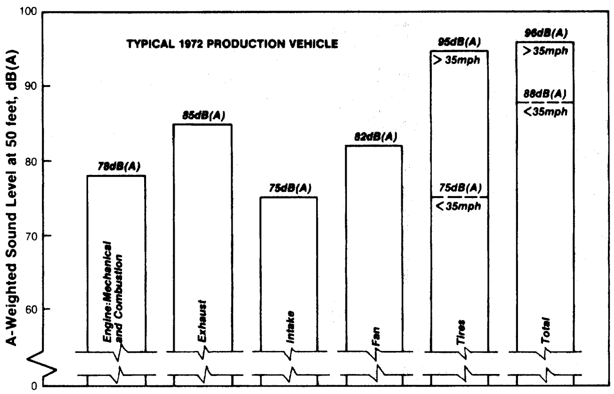
Figure VI.32. Exhaust Emission Projections.

ever to develop and enforce nationwide truck emission standards to eliminate concentration of pollution in such local trapping pockets. Rather, it may be more cost effective to attack the highway condition itself in addition to setting up reasonable vehicle standards.

Noise. Surveys have indicated that traffic noise is a common urban offender and have correlated the level of traffic noise with the number of heavy trucks in the traffic stream. Noise, along with pollution, is a frequent environmental objection to proposed highway expansion.

Truck noise arises from many sources such as engine, exhaust, fan, tires, transmission, and cargo, as shown in figure VI.33. While States have had regulations requiring mufflers, before 1975 only California had effective regulation of overall truck noise output.

Since 1975, the EPA has set truck noise standards, and DOT has been enforcing the standards pursuant to the 1972 Motor Carrier Safety Act. At highway speeds above 35 mph, tire noise—particularly that resulting from the crossbar tread designs usually used on the driving wheels—tends to dominate. At lower speeds, exhaust noise may be more prominent, but it is important to note that no single source can be indicted as the single truck-noise culprit. Quieting the dominant source results in some overall noise reduction but reveals the next noisiest offender.



Source: Interagency study of Post 1980 Goals for Commercial Motor Vehicles

Figure VI.33. Diesel Truck Noise Sources.

Planning Assumption on the Truck Issues

The LTL Issue. The LTL freight rates can be expected to reflect the cost of shipping. This could occur as a result of an administrative restructuring of motor carrier rates now under way at the ICC, or as a result of the various measures for regulatory reform proposed by the Department of Transportation. As noted earlier, it can never be practicable in any system of published tariffs to make the rate for each individual shipment correspond exactly to its particular costs. However, removing regulations forcing cross-subsidization or administrative restructuring by the ICC should result in a better correspondence of tariffs to costs and, if no other factors were involved, could result in higher tariffs for small shipments and lower tariffs for midsize and large ones.

A variety of other measures designed to eliminate enforced inefficiencies and encourage beneficial competition should result in an overall reduction in trucking costs. Thus, while the small-shipment rates will increase relative to the others, the absolute shipping costs are not likely to change substantially and, in fact, may go down. The various regulatory reform measures proposed include:

- Easing of entry into and exit from trucking markets, which will make it possible for carriers with "one-way" operating certificates to obtain operating rights for a backhaul load,
- Removal of "gateway" restrictions that force meaningless route circuitry,
- Removal of the exemptions of rate bureaus from antitrust laws, thus allowing free market competition in pricing,
- Speedup and simplification of tariff-filing procedures with emphasis on cost-oriented rates but greater freedom to change rates as conditions vary.

The LTL problem of a complex rate structure should be eased by a shift from commodity-oriented value-of-service pricing to cost-oriented pricing under competition.

The Cost-Share Issue. The issue of the truck-share of highway costs will properly continue to be the subject of investigation at both the Federal and State levels. A major improvement can come through reducing the timelag in the cycle that adjusts the truck taxes and fees to current highway truck-imposed costs. Key to reducing such lag is the recognition by the various legislatures of the need for flexibility to adjust for rapidly changing factors such as inflation. A fuel tax rate fixed in current cents per gallon actually becomes a decreasing tax in real dollars as fuel prices rise along with highway construction and maintenance costs.

A major improvement in truck payments for highway costs, with benefits both to the State and to the truckers, can be achieved with a nationwide system of prorating and apportioning truck registration, motor fuel taxes, and third-structure taxes. Such a system might combine both State and Federal taxes and fees into a single filing, operated by States with reciprocity on State taxes and fees. Truckers would benefit from the removal of the burden of paperwork associated with compliance with the many differing State tax systems. States would likewise benefit from reduction of administrative burdens in separately collecting taxes and fees. The recommendation for 1990 includes such a nationwide tax and fee system with rates based on continually revised estimates of truck-imposed highway costs. The Federal Government will take the lead in determination of cost-estimation methodology; States will determine costs applicable to their particular situations.

The Truck Size Issue. Very substantial improvements in fuel economy and overall transportation efficiency can be achieved by moderate increases in truck size and weight and by the introduction of a simplified single nationwide size and weight code. But the economic question of the effect on rail and water barges must be studied closely, and if the problem is resolved, the recommended size and weights shown would feature the following:

- Increased width to 102 inches to allow side-by-side positioning of 48-inch pallets with allowance for truck wall thickness and loading clearance;
- Limits set on trailer and truck cargo box length rather than overall vehicle length to remove the present incentive to sacrifice cab comfort, convenience, maintenance space, and aerodynamics in favor of reduced overall length;
- Increased weights to be introduced only after a transition period to allow for test and highway upgrading where needed;
- Use of double trailers subject to strict safety regulation.

The orderly progression toward greater truck productivity is assumed to take place over the next 10 or more years, with each step preceded by adequate study to insure that benefits will outweigh costs and with means developed to insure that those who benefit pay the costs. A tentative timetable follows:

1978—Completion of Federal study of general benefits and costs including study of the effects on the rail and water modes, with recommendation to the States

1980-82—Opening of the entire Interstate System to doubles, under 65-foot length, at no increase in GVW or overloading—Increased width to 102 feet—Limited increase in use of twin 40's under special permit with strict law enforcement and intensive data collection

1983-85—Completion of additional benefit-cost studies and cost-allocation methods—Increases of GVW for doubles permitted up to present axle load and bridge formula limits on Interstate and other State-designated roads roads—Bridge and surface reinforcement for higher axle loads placed into normal maintenance and rehabilitation cycle; costs paid by large trucks

1985-90—Most of Interstate- and State-designated primary roads opened for modest axle-load increase as recommended by the studies—Twin 40's in greater use but still by special permit under strict control.

At each step, as stated above, however, all decisions on truck size and weight must consider the safety factor, the environmental factor and the impact on competing modes, especially rail and waterway.

The Truck Safety Issue. Both driver and vehicle safety improvements will be needed to assure a high level of safety with increasing truck traffic and the larger vehicle on the road. Vehicle-related safety improvements to be considered include:

- Increased horsepower/weight ratio for uphill performance to eliminate the hazards of large speed differentials between truck and automobile traffic. Better hill-climbing performance will benefit truckers in improved overall speed in hilly country and will reduce the need for additional highway lanes to accommodate trucks. However, because added power will give a truck top speed well in excess of legal speed limits, it may be necessary to introduce speed governors on higher powered trucks.
- Improved braking beyond the Motor Vehicle Safety Standard (MVSS)-121 requirements, especially as applied to multiple trailer combinations;
- Enhanced underride protection;
- Onboard diagnostics, including low-tire-inflation warning indicators; driver drowsiness alarms;
- Improved splash and spray protection.

Driver-related safety improvements to be considered include:

- Modified hours of service regulations to reduce the hazard of overfatigued drivers on the road; perhaps inclusion of commercial vehicle operators under the Fair Labor Standards Act;
- More stringent driver qualifications and monitoring procedures combined with increased driver training and retraining requirements. Special driver qualifications for very large, multiple-trailer combinations will be needed to continue the good safety record of these vehicles;
- More specific and better enforced driver physical qualification standards;
- Improved State and Federal enforcement combined with added manpower to perform the enforcement tasks.

The Truck Emissions and Noise Issue. Major improvements in truck emissions are required if commercial trucking is not to become the principal polluter in 1990. In the interests of fuel economy and overall efficiency, however, emission standards should not rule out the diesel engine as the principal heavy-duty vehicle powerplant. The authority for setting heavy-duty vehicle standards should remain with the EPA Administrator. The following are recommended as the best feasible standards for the post-1980 period:

- In terms of the present Federal engine test—hydrocarbon, 0.5 grams per brake horsepower-hour (g/bhph); carbon monoxide, 10 g/bhph; oxides of nitrogen, 3 g/bhph.
- The development of new emission test and certification procedures based on vehicle use to be performed jointly with fuel economy testing should be accelerated. The target for truck and bus noise during the 1980's should be 75 dB(A) (decibels (dB), weighted measurement adjusted for human auditory sensitivity) at a distance of 50 feet, including tire noise controls at the best technology level for high-speed noise.

EPA has published new truck noise emission standards of 83 dB(A) for trucks built after January 1, 1978, and 80 dB(A) after January 1, 1982. These are low-speed, wide-open-throttle standards that do not take tire noise into account and are thus most nearly applicable to urban situations. It appears that tire technology, as well as improving engine, exhaust, and noise control technology, will permit the 75 dB(A) standard, urban and rural, for the late 1980's.

Impact on Other Modes. The earlier discussion in chapter V included some of the potential impacts of truck size and weight increases on other modes. Trucking competes with all other freight modes to some extent, with rail, water, air cargo and pipeline. The major concern, however, is with the potential impact of truck size and weight increases on rail revenues and the viability of the rail mode. In general, the total 1990 diversion of traffic and revenue from rail to larger truck is expected to be small—less than 1 percent. For markets not affected by the huge influx of Western coal and for higher value commodities, the local diversion could be considerably greater. In no market, however, does it appear that rail freight traffic volume or revenue in 1990 would be less than in 1975, even allowing for diversion to truck.

If the Nation's railroads were all healthy, then there would be no danger in the prospect of more attractive truck prices. With many northeastern and midwestern railroads in need of Federal support, there is danger that government actions to enhance trucking can impede the recovery of the railroads and prolong the need for government support. The benefits of higher efficiency in traffic shifted within the trucking mode need to be balanced against possible increased rail subsidy costs.

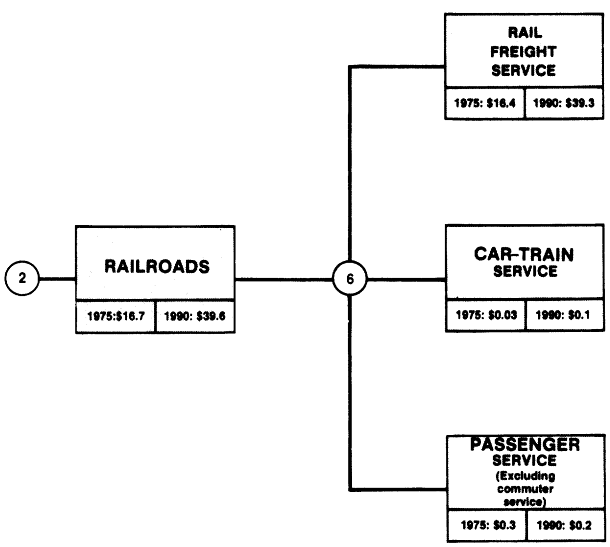
The studies that must precede and accompany changes in truck size and weight limits must include their transmodal impacts. It will be highly important to estimate reliably both the intramodal and intermodal shifts likely to result from each proposed action. The incremental sequence of size and weight increases, proposed above, will permit extensive data collection and analysis at each step.

CHAPTER VII
Railroads

INTRODUCTION

The role of America's railroads in the Nation's transportation system may be seen from table V.1, figure VII.1, and table VII.1. Railroads carry more than one-fourth of the freight tonnage in intercity transportation. In 1975, 2.3 billion tons and 753 trillion ton-miles at a cost of $15.4 billion were shipped by rail. Passenger travel by rail has declined markedly since World War II and is now substantially less than 1 percent of all national passenger travel. The industry employs over 525,000 workers whose average salary is over $14,000 per year.

At this time, parts of the railroad industry are beset with serious financial problems. Since 1955, although revenues have increased 13 percent and ton-miles have increased 23 percent, pretax earnings have dropped 50 percent. Thus, during this period, earnings available for interest on debt, income taxes, and capital expansion have been reduced by one-half. The average rate of return has not exceeded 4 percent in 20 years.



NOTE: The amounts shown are the transportation bills for 1975 and 1990 in billions of 1975 dollars.

Figure VII.1. Transportation Tree.

In 1975 the U.S. railroad industry comprised 58 major railroads (class I) and 435 smaller companies, which are preponderantly owned and operated by private industry. The Federal Government also owns and operates the Alaska Railroad. In addition, there is one federally assisted corporation: Amtrak was created by the Rail Passenger Service Act of 1970 to operate federally supported rail passenger service. There is also a privately owned corporation (ConRail) that received federal loans to rehabilitate freight services. ConRail is helped by the Railroad Revitalization and Regulatory Reform (RRRR) Act of 1976 to insure continuation of service after the bankruptcy of eight railroads in the Northeastern United States.

Operations of the railroad industry are subject to regulations administered and enforced by the Interstate Commerce Commission (ICC). Under ICC rules, all railroad companies are designated as common carriers. Class I railroads are those whose operating revenue exceeds $10 million per year (averaged over 3 years), and these companies represent 99 percent of the industry in terms of traffic, operate 96 percent of the mileage, and employ 93 percent of the rail workers. They are listed in table VII.2. The discussion and data that follow will pertain to these companies only.

Table VII.3 shows the relative dependency on rail freight services of the Nation's various economic sectors. The products of nine industries comprise 78 percent of railroad ton-miles shipped and 71 percent of the revenues. The most important commodity is coal, which represents 26 percent of the tonnage, 20 percent of the ton-miles, and 13 percent of the

Table VII.1
1975 ICC Statistics for Class I Railroads

Railroad	Dollars	Tons	Ton-Miles	Passengers	Passenger-Miles
Freight	15,366,943,740	2,369,145,612	752,815,863,000		
Car-Train	28,454,750			308,662	267,512,317
Amtrak Intercity	206,392,090			13,613,261	3,616,054,278
Other Rail Intercity	96,560,711			59,939,177	1,368,016,879
Total Intercity	15,698,351,341	2,639,145,612	752,815,863,000	73,861,100	5,251,583,474
Amtrak Commuter	6,037,795			3,160,294	137,338,503
Other Rail Commuter	200,021,966			191,776,387	4,375,633,837
Total Urban	206,059,761			194,936,681	4,512,972,340
Total Rail[1]	15,904,411,102	2,639,145,612	752,815,863,000	268,797,781	9,764,555,814

[1]Does not include miscellaneous receipts such as food, rentals, etc.

Table VII.2
1975 Status of Class I Railroads

Railroad	Total Operating Revenue[1]	Total Operating Expense (in thousands of dollars)	Net Operating Income (in thousands of dollars)	Income As Percent of Revenue
1. Duluth, Winnipeg & Pacific	16,127	12,163	3,964	24.57
2. Clinchfield	44,695	34,059	10,636	23.80
3. Chicago & Eastern Illinois	57,730	45,222	12,508	21.67
4. Chicago Illinois Midland	11,057	8,923	2,134	19.30
5. St. Louis Southwestern	174,288	144,029	30,259	17.36
6. Pittsburg & Lake Erie	47,285	39,336	7,949	16.81
7. Richmond, Fredericksbg. & Potomac	28,559	24,160	4,399	15.40
8. Southern Railway System	863,690	753,883	109,807	12.71
9. Denver & Rio Grande Western	148,454	131,067	17,387	11.75
10. Norfolk & Western	985,891	870,594	115,247	11.69
11. Union Pacific	992,029	879,157	118,872	11.38
12. Texas & Pacific	150,192	133,830	16,362	10.89
13. Western Maryland	70,850	63,418	7,432	10.49
14. Illinois Terminal	16,974	15,247	1,727	10.17
15. Chesapeake & Ohio	571,599	518,684	52,915	9.26
16. Bessemer & Lake Erie	76,923	69,175	7,748	8.75
17. Louisville & Nashville	588,854	538,685	50,169	8.52
18. Colorado & Southern	35,543	32,587	2,956	8.32
19. Soo Line	161,155	148,234	12,921	8.02
20. Missouri Pacific	630,873	580,726	50,147	7.95
21. Florida East Coast	42,079	38,763	3,316	7.88
22. Bangor & Aroostook	15,293	14,180	1,113	7.27
23. Atchison Topeka & Santa Fe	1,039,059	969,340	69,719	6.71
24. St. Louis–San Francisco	275,446	259,342	16,104	5.85
25. Fort Worth & Denver	38,437	36,365	2,073	5.39
26. Seaboard Coast Line	637,258	603,160	34,098	5.35
27. Texas Mexican	10,870	10,301	569	5.23
28. Kansas City Southern	128,718	122,280	6,438	5.00
29. Baltimore & Ohio	614,406	585,171	29,235	4.76
30. Burlington Northern	1,320,960	1,266,137	54,823	4.15
31. Detroit & Toledo Shore Line	10, 370	9,967	403	3.88
32. Duluth, Missabe & Iron Range	66,903	64,420	2,483	3.71
33. Maine Central	32,556	31,577	979	3.00
34. Georgia	14,698	14,312	386	2.63
35. Detroit, Toledo & Ironton	44,917	43,865	1,052	2.34
36. Toledo, Peoria & Western	15,251	14,924	327	2.14
37. Southern Pacific Co.	1,257,308	1,231,157	26,151	2.08
38. Illinois Central Gulf	547,450	538,422	9,029	1.65
39. Central Vermont	9,654	9,494	159	1.65
40. Western Pacific	102,932	101,432	1,500	1.46
41. Elgin Joliet & Eastern	80,599	79,599	1,000	1.24
42. Chicago & Northwestern	459,046	463,552	4,506	-0.98
43. Missouri-Kansas-Texas	90,005	93,987	-3,982	-4.42
44. Grand Truck Western	120,112	127,674	-7,562	-6.30
45. Chicago, MILW., St. Paul & Pac.	381,092	406,536	-25,444	-6.68
46. Delaware & Hudson	50,591	54,514	-3,923	-7.75
47. Chicago Rock Island & Pacific	321,571	353,622	-32,051	-9.97
48. ConRail	(2,721,724)	(3,038,382)	(316,658)	(-11.63)
Penna.-Reading Seashore Lines	10,414	17,075	-6,661	-6.40
Penn-Central[2]	2,173,392	2,409,960	-236,568	-10.88
Erie Lackawanna[2]	290,002	323,260	-33,258	-11.47
Reading Co.[2]	136,921	156,454	-19,533	-14.27
Central R.R. of New Jersey[2]	48,054	55,884	-7,830	-16.29
Lehigh Valley[2]	62,941	75,749	-12,808	-20.35
49. Boston & Maine	88,582	99,231	-10,649	-12.02
50. Canadian Pacific-In Maine	9,950	12,729	-2,799	-27.93
51. Northwestern Pacific	11,252	15,577	-4,325	-38.45
52. Ann Arbor	8,630	13,282	-4,652	-53.91
53. Long Island	117,622	243,601	-125,979	-107.10
National Total	16,278,938	15,927,914	352,024	2.16
ConRail	2,721,724	3,038,382	-316,658	-11.63
National Total w/o ConRail	13,557,214	12,889,532	668,682	4.93

[1]*Does not include minor revenue accounts.*
[2]*CLASS I railroads now part of ConRail.*

revenues. Of comparable importance is the food sector, which generates almost the same amount of revenue as coal but with less than one-half the ton-miles. For the most part, these nine industries sell bulk commodities.

For passengers, the intercity rail network extends over 28,000 route-miles in the 48 contiguous States and uses mainlines primarily dedicated to freight. Where passenger trains use lines that also carry freight, it is desirable that freight activity be sufficient to insure the lines are well maintained, yet light enough so that passenger service does not interfere with freight service. Thus, passenger trains gener-

Table VII.3
Relative Dependency on Rail Freight Service of the Nation's Various Economic Sectors

Rail Ton-Miles by Sector Ranked in Order of Decreasing Amounts, 1975

Sector Number	Category	Rank	Ton-Miles (billions)	Cumulative Ton-Miles	Percent Cumulative	Percent Cumulative Revenues
4	Coal Mining	1	170	170	20.48	5.39
8	Food and Drugs	2	93	263	31.69	18.80
10	Lumber and Products	3	82	345	41.57	22.27
1	Agriculture	4	73	418	50.36	37.46
5	Miscellaneous Mining	5	60	478	57.59	44.41
14	Chemicals	6	56	534	64.34	49.12
12	Paper and Products	7	49	583	70.24	52.73
17	Stone-Clay-Glass Products	8	35	618	74.40	56.55
18	Iron and Steel	9	29	647	77.95	59.91
32	Government Enterprises	10	24	671	80.84	61.46
2	Iron Ore Mining	11	20	691	83.25	62.53
19	Nonferrous Metal	12	19	710	85.54	64.11
16	Petroleum Products	13	13	723	87.11	76.00
37	Scrap Sales	14	13	736	88.67	76.72
15	Plastic-Paint-Rubber	15	12	748	90.12	80.19
24	Motor Vehicles	16	12	760	91.57	82.45
3	Nonferrous Mining	17	11	771	92.89	82.92
38	Railroads	18	9	780	93.98	83.37
33	Gross Imports	19	8	788	94.94	83.63
20	Fabricated Metal Products	20	8	796	95.90	85.54
35	Miscellaneous Manufacturing	21	5	801	96.51	87.17
11	Furniture	22	5	806	97.11	87.98
21	Farm Construction Machines	23	4	810	97.59	88.59
22	Industrial Machines	24	4	814	98.07	90.21
7	Ordnance	25	4	818	98.55	90.73
23	Electrical Machines	26	4	822	99.04	92.98
34	Business Travel, Gifts	27	3	825	99.40	93.50
26	Other Transportation Equipment	28	2	827	99.64	93.94
9	Textiles and Apparel	29	2	829	99.88	97.47
27	Scientific-Optical Instruments	30	.2	829	99.88	99.24
13	Printing	31	.7	830	100	99.93
25	Aircraft	32	04	830	100	100

ally run on lines that carry 10 million gross tons or more annually. Amtrak accounts for all but 2,000 miles of the intercity routes, with the Southern Railway System (1,150 miles), Denver and Rio Grande Western (570 miles), and Chicago, Rock Island and Pacific (230 miles) providing most of the rest. In addition, a small number of mixed passenger and freight services are still scattered about the Country. The most notable of these is the Georgia Railroad, which will carry passengers on certain freight trains in order to qualify for preferential State tax treatment. Finally, the Auto-Train™ Corporation operates over two routes, one between Louisville, Kentucky, and Sanford, Florida, the other between Lorton, Virginia, and Sanford.[1]

Any future perspective on the Nation's railroads must take into account the many institutional and financial barriers that inhibit further improvement. So that the issues can be properly addressed and viable solutions suggested, a summary of both institutional and financial problems faced by the railroads is given in the following discussion.

Institutional Structure

Competition. The impacts of competition on the railroad industry are apparent from table V.1. Since 1929, the railroad share of freight traffic has dropped from 75 percent to 37 percent. In chapter IX, it will be noted that improvements of the inland waterways have increased barge efficiency, and since these improvements were made at government expense, the barges can operate at very low cost. The most significant factor, however, has been the inroads of highway shipment on the railroads' preeminent position as carriers of the Nation's freight.

The impact of highways on rail is much like the impact of rail on the existing modes when it was first introduced. Rail provided large transportation capacity at comparatively low cost. At its peak in 1916, thousands of miles of track connected virtually all important sectors of the Country. The majority of people and businesses settled within hearing distance of the train whistle. Access to the railroad was essential to reach the market, and few factories lacked a railroad siding.

This pattern continued until the popularity of the auto stimulated an explosive growth in highway construction. A second beneficiary of this development was the joint user of the highways, the truck.

Not only did the network of highways expand the boundaries of land in use beyond the corridors formerly served by rail, but it also tied these sectors together with highly engineered rights-of-way generally superior to the best railroad mainlines. In addition, the high performance of the highways allowed trucks to become more efficient at the same time that rail lines in many areas were deteriorating and becoming less efficient. This allowed motor carriers to capture nonbulk, high-revenue rail traffic. Even worse for the railroads, reductions in truck costs put a competitive cap on rates.

The shift in modal shares away from rail to other modes has represented an even greater shift in revenues. Although rail transports over 37 percent of total freight, it receives only 20 percent of the revenues. This is consistent with the loss of nonbulk, high-value cargo to trucks.

Additional losses to competing modes of bulk cargo are still possible through the expansion of the waterway facilities and the introduction of coal slurry pipelines. Losses of the high-value cargo could also occur if heavier trucks or larger truck/trailer combinations become more widely used.

Discrimination Regarding Rights-of-Way. The difficult situation for the railroads is compounded by the fact that they own and maintain their rights-of-way. This large investment in rail property makes changes to the system more difficult and less flexible. Whereas in most other modes, public bodies undertake the costs of planning, building, and maintaining rights-of-way, the railroads themselves bear these large fixed expenses. In addition, these properties appear to be vulnerable to discrimination by governmental agencies, since they are classified as utilities in most States. The Association of American Railroads estimated that in 1970 railroads paid ad valorem (assessment on value) tax rates up to 58 percent higher than other commercial property. This amounted to $54 million nationwide for just the discrimina-

[1]In the following discussion, the Auto-Train™ service will be considered as part of the car-train mode.

tory portion. Over 50 percent of ad valorem taxes are paid on rights-of-way. Section 306 of the RRRR Act of 1976 makes it illegal for State or local governments to levy or collect discriminatory taxes on rail property after February 1979.

Regulatory Environment. Numerous regulatory policies have had an adverse impact on the railroads' financial burden, quality of service, and level of efficiency. Not only does this reduce earnings and the funding available for modernization, but the regulatory process also hinders innovations and encourages the retention of outdated practices.

Rate regulation, as it has been applied by the Interstate Commerce Commission and various State agencies, has limited innovative services and pricing flexibility. This has prevented the railroads from responding to the changing transportation market. It has also hindered the establishment of cost-related rates.

The time lag in the regulatory process has often forced continued operations at below cost for extended periods. This has been particularly troublesome during times of inflation. Recent experience in regard to inflation-related increases has shown that the allowed increase is overtaken by further inflation between the time of filing and implementation of the price increase.

Another inequality is that all rail rates are regulated while the same commodity carried by another mode may not be. Schemes to increase efficiency so that rail rates meet those charged by competitive carriers of farm products, for example, have a history of long delays before being approved. Often, the ICC tries to protect the competitive carrier by disallowing or delaying the approval of a new rail service. The result is protection of an exempt carrier, whose rates are not controlled by the ICC.

Balkanization. The fact that railroads own all their operating property tends to give them territorial prerogatives similar to those generally associated with political subdivisions. This phenomenon has been termed "balkanization," since it is similar to many of the characteristics that the Balkan countries exhibited during the early part of this century. In general, each region of the Country is identified with a group of railroads. The most general breakdown is by eastern, southern, and western districts, but further geographical divisions can be identified, such as the midwest granger roads.

This regional ownership has created many barriers to a truly national rail system. Since most of the longer haul traffic requires more than one carrier's line between origin and destination (the average shipment moves on the trackage of more than three railroads), when one railroad performs poorly, the entire system suffers. Too often, railroads view their interest as extending only as far as their property line, even though traffic flows may go beyond. The high proportion of interline traffic leads to complex problems: division of revenues and provision for the use of rolling stock and, to a lesser extent, locomotives. Hence the close supervision normally associated with a well-run operation is less attainable on railroads because of fragmentation. From a historical perspective, the main disadvantage of balkanization may be the discouraging effect it has had on innovative and technological progress.

The regulatory process has inhibited changes in the rail structure through abandonment of uneconomic lines or beneficial mergers to reduce the balkanized nature of the system. Provisions imposed upon mergers or acquisitions are generally made to preserve the status quo, nullifying much of the benefits of consolidation. As in the rate and service areas, regulatory barriers tend to stop many potential mergers before they reach formal proceedings.

Poor Utilization of Plant and Equipment. Nationwide mainline capacity use typically falls in the 40-percent range. This low utilization results in large part from duplicate mainlines. Reducing such duplication would save direct roadway capital and maintenance costs and would probably reduce line-haul circuitry.

While track use is poor, rolling stock use is worse. A typical freight car requires about 24 days between loads and spends only 14 percent of that in a line-haul move (8 percent loaded and 6 percent empty). The rest of the time is spent in yards and terminals. Any reduction in the car cycle would increase the productivity of the industry's freight car investment, which is today at least $15 billion.

Unreliability in the availability of equipment has encouraged some high-volume shippers to purchase their own cars. One development in this area that has been increasing steadily in recent years is car leasing, notably Trailer Train's container/piggyback traffic, and Railbox for general boxcar traffic.

Outdated Practices. Another contrast between the railroads and their competition is the general lack of aggressive marketing in the rail industry.

The industry needs to move carefully to control rail service and reliability so as to capture a greater share of the higher value merchandise traffic. Special tools such as unit trains, bulk distribution terminals, and Trailer On Flat Car (TOFC) services are needed to offer shippers the service they require. Railroads need the support of a cost system and traffic data base for control and to indicate how to gain a larger market share.

Railroad employment has declined over 65 percent in the last 20 years, although total compensation for the remaining 35 percent has nearly doubled. Not surprisingly, labor and management have had difficulties agreeing on the sharing of labor productivity savings.

This has resulted in funding labor retention rather than capital needs. For example, trains have been lengthened to reduce road crew costs per unit of traffic. The resulting reduction in train frequency and loss of reliability appears to have driven traffic to other modes.

A basic public policy question on which the Country needs a decision is this: Given that the Nation is dependent on a viable rail system to transport many commodities crucial to our economy, for which only highly expensive or prohibitively disruptive alternatives exist, then should prospective revenues from future growth go to support the financial stability of the railroads or can they be permitted to go to the financing of new modes such as coal slurry pipelines? The decisions regarding the movements of Alaskan oil and Western coal contain elements of this important public question.

Rail Passenger Operations

The ubiquitous, economical, highly personal automobile, the highly developed intercity bus network, and the high speeds of modern jet aircraft have reduced rail passenger travel to less than 1 percent of the national total. For years, in response to pressure from segments of the public, the regulatory agencies required the railroads to continue unprofitable passenger operations. From the perspective of the rail industry, the situation was resolved in part with the passage of the Rail Passenger Service Act of 1970, which established the National Rail Passenger Corporation, or Amtrak.

As will be seen, many of the Nation's rail passenger problems have yet to be resolved. In general, rail passenger services are not fully paying for themselves. They depend heavily on government support. The deficits include those sustained on commuter service, and losses on the remaining passenger trains provided by the carriers not in Amtrak. These losses from passenger operations between 1963 and 1973 are summarized in table VII.4.

Table VII.4
Passenger Service Deficit

Year	Deficit	
	Solely Related [1]	Total
	(in millions of dollars)	
1963	9	399
1964	18	410
1965	44	421
1966	31	400
1967	138	485
1968	198	486
1969	225	464
1970	252	477
1971 [2]	207	377
1972	179	329
1973	178	339
1974	271	460

[1] "Solely related" expenses are totally ascribed to passenger service, total costs also include the passenger service share of common costs.
[2] Deficit adjusted for Amtrak service initiated in 1971. Transportation Statistics, Bureau of Accounts, ICC.

Source: Yearbook of Railroad Facts, *1976 Edition.*

Financial Situation

Since the railroad industry's costs are largely fixed, its financial performance is more closely tied to ups and downs in the economy than other modes whose costs are more variable. Because profits were not adequate even in the good times, many railroads have not been able to survive economic downturns. The largest number of bankruptcies occurred in the 1930's, when at one point railroads owning one-third of all rail mileage were in reorganization. In the economic downturn of the early 1970's, railroads owning nearly 20 percent of the railroad mileage went into bankruptcy.

Unlike most corporations that enter bankruptcy, railroads have been deemed too essential to the public to be liquidated or physically restructured. Instead, debt structures were reduced or mergers with healthier roads were effected. The transportation demand created by World War II generated enough earnings to bring railroads back to solvency from the 1930's. The earning power of some railroads, as was demonstrated in the Northeast, however, tends to preclude reorganization by conventional means. The Regional Rail Reorganization Act recognized this possibility.

The railroads' rate of return on investment in 1975 was 1.25 percent, the lowest since this ratio has been recorded. The rate of return in 1974, a relatively good year for traffic and revenues, was only 3.44 percent.

Table VII.5 shows the return on net investment by region, with and without the lines absorbed by ConRail (United States Railroad Association lines), for two periods (1974 and the 12 months ended September 30, 1975). Rates are shown both on the former ICC basis and on the basis of recently ordered changes in ICC accounting regulations, conforming more closely to "generally accepted accounting principles (GAAP)."

Table VII.5
Railroad Return on Net Investment

Group	Year 1974		12 months to 9/30/75	
	Old ICC Basis	New GAAP[1] Basis	Old ICC Basis	New GAAP Basis
Eastern District, Excl. USRA lines and LIRR	6.52%	5.30%	4.48%	3.69%
Eastern Total	1.08	0.46	Deficit	Deficit
Southern District	5.69	4.73	4.20	3.76
Western District	4.41	3.66	2.65	2.14
U.S. Excl. USRA lines and LIRR	5.16	4.26	3.40	2.00
U. S. TOTAL	3.44	2.70	1.23	0.77

[1]*GAAP = generally accepted accounting procedures.*

It will be noted that not even the highest return region, the southern, reached the level of 6 percent, far below the prime interest rates that prevailed at that time. No major railroad has had a rate of earnings in any recent year as high as the average rate earned by corporations generally. In 1974, only three large roads enjoyed rates of return of as much as 6 percent.

In comparison with other carriers under ICC regulation, table VII.6 shows that the latter earn three to five times as much as do railroads.

Table VII.6
Rates of Return of ICC-Regulated Carriers
1975 (preliminary)

Carrier	Return On Net Investment (percent)	Return On Equity (percent)
Class I railroads[1]	.8	3.07 (1974)
Motor carriers of property	13.27	13.08
Motor carriers of passengers	7.90	12.21
Water carriers, inland & coastal	15.79	20.18
Pipeline companies	7.66	21.19

[1]*Rates of return for railroads shown here are reduced by inclusion of National Railroad Passenger Corporation (NRPC). Rates excluding NRPC in 1974 were 2.70% on net investment and about 4.8% on equity, calculated on a GAAP basis, including duplications.*

Source: 88th Annual Report to Congress, *ICC* .

Other industries also enjoy rates of return much higher than that of the railroads. According to the First National City Bank of New York, the average return on net worth for leading corporations in 1974 was 12.7 percent. Manufacturing corporations averaged 15.4 percent and mining, 25.0 percent. Public utilities, which are regulated but operate in less competitive markets than do the railroads, averaged 10.4 percent. Railroads averaged 4.3 percent (based on equity at the end of 1973) and stood next to last among a list of 71 corporate groups.

To produce even these relatively low-earning rates, many rail companies were forced to postpone maintenance and reduce service standards. In mid-1975, railroad reports to the ICC showed $2.8 billion in accumulated deferred maintenance. Other estimates place this figure much higher. About $4.2 billion in projected capital improvements was reported as delayed for lack of funds.

Internal cash flow in the industry has been insufficient to provide funds to support capital expenditures actually made in recent years, requiring the roads to draw on working capital, liquidate other assets, increase their borrowings at high interest rates, and turn to lease financing.

Conclusions Regarding the Present Situation

From this discussion, it may be seen that today's network of over 200,000 route-miles neither provides the level of service and productivity the system is capable of producing nor supports a financially healthy private industry. In 1974, despite an all-time record traffic volume in terms of ton-miles, the industry's return on investment was only 3.44 percent while other modes fared far better (table VII.5).

Much of this discrepancy can be traced to the high fixed portion of the railroad investment. The real earning power and the real buying power of the railroad industry has decreased drastically over the past years. Higher levels of investment are required for basic modernization, as well as for daily upkeep. With dollar outlays for expenses purchasing less, deferred roadway maintenance is now in the billions of dollars and a substantial portion of the industry is either insolvent or in marginal condition.

Neither traffic patterns nor available financial resources justify, as of now, a complete rejuvenation of the entire rail network. A high-volume, modern interstate system, however, needs to be established by the industry to supply efficient transportation where traffic densities allow efficient operation. In areas of high freight density, the railroads can provide an enormous volume of transportation at a moderate price and reasonable expenditure of labor, fuel, and capital.

If such a restructured system is to succeed, regional barriers need to be removed and capital productivity improved. Consolidation and restructuring of the Nation's railroads will realize improved capital productivity and establish a better financial base for the surviving carriers. Efficiency can be improved by the sharing of facilities and coordination of operations over the network, both in the road and in the terminals. The burden falls upon railroad management if the railroads are to serve as a private sector industry. As much managerial imagination and audacity will be needed to revitalize the railroads as originally made them great.

ELEMENTS OF THE RAIL SYSTEM

The American railroad system has 200,000 miles of railroad lines with 325,000 miles of track. This network of track is illustrated in the map located in the envelope in the back of the book. The high degree of excess capacity of this network and the fact that extensive segments of track are in need of rehabilitation is discussed in the next section.

With respect to equipment, the fleet of locomotives and rolling stock in use has changed gradually to match the demands of the commodities being shipped. Of the 28,000 locomotives, the great majority are now diesel driven; 210 electric locomotives and 11 steam locomotives remain in use. Table VII.7 illustrates how the stock has changed over the last 10 years. There are 1.72 million freight cars in use. About 6,200 passenger cars, one-tenth the number in 1921, remain in service (including equipment operated by Amtrak and Auto-Train™. On the average, the capacity of freight cars has been gradually increasing to reduce labor costs and better meet rate structures. This growth in size (and tonnage) has in turn accelerated the deterioration of the rail trackage. Table VII.8 provides more detailed data on the shifting mix of freight cars over the last decade. The general relationship between the capacity of these cars—the extent to which they are loaded, and the average freight train load—appears in figure VII.2. With an average lifetime of 28-30 years, the average age of the fleet is 15 years. Sixteen percent of these are leased by the railroads.

Equally important with the mix of the fleet is how it is used to serve rail's primary markets. With what efficiency is the fleet operated, and how is it allocated to the various commodity movements? The first area is explored in the next section. Table VII.9 provides selected details concerning the second, showing how these freight cars are used in the major markets, and what revenues are produced.

TRANSITIONAL ISSUES

From the formidable set of problems outlined in the preceding section, the future of the Nation's railroad industry is highly uncertain, but with the proper public policy, it is our belief that the freight system can be revitalized within 5 to 7 years. A number of remedial actions by the Congress and the Administration have been taken, and although many are in their initial stages and their effects cannot yet be deter-

Table VII.7
Locomotive Units In Service, Class I Railroads

Locomotive Type	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
Steam										
Freight	28	26	24	20						
Passenger	—	—	—	—						
Freight or Passenger	3	3	1	1						
Switching	3	—	—	—						
Steam TOTAL	34	29	25	21						
Electric										
Freight	208	186	201	182	175	127	120	112	112	99
Passenger	137	133	109	106	105	18	18	12	46	46
Freight or Passenger	10	10	10	10	10	118	116	113	81	81
Switching	38	33	24	23	15	13	14	13	13	12
Electric TOTAL	393	362	344	321	305	276	268	250	252	238
Diesel										
Freight	7,564	7,007	6,781	6,682	6,760	6,796	6,746	7,305	7,350	7,895
Passenger	1,824	1,807	1,738	1,666	1,432	1,253	1,173	886	834	502
Multi-purpose	10,582	10,587	11,531	11,900	11,967	12,616	13,036	13,168	13,695	14,075
Switching	7,867	7,708	7,431	7,061	6,858	6,049	5,841	5,543	5,191	5,078
Diesel TOTAL	27,837	27,389	27,481	27,309	27,017	26,714	26,796	26,302	27,070	27,550
Other Types	36	36	36	36	54	43	22	42	42	12
Grand TOTAL	28,300	27,816	27,886	27,687	27,376	27,033	27,086	27,194	27,364	27,800

Source: Transport Statistics of the United States, *issued by the Bureau of Accounts, ICC.*

Table VII.8
Total Revenue-Earning Freight Cars

Freight Cars	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Box Cars										
Plain	464,761	436,163	411,565	394,074	375,668	357,850	340,163	333,607	328,028	321,480
Equipped	126,840	140,877	148,507	162,154	171,237	176,644	181,131	178,329	178,169	173,679
Hopper Cars										
Plain	439,516	430,794	422,558	405,829	399,498	398,199	383,242	365,333	356,626	363,186
Covered	130,181	147,953	153,532	161,068	170,742	179,919	186,219	204,926	219,362	228,265
Gondola Cars	213,722	205,665	205,640	200,414	196,231	192,690	188,713	187,347	186,720	186,773
Tank Cars	173,304	175,640	177,617	180,797	174,749	169,955	162,350	165,309	169,237	170,876
Flat Cars	102,912	108,851	113,213	122,705	128,359	128,711	125,554	132,222	139,186	141,316
Refrigerator Cars	118,362	118,056	115,978	115,844	116,026	111,647	107,023	104,721	104,024	100,815
Stock Cars	19,645	16,877	15,324	12,169	10,477	8,863	6,621	5,307	4,980	4,423
Other Freight Cars	36,941	39,539	38,853	39,601	39,035	37,657	35,921	33,558	32,241	32,792
TOTAL	1,826,184	1,820,145	1,802,787	1,794,655	1,782,022	1,762,135	1,716,937	1,710,659	1,720,573	1,723,605

Source: Yearbook of Railroad Facts. *The Economics and Finance Department, Association of American Railroads, Washington, D.C.*

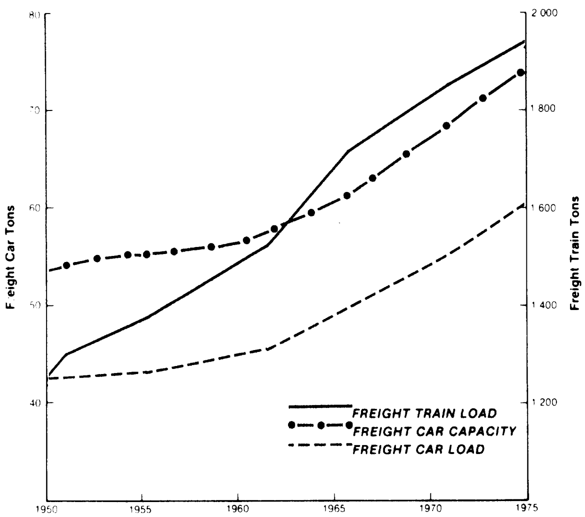


Figure VII.2. Average Freight Load and Capacity.

Table VII.9
1975 Rail Traffic and Revenues by Commodity

Commodity Group	Percent of Total Traffic	No. of Carloads (thousands)	Revenues (millions)
Coal	18	34,814	$14,688
Food and Kindred Products	9	18,115	844
Nonmetallic Minerals	9	16,740	4,829
Farm Products	8	15,850	12,385
Metallic Ores	8	15,571	4,147
Lumber and Wood Products	7	13,910	8,442
Chemical and Allied Products	6	11,007	12,824
Pulp, Paper or Allied Products	5	9,493	7,856
Transportation Equipment	5	9,101	10,102
Clay, Stone, Concrete and Stone Products	4	8,255	5,457
Primary Metals	4	7,138	7,065
Petroleum or Coal Products	4	7,098	4,813
Fabricated Metals	1	2,161	1,876
Electrical Machinery	1	1,584	1,463
Rubber or Miscellaneous Plastics	1	1,536	1,098
Furniture or Fixtures	1	1,459	864
Machinery (Nonelectrical)	1	1,231	1,426
Waste or Scrap Materials	4	6,981	3,062

Source: 1975 Waybill Sample.

mined, they may by 1990 influence operations substantially. The following material develops in more detail selected issues raised earlier, discusses the various prospects and options available, and examines how they might influence the future rail network.

Because rail passenger service is unique and a matter of some public interest, it will be treated first. We will then examine two areas of recent action: the newly reorganized northeast railroads under ConRail and the Railroad Revitalization and Regulatory Reform Act of 1976. (The issue of branch-line abandonment is a matter closely related to the rail network rationalization, but since it is more a problem of State and local concern than of interstate movement, it will be found in chapter XI.) The final transitional issues deal with the potentials for future operating improvements of both equipment and yards.

Rail Passenger Service

Rail passenger services in the United States can be divided into two categories: conventional rail passenger services and car-train. The preponderance of conventional rail passenger service is provided by Amtrak, the National Railroad Passenger Corporation established by Congress in October 1970. Amtrak services have been heavily subsidized by the Federal Government. Car-train services are provided by Auto-Train™, a private profitable corporation. Federal involvement with car-trains has been limited to a financial feasibility study of such services done before the private corporation came into being. The network depicted in figure VII.3 is the current and projected future configuration of the Amtrak and Auto-Train™ service.

Conventional Interstate Rail Passenger Service. Prior to the establishment of the National Railroad Passenger Corporation (Amtrak), the Nation was faced with rapidly deteriorating rail passenger service. The broad market that rail had previously served had been eroded by air carriers for high-speed, long-distance travel, by the convenience of automobiles, and by the economies and coverage of intercity buses. As these competing modes increased service and facilities in their specialized areas, rail patronage decreased to the point where revenues could no longer sustain the former rail passenger network. Declining revenues led to further service cuts. The railroad industry, losing vast amounts by continuing rail passenger services, had made numerous petitions to the

ICC for permission to discontinue rail passenger services.

Congress perceived that a basic rail passenger network would be preserved through a national rail passenger corporation, to be financially assisted through the infusion of Federal funds, and to relieve the Nation's railroads from the burden of providing intercity rail passenger service. The establishment of Amtrak resulted in major cutbacks in rail passenger service, decreasing the number of losing routes and transferring most of the remaining routes to Amtrak. There were hopes that under one management, and with the reallocation of equipment, reduced losses, and the greater revenues which would come from improved service, rail passenger service could be made more viable in a reasonable period of time.

Modern, efficient, intercity railroad passenger service was a necessary part of a balanced transportation system for the following reasons:

- Public convenience and necessity required the continuance and improvement of such service;
- Rail passenger service could help to end congestion on highways and overcrowding of airways and airports; and
- The intercity traveler should, to the maximum extent feasible, have freedom to choose the mode of travel most convenient to his needs.

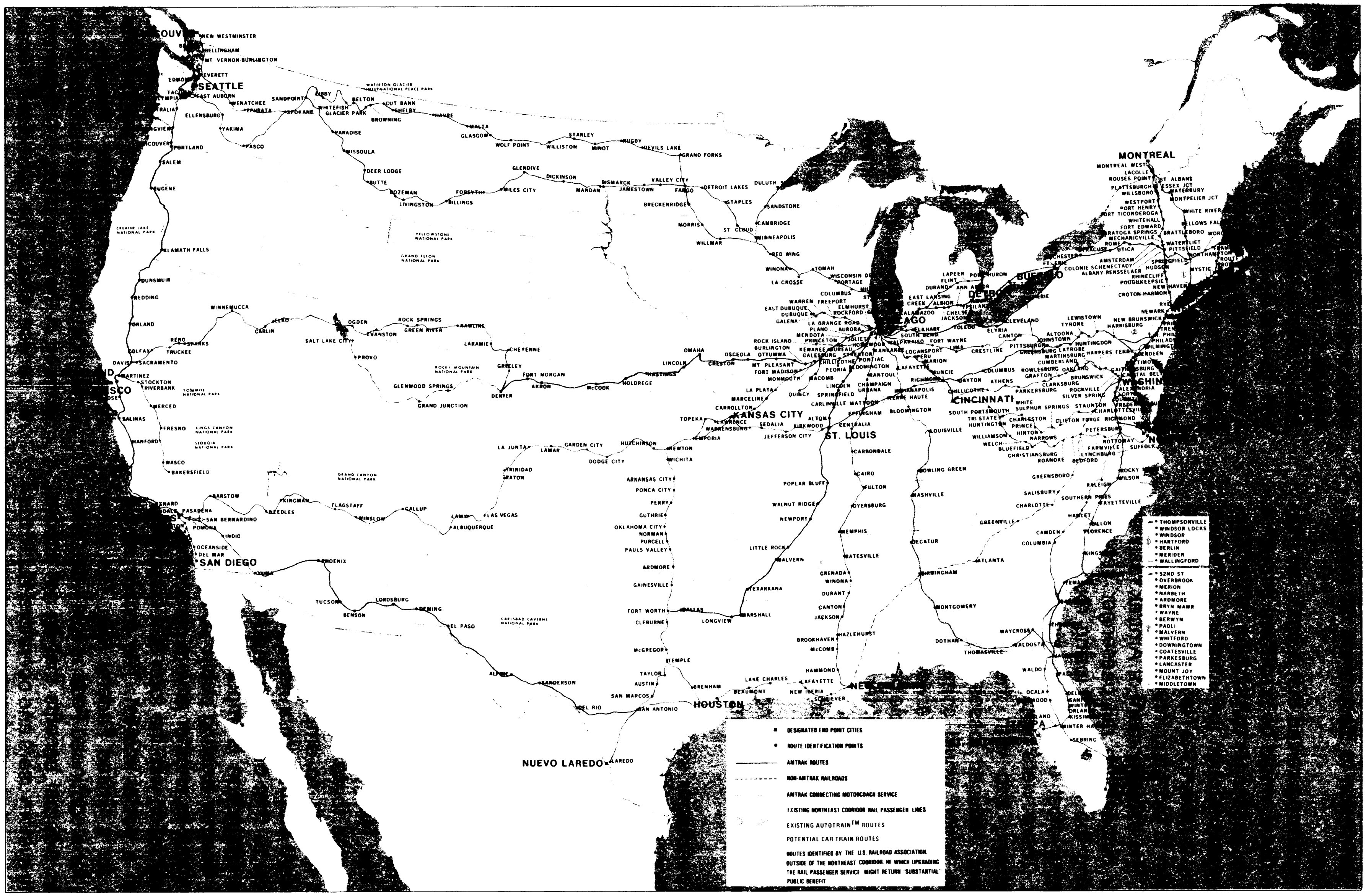
Section 301 of the Act states that Amtrak is to be a "for profit" corporation. The legislative history of the Act does not make clear whether the phrase "for profit" is meant to imply that the Congress expected Amtrak to show a net excess of revenues over expenses where the Nation's individual railroads had been unable to do so or whether it was intended merely to emphasize Amtrak's independent status with a management structure akin to that of private industry.

The distinction is important, since it relates to whether existing public policy should view Amtrak as another private corporation or as an institution with the form of a corporation but with a social interest. The former status argues for a limited Federal role. The latter argues for a continued Federal role—that Amtrak has external benefits that do not accrue solely to system users and operators, but to the public as a whole. In that case, sound public policy would require that such benefits be large enough to justify the costly course of Federal action taken in regard to Amtrak since its inception, as well as in planned future action. However, existing evidence does not appear to support this case.

The Federal financial commitment to Amtrak has been substantial. Grants and loan guarantees to sustain intercity rail passenger service have increased steadily over the years until they now are in the range of half a billion dollars per year. By the year 1980, this will have grown to approximately $700 million per year. Beyond this expenditure, the Government is expected to provide $1.2 billion for capital improvements and $1.7 billion for construction in the Northeast Corridor. These actions have been taken without any serious analysis of the public benefits and costs involved, or any evaluation of alternative uses or methods of operation that would enlarge public benefits.

The potential benefits cited have been intercity congestion relief, reduced air pollution, reduced energy consumption, and the provision of a wider range of intercity travel choice to the consumer. A counter consideration is that an oil shortage might increase the demand for public transportation services including Amtrak service. It thus might be in the public interest to promote energy efficient public transportation such as Amtrak and/or interstate busing. These potential benefits have not been sufficiently quantified to provide a substantive basis for subsidy determination, or for setting appropriate fare policies. Such quantification should be made and applied route by route. The rough data presently available do not tend to support the benefit arguments presented. Table V.2 indicates the relative costs of the modes available for interstate passenger traffic. Even with the safety, pollution, and energy characteristics incorporated into the relative costs, rail ranks last.

In many of the long-distance markets (greater than 500 miles), the impact of diversion of passengers to rail service from other modes is very small in terms of congestion relief and infrastructure requirements through 1990. Since most of the critical air pollution areas are centered in the large cities, the argument that rail service should be subsidized because it offers a less polluting form of travel is not



[1]Alaska trackage not shown.

FIGURE VII.3. INTERCITY RAIL PASSENGER ROUTES.[1]

relevant on most of the long-distance routes. Even if this were not the case, competing interstate buses could provide unsubsidized service with roughly the same emissions.

The actual modal preference on the part of the public for intercity travel may be seen by the fact that in 1975 only 0.4 percent of all intercity passenger-miles were by rail. Rail service is in a poor position to compete with the convenience of the automobile, the speed of our modern aircraft, or the coverage of intercity buses for most trips among metropolitan areas.

A number of financial viability studies of rail-passenger markets have been conducted. In general, such studies have shown the New York-to-Washington, D.C., corridor to be the most promising rail passenger market. Pre-Amtrak legislation estimates indicated that this market might become financially self-supporting. The projected estimates of other markets fell substantially short of this market in terms of potential profitability.

The Amtrak experiment has now been going on for several years. The experiment began with a relatively large, poorly equipped, in-place system. The encumbrance of maintaining existing services has diminished the opportunity for innovative experiments. Amtrak has frequently been in the position of providing poor service to a broad number of people, rather than focusing on how to attract ridership or at least provide a valid test of potential ridership. Many proposed improvements, particularly with regard to new equipment, are only now becoming available after 5 years.

Today, every route is losing money even though services have been substantially improved on certain routes. The most promising route (New York-to-Washington, D.C.), which has had the greatest improvements in service, is the closest to financial viability, but almost all other routes are experiencing severe losses.

Rail passenger services face a strategic dilemma. If emphasis is placed on higher speed/higher cost services, a market efficiently served by air, rail passengers may be lost to the automobile or intercity bus. On the other hand, if low-speed/low-cost services are emphasized, customers may be lost to the airlines or automobile.

Subsidized Amtrak rail passenger service competes with modes that are much less subsidized. The extensive subsidies to Amtrak appear especially unjustified in that intercity buses on a self-supporting basis often provide faster ground services to more places, at lower prices, with roughly comparable safety, emissions, and energy consumption per passenger mile.

Competing airlines provide faster service over the longer segments. With the exception of some local service air carriers, aviation provides competitive service without being subsidized. The present Federal subsidy for local air carriers averages about 15 percent of the cost of the service provided and could be replaced by air carrier services that would require far less Federal support.

Given the rising Amtrak subsidy costs, and a fare structure that has returned less than 50 percent of system expenses, it is essential that this experiment be restudied to ascertain the best use of the resources available and to permit an evaluation and policy decision on the future of rail passenger service. This restructuring has three crucial elements:

- The experimental nature of Amtrak must be recognized. Opportunities for flexibility and innovation must be expanded so that information can be gained for a final evaluation. Recognition of Amtrak as an experiment further implies a decision point at which the experiment is modified, continued, or concluded. This should be decided by 1985 at the latest. By that time sufficient knowledge should have become available, given adequate freedom to experiment and redirect resources, to permit soundly based decisions.
- Identification of user benefits, and public benefits derived from continuation of Amtrak services, is essential to any soundly based decision regarding future public support.
- Effective market analysis will be the key to a useful experiment, a sound judgment of public benefits, and recognition of the cost incurred. The present and potential users of Amtrak must be identified. Their service requirements, purposes, and time-and-price attitudes must be determined. These in turn must be matched to the costs of servicing these markets to permit focusing of resources on markets where large benefit returns can be realized.
- Any review must pay close attention to the effect of liquid fuel shortages or traffic conges-

tion on the highway system now projected for 1990.

If done correctly, the market analysis would take full account of the alternative services available from other modes. Rail passenger service should be most viable where it is mandated by (in the words of the Act) "the need for balanced transportation, the public convenience and necessity, congestion on our highways and airways, or the desire for choice." One of the benefits of the Rail Passenger Services Act of 1970 is that it exposes the real cost of passenger rail service. This will help focus the future public debate on how much the Federal taxpayer should support rail service as an alternative to the automobiles, air carriers, and intercity motor buses which, with the minor exceptions of some local service air carriers, provide competitive service without the need for subsidy.

Recognizing the need for experiment identification and measurement of benefits and for an analysis which will examine the benefits and resource needs for each market, the following outlines the potential future for Amtrak investments and services in different markets. They represent proposals for future programing, but only to the extent of obtaining information for decision by 1985.

Future Options, Long-Haul Markets. Regardless of whether long-haul travel service is approached from a purely economic perspective or a purely policy perspective, the outlook is not bullish. Table VII.10 identifies the long-haul markets now in operation, with a summary of their operating and economic status. These routes served only 23 percent of Amtrak passengers in 1975, but accounted for 60 percent of direct operating deficits. Moreover, it is in this market sector that the public benefits of Amtrak services are least evident. Air pollution and energy savings are minimal, if not nonexistent, in these markets.

The overall nature of the long-haul market is analogous to the leisure travel cruise-ship market. Neither the speed nor the price of

Table VII.10
1975 Route-by-Route Loss Analysis

Route	Cost/ passenger-mile (cents)	Revenue (millions of dollars)	Cost (millions of dollars)	Loss (millions of dollars)	Load Factor	Loss passenger-mile (cents)	Total Passenger-Miles (millions)
Short-Medium Distance							
New Haven-Hartford-Springfield	50	0.5	3.0	2.5	.20	41.7	6.0
Oakland-Bakersfield	40	0.6	4.0	3.4	.34	34.0	10.0
Washington-Cumberland	30	0.3	1.8	1.5	.22	24.6	6.1
Seattle-Portland	28	0.9	3.9	3.0	.42	21.4	14.0
Los Angeles-San Diego	24	1.5	6.7	5.2	.44	18.8	27.7
Chicago-St. Louis	25	2.9	9.3	6.4	.36	17.3	37.1
Chicago-Milwaukee	22	1.2	4.3	3.1	.36	15.7	19.8
Harrisburg-Philadelphia	18	2.0	6.3	4.3	.27	12.1	35.5
Chicago-Quincy	17	1.0	3.3	2.3	.23	12.0	19.3
Chicago-Detroit	17	2.2	7.4	5.2	.43	12.0	43.5
Chicago-Carbondale	14	1.4	3.7	2.3	.39	8.8	26.2
New York-Buffalo/Detroit	15	7.4	16.7	9.3	.35	8.3	112.2
Minneapolis-Superior	17	0.1	0.2	0.1	.40	8.3	1.2
New York-Philadelphia	13	7.7	20.7	13.0	.45	8.0	162.1
Boston-Washington (conventional)	13	37.4	69.5	32.1	.41	6.0	537.4
New York-Washington (Metro)	13	38.9	43.3	4.4	.50	1.3	333.2
Long Distance							
Florida-Chicago	23	4.6	23.3	18.8	.40	18.3	103.0
St. Louis-Laredo	20	1.1	4.3	3.2	.30	14.9	21.5
NY-Washington-KC-Denver	18	5.2	14.9	9.7	.40	12.0	80.9
Norfolk-Washington-Chicago	16	2.3	8.0	5.7	.31	11.6	49.2
New York-Washington-Chicago	14	10.6	22.4	11.8	.58	7.5	156.4
Seattle-Chicago	13	18.8	43.6	24.8	.50	7.4	335.1
Houston-Chicago	12	5.6	13.4	7.8	.43	7.1	110.2
San Francisco-Chicago	12	14.1	29.2	15.1	.50	6.2	242.8
New York-Florida	11	31.0	65.3	34.3	.54	6.0	573.9
Seattle-Los Angeles	12	10.4	21.0	10.6	.52	5.8	182.1
New Orleans-Chicago	10	3.9	8.4	4.5	.49	5.3	84.3
Chicago-Los Angeles	10	18.0	32.9	14.9	.53	4.6	325.2
New Orleans-Los Angeles	9	4.5	8.6	4.1	.50	4.3	96.1

Amtrak service in this market sector commends it to the consumer. Some of its appeal may, like the cruise ship, lie in the pleasure of traveling, rather than in the fact of arriving. If this perception of the nature of the market is appropriate, it yields two findings:

- The service characteristics of cruise travel are distinct. Appropriately oriented services could be provided at improved cost/revenue levels. Service changes would include improving onboard services such as food service, space available, scenic qualities, and other amenities. These increased costs can be traded off against service frequency. The highly discretionary nature of long-distance cruise travel permits considerable flexibility regarding departures. Like cruise ships, schedules should be aligned with demand via advance announcements and scheduled in a way similar to the excursion operations of the air and ship modes.
- Such a service approach has no claim for direct subsidy or Government operations. Luxury travel requires full cost return via fare revenues. Services, scheduling, and fare structure can then be aligned with the dictates of the marketplace. At current fare levels, costs would not be met even at 100 percent load factors on most routes. Flexible service innovations and scheduling experimentation could be used to determine whether a market exists for such services. If sufficient demand exists at cost-based fare levels for high-quality service, an attractive addition will have been made to our national transportation services. Removal of Federal level subsidies would not bar local or State tourism interests from supporting such services where their interest is dictated.

Future Options, Short-Haul Markets. Overall travel time relative to other modes will be the major determinant of market share on most routes in the short-haul markets, particularly for one-day round-trip service. The New York-to-Washington, D.C., corridor experiments have shown that publicly financed rail service can compete with other modes on the basis of travel and time in a market of sufficient density. Under the RRRR Act of 1976, $1.75 billion was provided for upgrading this service, including station improvements. In addition to these investments, however, it is essential that experimentation be extended to test what travel time and fare alternatives produce the greatest ridership and public benefit.

The greatest opportunity for improving travel times between high-density, short-haul corridors is through increased frequency of service, reduction of waiting time, and provision of better scheduling to the potential traveler. Improved speeds via road-bed upgrading and equipment enhancement would further expand the market opportunities.

The United States Railroad Association's "Preliminary System Plan" identifies 16 short-to-medium-distance corridors in densely populated areas outside the northeast corridor in which upgrading of rail passenger service might return "substantial" public benefits.[2] The principal characteristics common to these corridors are (a) end point cities contain Standard Metropolitan Statistical Areas (SMSA) populations of 1 million persons or more, (b) 300 miles or less separate the end points, and (c) railroad rights-of-way connect the end points and could be used for passenger trains with average speeds competitive with those of highway transportation.

Federal dollars saved as a result of discontinuing assistance to long-distance routes and other low-potential routes should be redistributed to achieve a greater impact in terms of reducing congestion, conserving energy, and improving air quality in high-potential corridors. Whether this redistribution of resources would result in a reduction of current Federal support for intercity rail passenger service would depend on the type and level of services proposed and the attendant fare policy.

Even without reduction in current Federal expenditures, the reward for such redistribution of resources would be substantial, first in terms of providing a true test of better rail service, and second, in increasing ridership per subsidy dollar. Ultimately, user and public benefits accrue almost wholly from increased use of the system. Ridership potential is the only justification for subsidies regardless of other benefits.

---

[2]In decreasing order of total SMSA population served: New York-Buffalo; Chicago-Detroit; Cleveland-Chicago; Chicago-Cincinnati; Chicago-St. Louis; Chicago-Milwaukee; Philadelphia-Pittsburgh; Detroit-Cincinnati; Detroit-Buffalo; Pittsburgh-Indianapolis; Washington-Pittsburgh; Cleveland-Pittsburgh; Washington-Norfolk-Newport News; Cleveland-Cincinnati; Indianapolis-St. Louis; and Cleveland-Buffalo.

As experience is gained via experimentation, fare policy and public benefit alternatives can be appropriately weighted to gain best return on a route basis.

Future Options, Commuter Operations. While not as distinct a market segment as the long- and short-haul markets, some components of Amtrak services accrue to daily commuters. Public support of commuter rail services is extensive. Congestion, pollution, and energy savings ascribed to Amtrak are most likely in the heavily traveled commuter corridors. A clear demarcation should be made of the respective roles of these markets. If commuter rail subsidy is appropriate, and Amtrak services support commuter operations in some corridors, this should be identifiable in the accounting, reporting, and decision making regarding Amtrak's future. Commuter subsidies should be separately identified. Amtrak schedules should be aligned with local commuter operations to assure compatible and coordinated services. Subsidy and operating decisions should be made in concert with local authorities with responsibility for coordinating local transit planning. In such markets, Amtrak could provide a dual service of coordinated commuter and short-haul operations.

Expanded Car-Train. The most positive, and in many ways most dramatic, development in rail passenger service has been the success of car-train service. Beginning from zero in December of 1971, Auto-Train™ now carries almost 309,000 passengers and their cars per year, operating routes from Lorton, Virginia, and Louisville, Kentucky, to Sanford, Florida.

The service, carrying both passengers and their vehicles, provides an alternative to Florida-bound travelers who want an automobile there, and who would otherwise drive the entire route, or travel by common carrier and rent an automobile in Florida.

Auto-Train™, an entirely privately funded corporation, has succeeded in overcoming initial barriers to their idea and has established a profitmaking service. Auto-Train™'s market can be viewed as those people living within a 4- to 5-hour drive from Lorton, Virginia, who by a short auto ride eliminate approximately 900 miles of driving, the cost of gasoline, motels, etc., and arrive at major distribution points. A market analysis of major traffic flows indicates that the following markets may be conducive to this type of service: San Antonio, Texas, to Yuma, New Mexico; Chicago to Denver; Portland to Los Angeles; Chicago to Dallas; New York to Chicago. While the market for such a service is narrow in terms of the share of national travel, an expanded network of car-train services would be an attractive addition to national passenger service.

The recently concluded agreement between Amtrak and Auto-Train™ to expand Auto-Train™ services under Amtrak's operating charter holds the possibility of mixing car-train service with Amtrak's long-distance trains. This arrangement has the potential for reduced costs for both companies by sharing locomotives and crews on routes where traffic will not support economical operations of a separate car-train. For example, the Louisville-Sanford route can now support one Auto-Train™ run per week. By combining with the Amtrak train, smaller trains with more frequent departures might be feasible for Auto-Train™.

ConRail

The ill health of the railroad industry was demonstrated by the bankruptcy of eight railroads in the 17-State Northeast and Midwest quadrant of the United States. The railroads involved accounted for just under half of the revenues, ton-miles, and track-miles of the region, and on a national scale made up 12 percent of the rail-line-miles of the industry, 19 percent of its employees, and about 17 percent of its revenues. The magnitude of these bankrupticies was of major public concern, leading the government to lend money to make possible the greatest corporate reorganization in our history.

Both the procedures followed and the anticipated results of this Federal action deserve special interest. For future planning they will provide an early indication of how well a reorganized healthier railroad may be expected to continue service. In addition, they will provide an early test of how much and how enduringly government loans will be necessary in order to assure continued operation, when it is our objective to retain full ownership and management control in the private sector.

Under the Regional Rail Reorganization Act of 1973 (Public Law 93–226, hereinafter designated as the RRR Act of 1973), the United

States Rail Association (USRA) was established to restructure the region's bankrupt railroads into a more efficient system capable of fulfilling its rail service needs. This plan was submitted to Congress on July 26, 1975, for approval. It recommended that a new organization, ConRail (Consolidated Railroad Corporation), operate a network reduced from 24,000 miles to 15,000 route-miles. It was also expected that the solvent carriers serving the region would purchase significant portions of the bankrupt properties to improve their system and provide for additional market penetration. For public policy purposes, the Southern Railroad should acquire the Delmarva Line and the Chesapeake and Ohio Railroad should acquire the Erie Lackawanna Railroad as initially planned by USRA, since it is not in the public interest to have a monopoly in rail service in the East by ConRail. These expectations were only partially fulfilled, however, and the final resultant network is shown in figure VII.4.

ConRail began operations at midnight on April 1, 1976. The RRRR Act of 1976 provided a massive infusion of public funds to its support. It authorized USRA to purchase up to $1 billion in ConRail debentures and thereafter up to $1.1 billion in ConRail series A preferred stock. It also authorized the issue of series B preferred stock, common stock, and certificates of value to the estates of railroads in the reorganization and others based on the net liquidation values of the rail properties transferred to ConRail. At that time, ConRail became the Nation's largest railroad in terms of traffic and second largest in miles of route.

ConRail will also operate Amtrak intercity passenger trains over designated routes of its network. These runs account for the majority of Amtrak's U.S. passenger volume. In addition, ConRail will operate suburban commuter passenger service in eight States, chiefly under contract with local authorities.

A major innovation of the reorganization was the procedure for determining light-density lines, or those whose level of present and foreseeable freight traffic will not yield sufficient revenue to cover the costs of operating and maintaining the route, including track upkeep and taxes. Of the total 24,000 route-miles of line originally operated by the seven bankrupt railroads in the northeast region, USRA recommended 5,757 miles of track be either abandoned or continued under subsidy.

The annual operating (direct costs) loss on the excluded lines was estimated at $33 million. In addition, the cost of upgrading track structures to meet the minimum Federal standard (10 mph) would be $53 million. Translating the net burden of continuing the excluded lines into its financial forecast, USRA estimated ConRail's extra cost of continued operation (without subsidy) would have increased its cash expenditures through 1985 by $670 million.

Extensive hearings by the Interstate Commerce Commission held in the territory affected indicated that only 1 of the 279 counties affected by a potential abandonment would sustain a loss in real income as high as 2 percent. On the other hand, USRA noted the net increases in employment and incomes from added maintenance expenditures and rehabilitation of the remaining lines should offset any negative impacts of line abandonments.

In both the RRR Act of 1973 and the RRRR Act of 1976, Congress acknowledged that private railroads should no longer be forced to provide unprofitable services on light-density lines. Both Acts provide for Federal-State public subsidy programs to temporarily underwrite losses on light-density lines, which the public wishes continued. The RRRR Act of 1976 also provides for use of subsidy funds for nonrail alternatives to rail transportation, which promise to be more cost effective than rail service. Congress has clearly indicated, however, that the service continuation subsidy is to be viewed as a short-term, transitional measure—not a permanent solution to the problem.

USRA produced a plan for ConRail through 1985 based upon the expectation that the system "can succeed as a viable private sector enterprise." These expectations are conditioned firmly, however, on a large number of significant changes in the system's operating and marketing strategies and in the government-related climate in which the system must live.

The revenue forecast for the unified ConRail ("Supplemental Report for Final System Plan," p. 117) shows a $391.7 million constant 1973 dollar increase in freight revenues between 1973 ($2,155.3 million) and 1985 ($2,547.0 million).

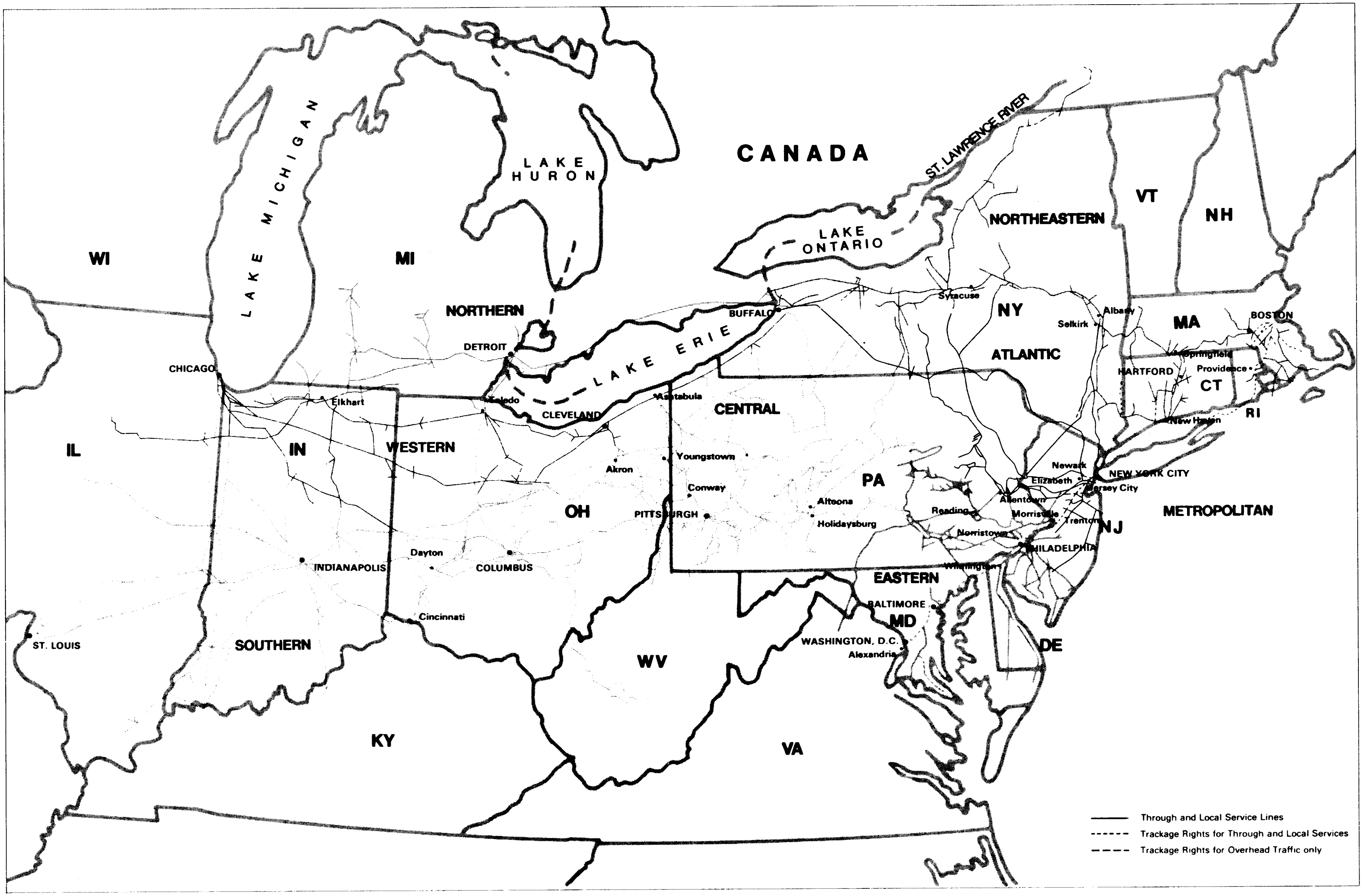


FIGURE VII.4. CONRAIL SYSTEM MAP.

Basic economic growth $341.5
Selective rate increases (on presently loss-producing traffic)..................................63.0
Diversion to long-haul routes 54.8
Light-density line abandonments (net loss of traffic)..................................(50.0)
Market transfers to solvent carriers (loss)...(17.6)
Total increase..$391.7

The revenue and tonnage forecasts from the "Supplemental Report" appear in table VII.11.

The RRRR Act of 1976 makes available to ConRail $2.1 billion in Government funds for working capital, refinancing, acquisition of equipment, and for modernization, rehabilitation, and maintenance of properties acquired from the bankrupt railroads. In addition, it provided subsidy for the light-density lines and started in motion the machinery leading to a modernized regulatory environment.

Table VII.11
Unified ConRail Revenue and Tonnage Forecasts

Revenue (millions of 1973 dollars)

Category	1973	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Farm products	84.2	61.3	65.7	82.6	73.4	75.5	76.5	77.7	78.9	80.0	81.3
Metallic ores..........	97.5	79.8	85.4	80.5	84.3	96.2	99.0	101.9	104.7	107.7	110.6
Coal	242.5	242.5	251.4	250.8	258.1	272.9	283.7	295.1	307.0	319.3	331.9
Nonmetallic minerals...	60.5	52.0	53.0	50.7	52.9	56.8	57.5	58.1	58.8	59.5	60.3
Food products.........	203.6	186.2	186.0	172.8	169.9	170.4	172.3	174.3	176.2	178.3	180.3
Lumber	74.1	61.0	62.8	58.2	65.5	78.4	80.4	81.6	82.8	84.0	85.3
Pulp and paper	128.5	117.7	124.7	130.6	133.5	139.6	145.2	150.0	155.0	160.1	165.7
Chemicals	109.8	152.9	159.8	152.9	155.2	164.9	168.3	172.0	175.8	179.7	183.7
Stone, clay, and glass ..	82.0	68.8	69.3	64.6	69.6	77.7	79.7	81.4	83.2	85.1	87.0
Primary metals	194.2	179.6	192.4	186.2	190.8	208.0	214.8	221.5	228.8	236.2	243.7
Transportation	265.3	235.3	265.4	246.0	252.3	287.8	298.3	309.0	320.7	332.5	344.7
Waste................	83.6	77.3	82.7	89.4	91.3	98.6	101.5	104.6	107.6	110.7	113.9
Coke	31.4	29.5	31.4	30.7	31.3	33.4	33.8	34.3	34.7	35.4	35.9
TOFC[1]	215.3	183.6	202.6	200.0	208.6	225.9	235.9	246.6	257.9	270.1	282.9
Other (non-TOFC)	222.8	183.9	193.5	189.8	194.1	208.7	214.5	220.5	226.5	233.2	239.8
TOTAL.............	2,155.3	1,911.4[2]	2,026.1[2]	1,985.8	2,030.8	2,195.8	2,261.4	2,328.6	2,398.6	2,471.8	2,547.0

Tonnage (millions of tons)[3]

Category	1973	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Farm products.........	14.2	10.7	11.1	11.9	10.5	10.9	11.0	11.2	11.5	11.6	11.7
Metallic ores..........	39.2	32.3	33.7	31.4	32.8	37.5	38.7	39.6	40.9	42.1	43.3
Coal	100.3	101.9	104.8	104.5	107.6	113.8	118.3	123.2	128.2	133.5	138.8
Nonmetallic minerals...	24.8	21.3	21.3	19.6	20.4	22.1	22.2	22.6	22.8	23.3	23.5
Food products.........	31.0	28.7	28.2	25.7	25.1	25.3	25.5	25.6	25.9	26.4	26.5
Lumber	10.8	8.9	8.9	7.9	8.9	10.6	10.6	10.9	11.0	11.5	11.6
Pulp and paper	24.5	22.3	22.8	22.0	22.3	23.8	24.6	25.5	26.3	27.1	28.1
Chemicals	26.8	24.3	24.9	23.5	23.5	25.0	25.5	26.0	26.6	27.2	27.7
Stone, clay and glass ...	19.0	16.2	15.9	14.7	15.7	17.6	17.9	18.2	18.6	19.0	19.5
Primary metals	34.6	32.0	33.5	32.0	32.8	35.7	36.9	38.1	39.5	40.8	42.2
Transportation	16.3	14.4	15.7	14.3	14.7	16.5	17.2	17.7	18.5	19.3	20.0
Waste................	19.1	17.8	18.7	17.6	18.0	19.6	20.3	20.9	21.8	22.4	23.1
Coke	8.3	7.6	7.9	7.7	7.8	8.5	8.6	8.6	8.7	8.7	8.8
TOFC[4]...............	10.3	8.3	9.3	9.0	9.5	10.6	11.2	11.9	12.7	13.5	14.3
Other (non-TOFC)	22.1	20.1	20.7	19.6	19.9	21.7	22.3	22.8	23.5	24.0	24.7
TOTAL.............	401.3	366.8	377.4	361.4	369.5	399.2	410.8	422.8	436.5	450.4	463.8

[1]Includes all TOFC movements. [2]Excludes light-density line subsidies. [3]Tonnage contains some double counting because of joint movements by two or more constituent ConRail carriers; this double counting was eliminated in preparing pro forma revenue and expense projects for ConRail. [4]A small amount of TOFC is also includod in other traffic commodity groups.

Rail Network Restructuring and Rationalization

The preceding discussion illustrated how it became necessary for the government to act, to provide money for ConRail, to resolve bankruptcies in the Northeast-Midwest. This occasion serves also to provide notice of the importance of additional government action, through the RRRR Act of 1976.

Introduction. One major aspect of the presently tenuous condition of the industry focuses on the roadbed. Large segments of it are in poor condition and other large segments are underused. The RRRR Act of 1976 set as a major objective the restructuring of the Nation's rail network in order to restore its vitality. Such a restructuring ties together four of the fundamental problems of the industry today:

- The balkanization of the industry;
- The fact that traffic on many rights-of-way is too light to support the cost of continued operation and maintenance of the route;
- The fact that the decline of traffic has often left too many lines competing for a volume of business that can only support a few; and,
- The fact that a lack of operating funds and the deferred maintenance that resulted has left many rights-of-way and other parts of the plant in need of major rehabilitation.

With respect to the last point, the magnitude of this deferred maintenance is unclear. A preliminary estimate by the Association of American Railroads indicated that, as of September 1975, the industry's level of deferred maintenance for roadways alone amounts to $2.5 billion. Delayed capital improvements for roadways add another $2.1 billion. Deferred maintenance on equipment is estimated to be approximately $368.5 million, and delayed capital expenditures for equipment another $2.1 billion. These figures, however, are not based on any rationalization concept and, under Section 504 of the RRRR Act of 1976, they will be restudied and interpreted.

The need for this restructuring, and the responsibilities newly placed on the Secretary of Transportation, will substantially alter the balance between what formerly were railroad matters handled solely in the private sector and what will become the province of a national interest railway network. Under the provisions of the Act, the Nation's taxpayers, who in addition to the $2.1 billion for ConRail will make $1.6 billion in loans and loan guarantees available to improve rail facilities and equipment, must clearly be protected against having to subsidize or guarantee loans for the rehabilitation of more facilities than are required by the demands of the traffic. Nevertheless, in a setting characterized by too many railroads concurrently maintaining more lines than are needed to handle the traffic, any selection by the Government of which competing facility is singularly worthy of Federal funding assistance would constitute a new form of influence on a competitive market. One way of minimizing this intrusion is to encourage voluntary actions from the industry which are compatible with the planned restructuring.

The restructuring or rationalization of the Nation's rail network can be effected in a number of ways:

- *Corporate merger or consolidation* — The unification of separate companies into a new corporation, or control of one by another, for the purpose of unifying management and disposition of route structure. During the past several decades, mergers, acquisitions, and lease agreements have reduced the number of independent class I line-haul operating companies from 110 in 1957 to the 58 shown in table VII.2. In considering them, the ICC possessed no explicit plan to which conformity was encouraged. Most of the larger mergers were parallel (combinations of carriers serving the same region), as opposed to end-to-end (carriers serving essentially different, if contiguous, regions). They frequently resulted in abandonment or downgrading of duplicating lines.
- *Coordination agreements between companies which retain separate corporate ownerships* — Trackage rights for one company to use the route of another, or other joint facility use; paired track merging the operating capacity of parallel, separately owned routes to provide a flexible multitrack route for both companies; movement of another road's cars under contract rates. A number of these agreements are in effect on U.S. railroads, but growth in this means of rationalization has not been vigorous. Encouragement of restructuring by this process has the advantage of involving little or no capital expenditures and, generally, is not irreversible.

• *Transfer of routes between separate railroads to enhance the system market capability of each.*
• *Abandonment of light-density lines of individual railroads on the ground of operating losses.*

Features of the RRRR Act. The RRRR Act of 1976 reflects both an immediate and a long-range perspective by which to restructure the network. Under title IV of the Act, the Secretary of Transportation is made an active agent, developing plans, proposals, and recommendations, assisting merger negotiations, conducting studies to determine potential cost savings and possible improvements in quality, and holding conferences with respect to any proposed unification or coordination project. An expedited merger procedure is also provided for, in which the Interstate Commerce Commission is limited to 2 years in which to render its decision of approval, denial, or revisions of merger applications from the carriers.

Under title V of the Act, $1.6 billion in loan guarantees and other forms of financing are provided to support rehabilitation and improvement projects. A Railroad Rehabilitation and Improvement Fund is established, the purpose of which is "to provide capital which is necessary to furnish financial assistance to railroads, to the extent of appropriated funds, for facilities maintenance, rehabilitation, improvements and acquisitions, and other financial needs as the Secretary approves." Applications for financing under title V will be conditioned upon adherence to guidelines and route designation standards established by the Secretary dealing with classification of rail lines, track standards, capital needs, and other areas.

The RRRR Act of 1976 directed the Department of Transportation to work with the railroads to classify and designate the Nation's class I rail lines. The prime purpose of this process was to categorize the rail lines of the Nation according to reasonable measures of priority so that governmental investments in track could be directed where they would do the most good.

As a result, all rail lines were divided into six preliminary classifications, whose descriptions were published in August 1976. These preliminary classifications will be subjected to public hearings and review conducted by the Rail Services Planning Office of the Interstate Commerce Commission before final designations are made in early 1977. The ICC's Rail Services Planning Office has disagreed with the definition of preliminary classifications and some of the methodology employed. We expect to have active discussions with them on these issues. The definitions we used are described in table VII.12 and the segments are shown in the map located in the envelope appearing in the back cover of this book.

Table VII.12
Preliminary Categories of Class I Railroads

Category Title	Category Description	Percent of Designated Route-Miles of Class I Rail Network
A Mainline	20 million or more gross ton-miles per mile per year.	15.5
	Three or more daily passenger operations in each direction.	0.8
	Major transportation zone connectivity.	0.8
Potential A Mainline	A temporary status for through lines located in corridors of excess capacity. They will be designated to another category upon resolution of the redundancy.	11.6
B Mainline	Less than 20 million gross tons, but at least 5 million.	21.7
A Branchline	Less than 5 million gross tons but at least 1 million.	21.9
B Branchline	Less than 1 million gross tons.	25.6
Defense-Essential Branchline	Required for access of over-sized military shipments.	2.1

The Department defined corridors as having excess capacity if:
• It is served by three or more mainline through routes providing through service,
• The total capacity of the mainline through routes exceeds their annual density by 50 percent.

The classifications were based on rail conditions as of the end of 1975. As will be noted, the track classifications are likely to change over time as rail traffic flow patterns shift as a result of changes in the economy, industry locations, competing forms of transportation, rail passenger services, and other railroading. The Department, in addition, realizes that such preliminary classifications are subject to rules for connectivity and needs for energy.

Under title IX, the Secretary is directed to conduct a number of studies, including a comprehensive study of the American railway system (both physical and corporate). This study called for under section 901, is due February 4, 1978, and is to include the following:

- Potential cost savings and improved service performance of restructuring;
- The potential economies and improvements resulting from improved local and terminal operations;
- The savings if rehabilitation is limited to portions essential to interstate commerce and national defense;
- An assessment of the extent to which common or public ownership of fixed facilities could improve the system;
- The effects of alternative rail corporate structures;
- The assignment of priorities to properties for improvement;
- An assessment of the potential benefits of electrification;
- An analysis of the financial and physical condition of facilities, rolling stock, and equipment of the Nation's railroads.

Carriers who wish to propose merger or consolidation are not required to wait for the conclusions of the section 901 study. The Secretary must respond to their filings within a narrow time frame. These will be heavily influenced by the criteria for financing proposals, and by the degree of recognition its position receives in merger proceedings before the ICC.

If the carriers do not initiate consolidation or merger proposals within a reasonable time after enactment, the Department has the authority to recommend supplementary transactions and consolidations in "corridors of excess competition." Such proposals would need to be voluntarily accepted by all carriers involved.

The restructuring goals of the Secretary are expected to:

- Provide the industry with the Government's view of the requirements for a national rail system;
- Include a reduction in the number of rail corporate systems to diminish the interline traffic problem and excessive route duplication, while providing rail competition between major markets;
- Be oriented toward a system of privately owned and operated properties requiring minimum financial support and economic regulation by government.

Railroad Work Rules. Railroad work rules have been a matter of widespread public interest and concern for most of the last 20 years. Between the mid-1950's and the early 1970's, the railroads and the unions waged fierce and bitter battles in every possible private and public arena. The parties argued their cases across bargaining tables, before investigation and arbitration boards, on picket lines, in the media, before congresses and presidents, and in countless courtrooms. They left no legal question unresolved short of the Supreme Court. The residual rancor found its way to the very roots of the industry into individual relationships between employees and supervisors. The president of one union described it as a cancer that had to be removed before the industry could begin to recover. The Union Transportation Union summarized the situation in their 1972 report "*Project Seventies*." The following lists the most pressing complaints:

"1. Deliberate contract violations and refusal to pay: 'Sue-us—collect-it-the-hard-way' attitude.

"2. Employees being held out of service for alleged physical disabilities despite medical evidence to the contrary.

"3. Carriers' refusal to hire new employees and then working present employees excessively long hours.

"4. Carriers harassing employees because of on-duty personal injuries.

"5. Intimidation of employees.

"6. Unwarranted and frivolous investigations.

"7. Refusal to correct hazardous conditions, then disciplining employees because of injuries resulting from such conditions.

"8. Encouraging employees to ignore transportation and safety rules in order to get work done faster; and, then, when accidents occur, refusing to acknowledge such encouragement but instead disciplining employees for doing sulted in a lower level of service to shippers and contributed to the deterioration of the plant. These, in turn, have probably been major reasons for the railroads' declining market share of intercity freight transportation.

Recent reforms are only small steps toward the modernization necessary to realize the full potential of rehabilitation, rationalization, and technological growth. Incentives for work rule reform did not develop as part of the recent legislative programs. Work rule disputes, in fact, thwarted the implementation of the USRA's Final System Plan and resulted in a monopoly situation for ConRail in some major markets. Further, ConRail is faced with negotiating work rule changes to achieve the full benefits of reorganization and rehabilitation that may well turn out to be essential to ConRail's survival as a private enterprise.

The planning for reorganization of the bankrupt Northeast railroads carefully excluded work rule modernization from the scope of its Final System Plan. Planning mandated by the RRRR Act also excludes this area. Yet it has long been recognized that the collective bargaining process in the rail industry could benefit substantially from a planning exercise in which the parties viewed the labor agreements in the context of the industry's long-run financial needs as well as its long-range manpower requirements. In 1962, the Presidential Railroad Commission (PRC) urged such an action in its final report:

> "It is our view that railroad management and the operating brotherhoods should consciously plan the decade of the 1960's as a period of transition and adaption to the new arrangements herein proposed. It should be their objective to achieve a rational system for the development and compensation of the labor force and reasonable job security for those who have committed their lives to the industry." [p. 2]

Such a plan was never developed. Instead, the parties waged war for 10 years. As the new era, created by recent legislation, begins for the rail industry, one might wonder if history will repeat itself. When can the full benefits of Federal financial assistance be realized? In 1962, the PRC wrote:

> "It is our view that the parties should take positive action to insure that the transition proceeds satisfactorily and rapidly, and that future adjustments to changes in technology and economics are handled without the occurrence of multi-decade lags." [p. 16]

If this historical labor-management lag is not eliminated, the approach that has been launched by recent legislation may very well fail to achieve its goals. The results would likely include a transportation system where the role of railroads is drastically different from the one envisioned by the present plan.

There are signs of hope. There is a growing recognition of the notion that some kinds of railroad labor agreements are not in the best long-run interests of either rail management or labor. As a result of this situation, future rounds of national collective bargaining can be expected to address the specific issues of crew consist requirements, basis of pay, and divisions of work among job crafts.

Also, recent years have witnessed great improvements in railroad labor relations. Realizing that a growing, competitive industry impacts favorably on both employment and net income, some elements within rail labor and management have become cognizant of the fact that their interests are one and the same and that there are mutual benefits to be derived from a cooperative approach to industry problems. This spirit of cooperation has manifested itself on numerous individual roads and on an industry wide basis through the activities of the Task Force on Rail Transportation of the Labor-Management Committee. This group has realized significant improvements in car detention time and service to shippers in the St. Louis Terminal on an experimental basis and has recently decided to expand its experimentation to another terminal and to a line-haul operation. This labor management cooperative approach is probably the most significant recent development in the labor relations field, and its future expansion is almost assured.

exactly what the local officers encouraged them to do.

"9. Promulgating rules' notices during strikes. Seniority rules and craft lines ignored. Employees mistreated. Some held away from home 24 to 36 hours and then told to get home the best way they could."

Industrial peace came to the industry in the early 1970's when railroad presidents realized that their ambitious plans for Federal financial assistance and regulatory relief could not be achieved without the active support of organized labor. When the unions testified against legislation implementing the industry's program, the railroad presidents quickly responded to union demands for improved labor relations down to the level of the employee.

National agreements were signed settling the firemen's dispute and allowing for work rule changes in several major areas, as follows:

- To submit disputes over changing boundaries between yard and road crew to final and binding arbitration in certain cases;
- To allow yard crews to perform switching services beyond traditional limits;
- To allow crews interchanging cars between railroads to move cars in both directions and to relax the rules for specification of interchange tracks by the carriers;
- To allow road crews to pick-up and set-out cars for their own trains even though yard crews are employed at a site; to handle their own engines and cabooses; and to receive from or deliver their trains to connecting carriers;
- To eliminate additional payment for train and engine employees who use radios and telephones during operations;
- To submit disputes over the conditions for increasing the length of run of crews on trains to final and binding arbitration;
- To combine the seniority rosters of trainmen and yardmen; and
- To provide fair and equitable arrangements to protect for up to 6 years the interests of employees adversely affected by changes in the rules governing interchange, work of road crews in yards, and length of run.

During this period, wage negotiations with most unions proceeded smoothly. For example, contracts with operating employees provide for 16 wage increases totaling almost 65 percent in the 8-year period ending January 1, 1978. The Association of American Railroads Index of Wage Rates and Supplements rose to 207.1 from a 1967 base of 100 at the end of 1975. Increases scheduled for 1976 and 1977 should raise this index close to 225. Subject to the limitations of regulatory lag, railroads have financed these wage increases primarily through general rate increases approved by the ICC. Unfortunately, the economic benefits of the 1972 work rule agreements have contributed little to offset the wage increases. The industry reported in August 1972 that the estimated savings represented less than 1 percent of operating payrolls.

Beginning in 1972, railroad management and labor joined forces in obtaining congressional support of the railroad industry. In addition to the RRR Act of 1973 and RRRR Act of 1976, several major pieces of legislation became law during this time:

- The Railroad Retirement Act of 1974, Public Law 93-445, which provided for removing the projected possibility of bankruptcy and putting the retirement fund on a sound actuarial basis;
- Railroad Unemployment Insurance Act Amendments, Public Law 94-92, which increased unemployment and sickness benefits to railroad employees.

These Acts represent significant accomplishments for rail labor and management. Substantial amounts of public assistance have been committed for the reorganization, rationalization, and rehabilitation of the railroad industry, and provisions have been made for protecting employees from adverse effects of these processes. In the case of the reorganization of the bankrupt railroads, the Government has provided $350 million for the cost of employee protection. In the case of rehabilitation and rationalization projects, the law requires carriers to cover the costs of protecting employees for up to 6 years.

Despite these accomplishments, high labor costs and constraining work rules are widely accepted as still being high on the list of the rail industry's chronic and critical problems. In theory, the work rules have induced management to increase capital inputs relative to labor inputs over the last several decades. Management reaction to high crew costs has been to run longer, less frequent trains. This has re-

Future Equipment and Facility Improvements

The rationalization and rehabilitation of the right-of-way was discussed in the previous section. The ability of the rail industry to compete and survive in the future will also be based on how well it can overcome outdated practices and increase the productivity of its equipment and facilities. The following sections examine the trends now unfolding and the potentials for future improvements.

Freight Car Control. The poor utilization of freight cars was cited earlier. In the period between 1956 and 1972, net investment in freight cars increased 154 percent while freight revenue increased only 40 percent. By 1973, the freight car fleet had become almost 50 percent of the railroad industry's net capital investment. How crucial the need is to remedy this situation may be seen by noting that in 1974 industry earnings, the best in 8 years, produced an average return of only 3.44 percent on net investment while the cost of borrowing exceeded 9 percent.

Despite an alleged freight car shortage, the existing fleet of cars continues to be poorly utilized. The average rail car in the national fleet of approximately 1.7 million cars handles only 15 revenue loads per year, or one load every 24 days. This compares with a 17-day average load cycle in 1947, and an 11-day average cycle in 1922.

Some part of the shortage of freight cars for shipping freight is attributed to their use by customers as a means of temporary storage. Demurrage charges to customers are $10 per day after a period of free time, $20 per day the next 2 days, and $30 per day thereafter. Present demurrage rules exacerbate the poor average load cycle, as a result of the 7 a.m. demurrage day, demurrage averaging agreements, and weekend and holiday free time.

Since over 75 percent of loaded freight cars are currently handled by more than one carrier, improving equipment utilization and reliability is a goal that transcends the individual roads and applies to the entire railroad industry. There is a maze of constraints associated with work rules, regulations, organizational balkanization, and financial decay. Action can and must be taken to improve service reliability and equipment utilization. Over a year ago a National Steering Committee on Car Utilization (research/demonstration/action) was established, which brings together the shipping industry, the individual railroads, the Association of American Railroads, the ICC, and the Federal Railroad Administration. Several programs designed to increase service capability and car utilization have been initiated and are being carried out by task forces under the aegis of this committee.

The Clearinghouse. The Rail Car Clearinghouse is an accounting mechanism tried experimentally since 1974 on three railroads, by which debits and credits are exchanged instead of physically exchanging empty cars. This experiment resulted in a decrease in empty car-miles of over 30 percent, increased revenue carloadings of 37 percent, and a decrease of the load-to-load cycle by approximately 20 percent, or more than 4 days. In the first 12 months, empty car movements were reduced by about 5 million car-miles, with an economic value of $700,000 at 14¢ per car-mile. These savings were achieved during a period of car surplus and depressed economy. The Clearinghouse has since been expanded to 10 railroads, which represent over 35 percent of the Nation's car fleet and car loadings. Annual car-mileage savings of $1.5 million and car-day benefits of $1.9 million per year are estimated for these 10 railroads. A nationwide savings of $10-$20 million per year could be expected if the Clearinghouse method were implemented nationwide.

Hourly Car Hire. For decades car hire has been on a 24-hour or per diem basis. This practice causes terminal congestion and late evening fleeting of trains. It further militates against high-quality service, reliability, and effective car utilization. Feasibility studies indicate that hourly car hire can reduce the load-to-load car cycle while enhancing interline throughput, which approximates 65 percent of the Nation's rail traffic.

Conversion to hourly car hire was recently passed unanimously by the Operating-Transportation Committee of the Association of American Railroads and will be implemented in January 1978. The conversion costs are estimated to be $1.6 million; however, the potential cost savings are estimated to have a present value of $40-$80 million for the national railroad system, with annual net cost savings of $19-$33 million.

Reductions in Operating Expenses. Through a program known as the "St. Louis Terminal Project," experiments are being directed toward reduction in operating expense, improving terminal throughput, and enhancing the salability of the rail transportation product. These experiments are being conducted with the joint participation of the Federal Rail Administration, railroad labor, and railroad management. Some of the experiments will soon be applied to the Chicago Rail Terminal Information System. Since over one-third of all cars loaded in the United States originate, terminate, or pass through the Chicago Terminal (over 50,000 cars moving on over 1,500 trains daily), significant benefits may be realized shortly at a national scale. These gains will have been accomplished with minimal capital expenditures.

Freight Car Scheduling. A freight car scheduling system developed by the Missouri Pacific Railroad (MOPAC) and partially funded by the Federal Railroad Administration will be demonstrated shortly. Although developed by the MOPAC, the system is designed as the foundation for interline car scheduling on a national scale—nationwide freight car scheduling is estimated to result in a total savings of $1.5 billion.

The Grand Trunk Western information and control system is a similar endeavor capitalizing on the current technology found in optical automatic car identification. This system is designed to provide a high-quality integrated data base and will greatly enhance transferability and eliminate redundant, splintered, and uneven system development by other rail carriers.

In the longer term it is hoped that these programs will reduce average car-trip times to between 4 and 5 days over an interstate rail network (as opposed to 6 to 7 days at present) with an associated gain in service reliability. This potential improvement translates into a 15-percent reduction in the car cycle, which is equivalent to adding 250,000 cars to the fleet, and avoiding capital investment of $6.25 billion over several years. In addition, it would have favorable impacts on car requirements, yard switching costs, and shipper in-transit inventories through reducing the number of classifications by 20 percent (which would save an estimated $300 million per year) and reducing shippers' in-transit inventory by $300 million per year (assuming 15 percent for the cost of their capital).

While it must be kept in mind that these are but preliminary estimates, any accomplishment in this direction should enable the railroads to achieve a better competitive position relative to the other modes.

Yards. Another area where major gains in productivity are believed possible is in the classification yards.

Nationally, there are over 4,000 yards, handling over 1 million cars per day. About one-third of rail operations are not only a direct contributor to delays, but also have a major effect on the unreliability of transit times. The nature of railroad operations is such that cars will always go through some yards, and yards will always be bottlenecks for point-to-point rail transportation. Yards are the hubs and production centers of railroad operations, where the cars are serviced and made up into trains, yet each offers major opportunities for delay and increased unreliability.

At each yard, cars moving to common intermediate or final destinations are consolidated into "blocks" and then added to a train routed in the direction of the ultimate destination. These blocks will be handled together until arrival at the next yard, which may be more than a 1,000 miles distant. Whenever a car is set off from a train, or the train reaches its destination, the car is reswitched and consolidated with other traffic into a new block and a new train. This procedure is repeated until the car reaches its final destination.

This process of switching and consolidation results in longer transit times than would be required for direct movement, such as by unit train. Each time a car is switched, the potential for a missed connection at that yard exists.

Missed connections are critical in that they lead to car delays in the order of 12 to 24 hours (the time until the next appropriate outbound train), large variations in transit time, and unreliable performance. Figure VII.5 shows the magnitude of transit-time delay and transit-time variance as a function of the probability of a missed connection at a yard.

A car may miss its outbound connection for a variety of reasons:

- *Outbound train cancellations* — The outbound train or block did not run owing to a lack of power, crew, traffic, or other causes.

• *Train length/weight constraints* — If the appropriate outbound train has already exceeded its length or weight restrictions, the car in question will not be accommodated. Clearly, train cancellation on one day may well lead to excess traffic on the next day.

• *Other causes* — Car misclassification, car repairs, missing waybill, etc., contribute to delay.

• *Late arrival of car* — The inbound train carrying the car in question may arrive behind schedule. It has been shown that the primary cause of late arrivals at a yard is late departure from the preceding yard. Hence holding trains to allow particular connections to be made may lead to inbound lateness at succeeding yards and the possibilities of other missed connections.

Cars lose time in yards because of inefficiencies in yards. In a recent survey of how cars spent their time in classification yards, it was found that about half the time was spent in waiting to be "accumulated" with other cars and made up into trains. The respective proportions for hump yards and flat yards appear in figures VII.5 and VII.6. There are a number of reasons for the inefficiencies in yard operations. These are listed in figure VII.7.

With regard to the prospects for future improvement of the overall rail system, yard problems can be mitigated by finding ways to improve the performance in each yard, or by reducing the number of yards through which a car must pass. The latter can be done by running more frequent and shorter trains between specific origin-destination pairs so that the cars do not have to be switched between trains so often. Such a strategy, however, must consider trade-offs between labor utilization and locomotive utilization. Current work rules controlling crew sizes make the short-train concept economically unfeasible. The short-train strategy also requires cooperation between adjacent railroads, which may or may not exist.

Substantial opportunities for improving yard operations lay in the area of physical improvements. These have frequently been deferred because of inadequate capital and maintenance funds. Some of these projects will be eligible for financial support under the RRRR Act of 1976. The following options might be considered to improve yard operations and reduce time spent by cars in yards:

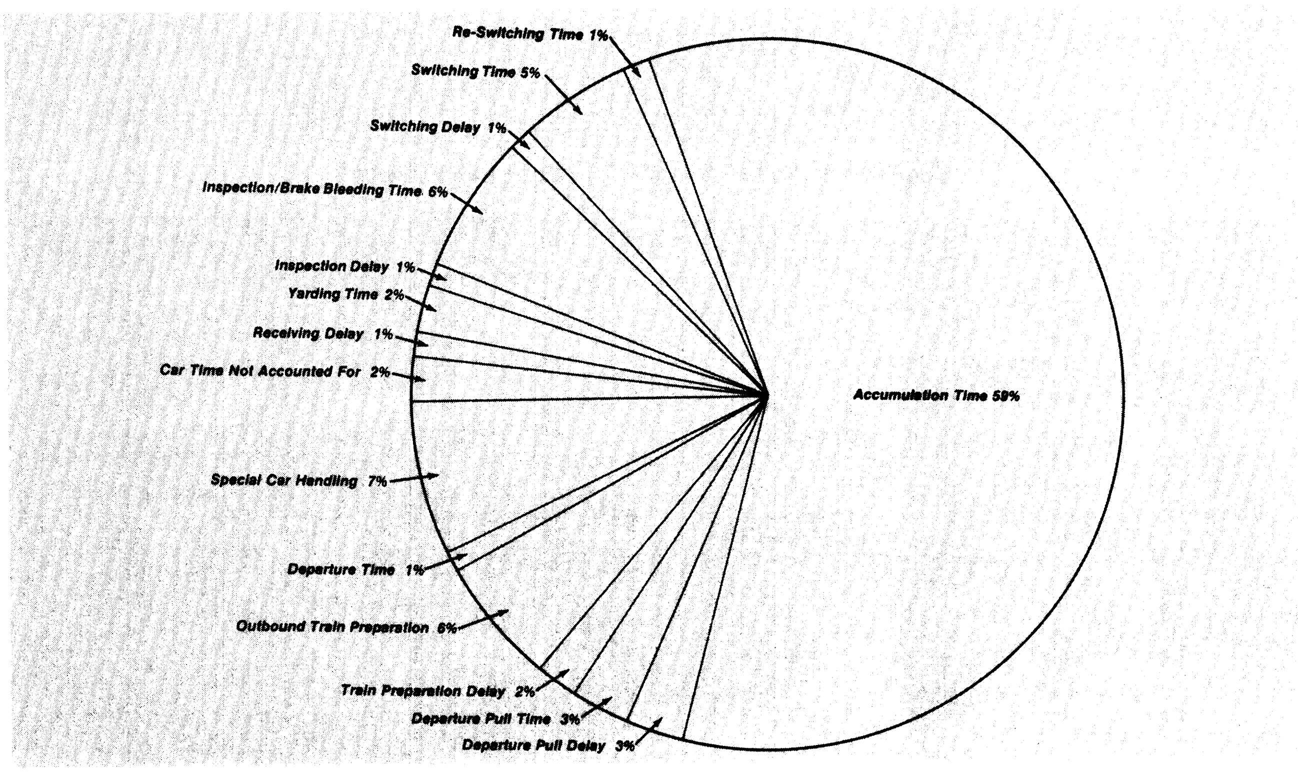


Figure VII-5. Distribution of Car Time in Flat Yards

- Consolidating yards by closing some and increasing the capacity and workloads of others, gaining economies of scale and greater opportunities for high volume throughout. This should be done only through a total system study of all the yards involved, and the origins and destinations of all the cars served by them.
- Upgrading flat yards to hump yards to take advantage of the greater classification switching throughput generally provided by hump-switching rather than flat-switching operations.
- Developing and installing computerized yard planning and inventory control systems which show the location and status of all cars in the yard, and plan for their disposition. For greatest effectiveness, such systems must be tied into the railroad company's systemwide car management information system.

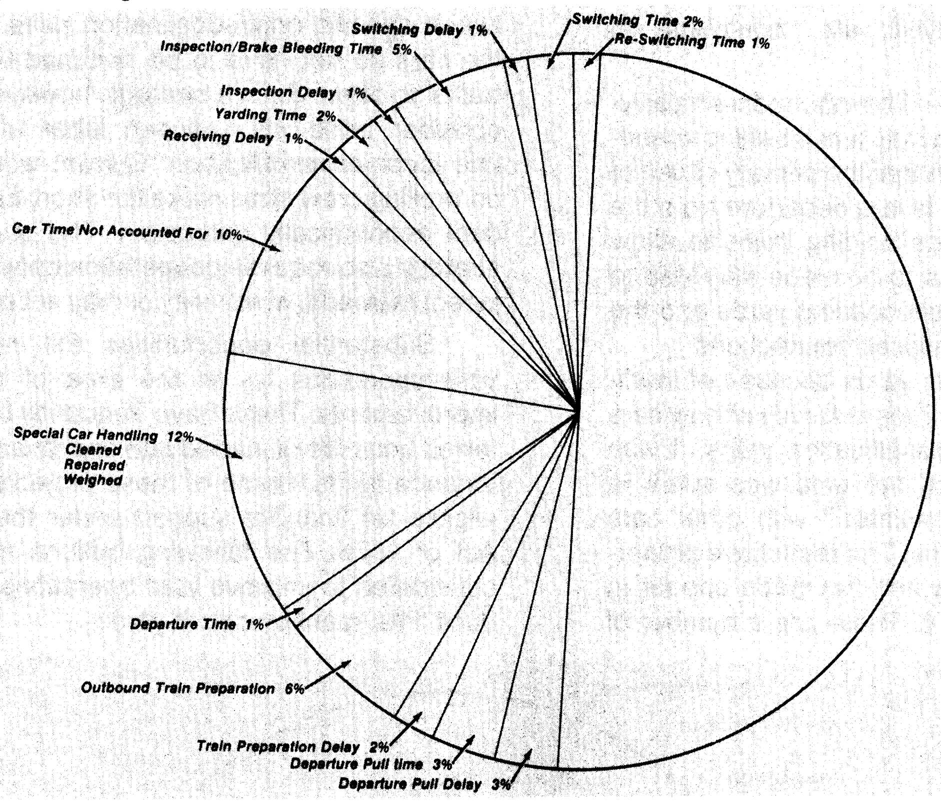


Figure VII.6. Distribution of Car Time in Hump Yards.

In many yards, car speeds may be restricted by condition and/or weight of tracks that were designed to handle smaller and lighter cars in use years ago when the yards were built, but the tracks have not been upgraded for current bigger and heavier cars.

Deferred yard track maintenance may have reduced yard capacity and capability by rendering certain tracks useless for certain, if not all, cars.

Yards may be in congested urban areas with grade crossings, and city ordinances may restrict operations across grade-crossing tracks during certain periods of the day.

A gradual degradation of yards due to lack of maintenance may have caused a redistribution of yard workload throughout a railroad system to other yards, thereby increasing the workloads on these yards beyond their intended capabilities.

Essential yard operating support facilities, such as lighting, communication systems, drainage facilities, etc., may be neglected and therefore contribute to reduced yard productivity.

Theft and pilferage in certain yards, despite railroad prevention attempts, may have encouraged railroads to reduce operations at some yards which might otherwise be better utilized.

Customary railroad labor craft distinctions may delay the accomplishment of yard tasks that could be done by personnel in proximity to the need, but instead must be done by other workers who must be called to and transported to the task site.

Reductions in yard workload volume due to business reductions or changes in operating patterns may have suggested consolidations of yards; however, labor constraints and/or railroad management disagreements may have discouraged such attempts.

Starting-time work rules require using two shifts of yard crews even though actual work might require less than 8 hours.

A shortage of FCC-granted radio frequencies may inhibit adequate radio communication around the yard.

Certain services such as weighing and inspection may divert a car from an otherwise faster flow or processing through the yard.

Disposition of a car approaching or in a yard may not always be known, so that it must be delayed until such disposition is determined.

Locomotives may not be available to move cars within a yard.

Cars that have been poorly maintained are more vulnerable to damage in yards, where they undergo more handling, bumping, acceleration, and deceleration than in well-maintained yards.

Figure VII.7. Causes of Inefficiencies in Yard Operations.

• Installing more automation in car handling such as weighing-in-motion scales, automatic (rather than manual) retarders which regulate the speed of rolling cars, and automated repair and service facilities of various types.

To be fully effective these capital improvements should be accompanied by changes in labor craft distinctions and work rules that will permit greater labor productivity in yards.

Improvements such as these are already being applied by the railroads that can afford to do so. Within the last 10 years, a number of significant yard enhancements have been put in place and some railroads have built new large-freight classification yards which represent the latest state-of-the-art in yard technology.

Electrification. Under some circumstances, electrification of high-density rail routes may prove helpful in lowering railroad operating costs and reducing oil consumption. Current research on the subject is not yet sufficiently advanced to provide definitive answers as to when it becomes desirable to electrify rail lines, but the relevant parameters that must be considered have been identified.

The cost of purchasing and delivering electricity must be lower than the cost of continuing to use diesel-electric technology to move the trains if electric facilities are to be installed.

Transmission facilities must be installed and electric locomotives purchased before electric operation can commence. The capital costs associated with electrification, depreciation, and maintenance are additional costs not now borne by the railroad. Savings take the form of reduced costs of maintenance of electric locomotives relative to diesel equipment and lower fuel costs. Investment in electric locomotives replaces some investment in diesel equipment, but there is not a one-to-one tradeoff because of the necessity of keeping extra equipment to facilitate switching from diesel to electric locomotives and back, as one passes over alternate electrified and nonelectrified stretches of track.

Electrification is not oil saving if the source of electricity is oil. It is oil saving if the source of electricity is coal, nuclear power or hydroelectric power. At this point, however, it is not clear whether turning coal into electricity is preferable to developing a locomotive that burns coal or a coal derivative to power the locomotive directly.

A recent Department of Transportation study, *Preliminary Standards, Classification, and Destination of Lines of Class I Railroads in the United States,* identified approximately 8,200 route-miles of line, carrying traffic density greater than 40 million gross tons per mile per year. These lines are the most likely to be electrified if it proves to be cost effective to electrify any rail lines. Research is continuing in an effort to provide a definitive answer to the question of when it becomes desirable to electrify a rail line.

Transportation of Hazardous Materials

The railroads have been handling large quantities of hazardous materials since the Civil War. The first petroleum tank cars were placed in service in 1868, and explosives, particularly for mining, were being transported in quantity by the 1880's. By 1905, the railroads had developed rules covering the acceptance, placement, and handling of hazardous articles. In 1907, however, several disasters in the transportation of high explosives by rail led Congress to pass legislation regulating the railroad carriage of explosives and certain other hazardous materials.

In the mid-1950's financial difficulties caused the railroads to defer maintenance of equipment and track and to reduce the number of inspections. During this time of general deterioration of the railroad transportation plant, the size and weight of tank cars were allowed to increase up to a maximum of 60,000 gallons. In addition, the center sill and uninsulated type of tank cars for the transport of compressed gases were developed. In 1969, the combination of these events resulted in numerous catastrophic rail transportation accidents involving tank cars carrying hazardous materials.

The need for additional safety measures to reduce the frequency of these accidents has resulted in a new regulation. The maximum size of railroad tank cars was limited to 34,500 gallons or 263,000 pounds gross weight. New rules appeared regarding the head shield requirements for uninsulated tank cars and certain handling restrictions in railroad yards for these same cars.

The Rail Safety Act of 1970 gave the Department of Transportation jurisdiction over all areas of railroad safety, including track, roadbed, freight car standards, employee qualification standards, etc. and provided funds for research.

Tank car research was begun, including a testing program and safety analysis of tank cars, the development of a thermal shield to withstand accident-caused fires, a practical and effective insulation material for tank cars exposed to high temperatures, and tank car safety relief devices to prevent loss of material during transportation, accidental derailment of tank cars, disastrous fires and explosions.

Training and emergency information for handling hazardous material after an accidental loss is being disseminated to firefighting personnel and other interested personnel.

Addition material on the transportation of hazardous materials will be found in chapter II.

PLANNED RAIL SYSTEM

The preceding section has illuminated the actions and issues that surround the future evolution of the Nation's railroads. The recent actions by the Federal Government in support of the railroad industry reflect forceful Government efforts to achieve the policies and objectives described. An impressively large number of objectives set forth in the "Statement of National Transportation Policy" have already been treated in some fashion in the RRRR Act of 1976. In some cases these objectives have been enacted into law; in others the Department of Transportation or the Interstate Commerce Commission has been charged with the task of producing the information required for decisions yet to be made under the Act.

Substantial infusions of funds were authorized under the RRRR Act of 1976. In summary they are as follows:

Perhaps the most significant effects of the RRRR Act of 1976 upon the planning process are its new requirements and authorizations for obtaining, collating, and evaluating hitherto unavailable, incomplete, or noncomparable data regarding the railroads, and the many studies mandated on how to reverse the present adverse trend of the industry in order to restore its transportation capabilities. The inclusion of such studies in the Act opens the way to acquiring the data necessary both to evaluate present industry requirements and to forecast future rail vitality and traffic share. These data will emerge under the 12– to 24-month deadlines imposed for most of the major studies.

Recognizing that, at the time of this writing, most of these data are still many months away, this section nevertheless attempts to delineate the 1990 system and its performance. It begins with the market in which the industry will be operating (i.e., the projected demand for rail freight services) and then discusses the industry response. It thus interprets and summarizes the future implications of the many possibilities.

The Projected Demand for Rail Freight Services

The 1990 demand for rail services, based upon the forecasts in chapter II, appear in figure VII.8. It will be recalled that the forecast of 1990 freight flows is based on the OBERS projections, with modifications including the movement of western coal as forecast by the FEA and as was previously described. On that basis the overall demand for rail services is forecast to increase by 42 percent between 1975 and 1990. The rail demand shown here is an extrapolation of a proportionate share of trips by each commodity group between each pair of Bureau of Economic Analyses (BEA) regions as was captured by rail in 1972. It must therefore be considered a baseline forecast. Whatever gains may result from the improved competitive position of the railroads expected in 1990 have not yet been taken into account. It will be recalled from earlier discussions of this type of diagram that the density of each line segment portrays the tonnages that are expected to move into and out of each BEA region. It indicates the general pattern of flows, but does not take into account how other features of the rail routes between these regions (the capacity of the right-of-way, the ownership of the various route segments, or the work rules that prevail) may influence shippers or carriers to choose alternative routes by which to get their goods to their eventual destinations. Also it does not take into account changes that will occur if there are major modifications in public policy of the type we identify in the last part of the document.

FIGURE VII.8. 1990 RAIL FLOWS.

The Industry Response

The preceding section described the many actions that have been taken and the options that appear to be emerging that have major potential for improving the health of the railroad industry. While each will have favorable impacts on the industry's ability to reduce costs, improve service, and compete for higher revenues, it should be noted that the estimates shown represent the assessed impact of these measures when taken independently. In actual practice, each will realize only part of the overall potential indicated.

Nevertheless, there are prospects for the good health of the railroad industry. The more salient of these are summarized by the following charges, which are assumed to have taken place by 1990.

Revenues. From the baseline forecast, the absolute volume of ton-miles of traffic by 1990 is up 140 percent. This increase in traffic, together with anticipated adjustments in rates, should result in significant improvement in the industry's revenue balances. Under the regulatory reforms of the RRRR Act of 1976, the railroads will have taken advantage of the increased pricing flexibility and adjusted their rates to meet competition on the downside and to maximize revenues on the upside. All competition rates that were artificially low will have been raised to their incremental cost. Conversely, the rail carriers themselves will no longer be setting rates below their variable cost. The railroads will thus have adjusted their rates to maximize profits in all markets except in those where they are prohibited from doing so because they have been found to have "market dominance" (defined by the Act as "an absence of effective competition from other carriers or modes of transportation for the traffic or movement to which a rate applies"). Even in those cases they will still have sought some increases on the grounds that additional revenue is needed, or that the rate would not be unlawfully high.

Under another provision of the Act, the railroads will have been given greater latitude to establish rates based on seasonal, regional, or peak demand for services. This will have enabled the railroads to respond more completely and rapidly to each individual shipper's specific changing needs. Each shipper need purchase only that service package that he desires, and he no longer has to pay for services he prefers to do without.

As a consequence of this increased flexibility in the provision of alternative price/service combinations, the railroads will have found themselves in a better position to compete against carriers of other modes. Their marketing operations will have become more in tune with the shippers, more aggressive, and more modern.

Waterway-User Charges. With the implementation of waterway-user charges by 1990, the competitive rail lines will have raised their rates to the point where they have obtained a combination of higher revenues received versus minimum traffic diverted to other modes.

Light-Density Lines. The railroads will have been relieved of a large part of the estimated $250 million burden of maintaining unprofitable routes and light-density lines. State and local governments will have determined where the continued operation of such lines is vital to the economy of their region, and will be covering the losses in providing service on them.

Discriminatory Taxes. By 1990, the estimated $54 million in discriminatory taxes on rights-of-way charged by State and local governments will have been eliminated so that they now match those of similar properties in other industries.

Operations. Major portions of the main lines will have been rehabilitated by 1990. As a result of the Clearinghouse, hourly per diem freight car scheduling, and other organizational improvements, it is estimated that a savings of over $1.5 billion will be realized in handling rolling stock. The use of computers, automated data bases, and management science techniques will have become more widespread in the industry. The status of large portions of the freight car fleet will be maintained on an up-to-the-minute basis. The yards and the management of freight cars will have become more automated. The automated demand forecasting, supply forecasting, and car allocation systems projected to be in effect, with their associated service, will realize improvements estimated at better than 10 percent. Other high-technology improvements will be experiencing broader application. Some type of automatic car identification system will be in operation to

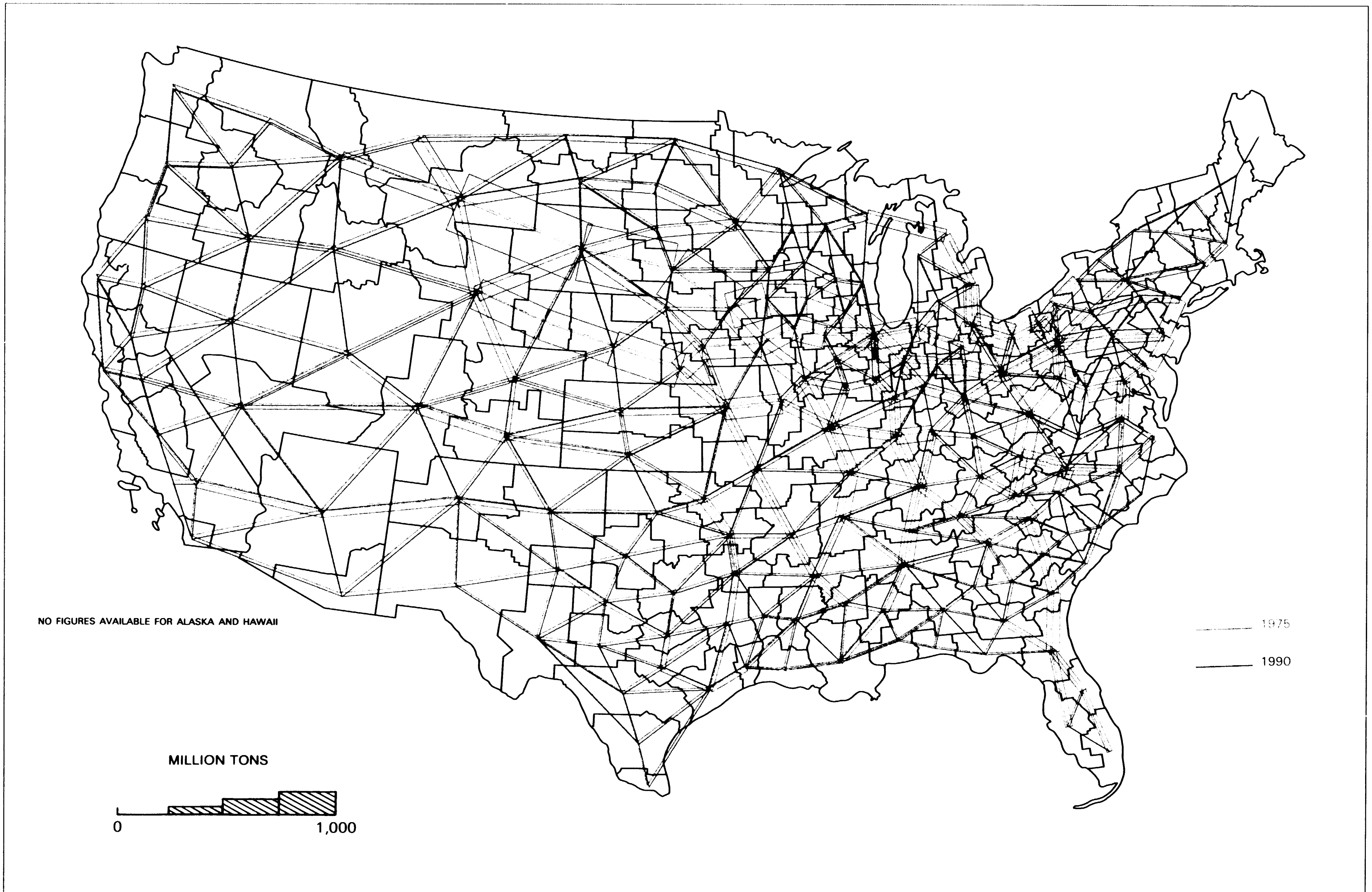
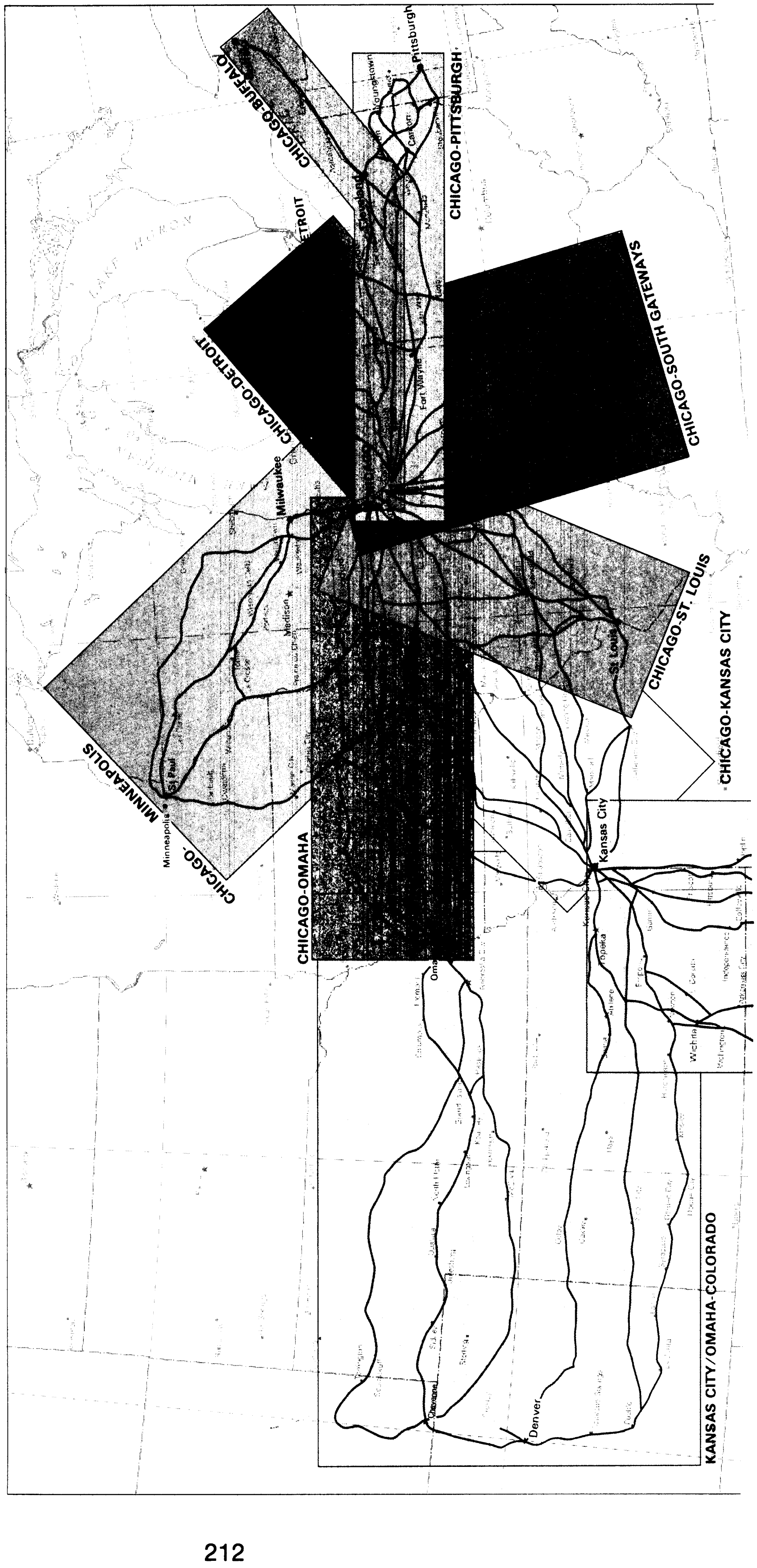
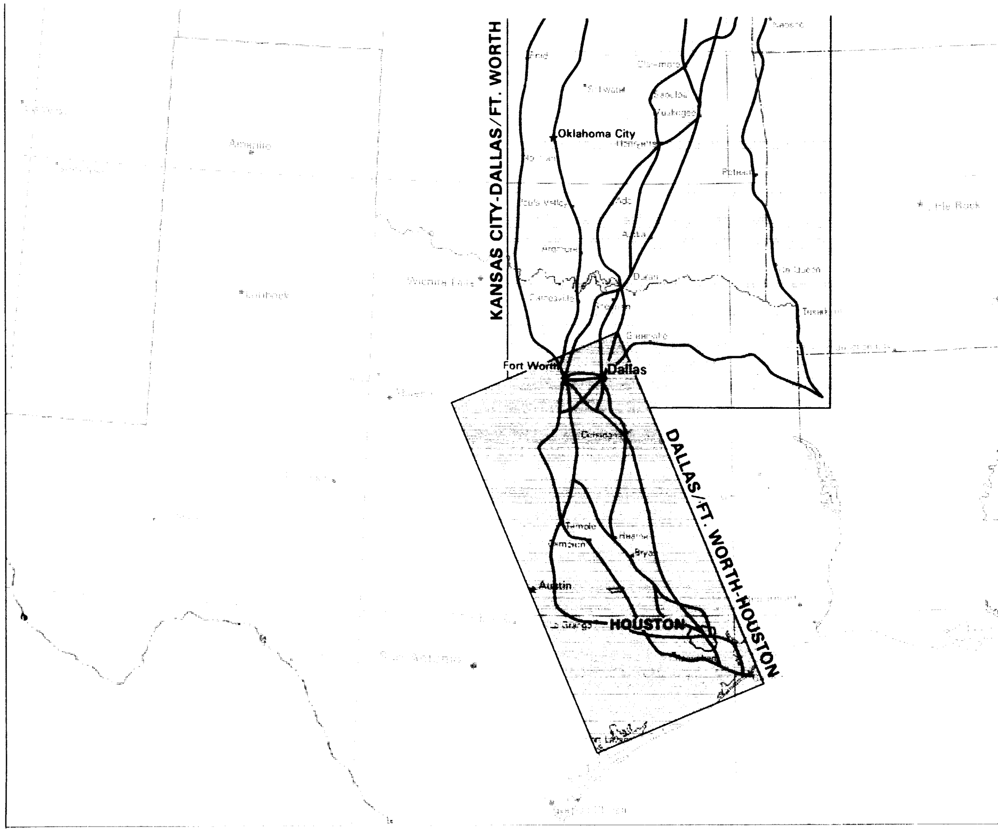


FIGURE VII.9. 1975-1990 RAIL FLOWS.



CHICAGO-BUFFALO
CHICAGO-PITTSBURGH
Pittsburgh
CHICAGO-DETROIT
CHICAGO-SOUTH GATEWAYS
Fort Wayne
Milwaukee
Madison
CHICAGO-MINNEAPOLIS
Minneapolis
St Paul
CHICAGO-ST. LOUIS
St Louis
CHICAGO-KANSAS CITY
Kansas City
Topeka
Wichita
CHICAGO-OMAHA
Denver
KANSAS CITY/OMAHA-COLORADO



CORRIDORS OF EXCESS CAPACITY*
1975 STATUS AND 1990 FORECAST

CORRIDOR	MILLIONS GROSS TON-MILES			PERCENT Excess Capacity	
	1975 Capacity	1975 Demand	1990 Demand	1975	1990
CHICAGO-PITTSBURGH	427	163	196	162%	118%
[redacted]					
CHICAGO-KANSAS CITY	362	167	423	117%	-17%
KANSAS CITY-DALLAS/FT. WORTH	189	120	183	58%	3%
DALLAS/FT. WORTH-HOUSTON	157	81	181	94%	-13%
[redacted]					
KANSAS CITY/OMAHA-COLORADO	280	127	491	120%	-43%
CHICAGO-MINNEAPOLIS	272	111	348	145%	-22%
[redacted]					

*A corridor of excess capacity is defined as one in which three or more parallel through-routes, operated by three or more carriers, serve the corridor and the practical traffic-handling capacity of the combined routes which exceeds the actual traffic density by 50 percent or more.

FIGURE VII.10. 1975-1990 CLASS I RAILROADS — CORRIDORS OF EXCESS CAPACITY.

support these information systems, yard operations, and terminal operations. Smaller trains will operate with fewer yardings, resulting in reduced transit times and adding to improvements in reliability. Carrier marketing departments will be promoting their new improved speed and reliability in service, featuring the estimated $300 million savings in inventory carrying costs to shippers.

Future Traffic and Network. Many of the mainlines will have been consolidated through mergers, joint trackage rights, and other measures. A substantial portion of the excess lines noted in the map found at the back of the book will probably be downgraded to a classification reflecting their primary function as local service lines.

In contrast, the ton-miles of traffic will have more than doubled. Part of this is the result of the projected increase in general economic activity by 1990. A far larger part will be the result of new flows of coal from the Northwestern States forecast by the Federal Energy Administration and described in their "National Energy Outlook for 1990" report.

The increased growth in demand for rail movement is seen in figure VII.9. The effects of the tenfold increase in low-sulfur coal movements from the western Great Plains is apparent. It is also assumed in this projection, however, that these major coal slurry pipelines, as described in chapter X, will also be in operation.

One question of immediate interest is how this increased movement is related to the August 1976 preliminary classification of class I lines performed in accordance with section 503 of the RRRR Act of 1976. That report was based on 1975 traffic levels, and identified 11 corridors of excess capacity, categorizing them as Potential A Mainlines. By 1990, however, much of this capacity will be needed for the projected movement of coal. This may be seen in figure VII.10, which contrasts projected 1990 traffic in these corridors with that of 1975. It appears likely that five of the corridors will actually need to have their effective capacity increased to do this, physical and operational improvements will have to be made for permit full capacity of the existing trackage to be exploited; in selected instances, new trackage will also be required.

Return on Investment. By 1990 revenues and returns on capital investment are assumed to be up. The industry will have achieved a more favorable financial position from which to repay loans guaranteed by the Federal Government.

The Interstate Rail Passenger Network. Amtrak will operate all the intercity passenger routes. They appear in figure VII.3. The segments remaining will be self-supporting. In each city, the terminals will be co-located with intercity bus terminals and taxi stations.

The northeast corridor route between Washington and Boston, upgraded at a cost of $1.75 billion, will carry an estimated 45,000 passengers per day. In the event of an energy shortage similar to the one in 1974, it will carry 65,000 per day.