$1.4 billion, compared with an approved list of $22.7 billion in projects to complete; for the Bureau of Reclamation, appropriations have averaged $503 million a year as against $12.8 billion in projects.

In looking at these programs, the General Accounting Office (GAO) has found not only a low federal confidence in the need to complete construction in many cases, but also a reluctance or even refusal on the part of local authorities to share in financing.[9] If priorities among projects were clearly sorted out by applications of a common discount rate and if there were an effective way to retire projects, many of the backlog projects would be removed from project lists or modified. GAO reports the Corps' estimate that half the active project list should probably be discontinued.

A look at the Corps' 1986 budget request for construction projects suggests that the list of approved projects could indeed be substantially cut without economic loss. The 1986 request includes 84 construction projects that are less than 80 percent completed and for which the result of an economic evaluation is available. The combined worth of these projects is $15 billion, of which $5 billion has already been spent. For 33 of these projects, no construction work has yet been undertaken. According to the Corps' estimates, all the projects have ratios of discounted benefits to discounted costs of 1-to-1 or more: the lowest ratio is 1.02-to-1 (at an 8.375 percent discount rate) and the highest is 27.3-to-1 (at a 2.625 percent discount rate).

Were the discount rates the same, a higher ratio of benefits to costs would indicate a stronger economic justification for the second project. But because the discounted amounts reflect both the timing of benefits and costs, as well as the discount rate, the Corps' ratios give no information on the relative worth of the two projects. Moreover, because the 2.625 percent rate is so much lower than the other, whether or not the second project would achieve the minimum 1-to-1 ratio at the higher rate is unclear.

For the 84 projects proposed, present values (that is, the difference between discounted costs and discounted benefits) have been recalculated, using a 10 percent discount rate for all projects, but using the Corps' estimates of annual benefits and operating costs and projected completion dates for construction. All projects were assumed to have 30-year lives before major rehabilitation expenditures would be needed and to be 100 percent productive from the first day of operation. Both of these

9. See General Accounting Office, *Water Project Construction Backlog--A Serious Problem With No Easy Solution*, GAO/RCED-83-49 (January 26, 1983).

assumptions tend to favor projects. Even so, the present values for 34 projects are negative. In other words, if these projects were completed, the remaining construction costs would exceed the benefits generated over a 30-year operating life. With nonfederal shares included, the proposed 1986 expenditure on projects with negative net benefits is about $350 million, and the combined value of the projects is $6 billion. Were these projects cancelled instead, future expenditures of some $4.4 billion could be saved. If this amount were redirected to completing projects with positive present values, these projects would be finished about six years earlier.

Clearly, a more accurate picture of current commitments, as well as a better understanding of priorities, would follow from simplifying the procedures for reviewing priorities for long-lived projects and for terminating projects that, as planning proceeds, are found to be of dubious economic worth. This process would apply not only within the multiple purposes in the general water resources category--irrigation, flood control, power generation, and shipping--but also among other purposes. Before 1970, there was no process by which an approved water resources project could be cancelled if found later in the planning process to be unwarranted. Now a project can be scrapped, but a minimum of eight years passes between when it is first deactivated and finally withdrawn. In the interim, apparent federal commitments to water resources development are inflated, and financing for worthwhile substitute projects is deferred.

THE LIFE CYCLE APPROACH

Finally, there is the issue of whether projects with different duration--such as pothole filling and road resurfacing--are allowed to compete equitably for approval and funding. Taking a life-cycle approach in comparing options deals consistently with differences in the timing and durations of events and their effects. To compete on equal terms, proposed projects with high initial costs but long-term effects, others requiring small repeated corrections with shorter impacts, and a policy of maintaining current operations must all be compared over a span long enough to reflect all the costs and benefits. When capital investment is one of the options, this can mean projecting costs and other consequences over 20 or more years, reflecting the useful lives of assets to be provided. Under its Technology Sharing program, for example, the UMTA distributes a report to local users on a simplified method for making life-cycle cost comparisons between bus rehabilitation and purchasing new buses.[10/] Bus rehabilitation involves

10. Puget Sound Council of Governments, *The Role of Rehabilitation in Transit Fleet Replacement*, U.S. Department of Transportation (March 1983).

lower initial costs but greater maintenance and a shorter useful life; bus purchases increase investment costs, but they lower maintenance and extend useful time in service.

Not considering costs and benefits over the life of projects discriminates against options requiring investment, tending instead to favor options with low current costs. The crudest patching methods for potholes in roads, for instance, will always appear cheaper than reconstructing badly deteriorated pavement, unless the costs of repeating the patches each two to six months is compared over a seven-year or longer initial life for the new pavement. Technological changes in infrastructure systems and strategic modifications for achieving goals are more likely to be carried out when the management system takes a long-term view.

Measuring Life-Cycle Costs

Though broadly based, examples of evaluation systems that lack the life-cycle approach, can be found in Environmental Impact Statements, and in Alternatives Analyses for new transit proposals. In most cases, these planning studies give snapshot comparisons of different courses of action, usually for a single year somewhere near the mid-life of a favored solution. Though often broad enough in coverage to include information and all of the various proposals' important advantages and drawbacks, the limited depth of that coverage--a single mid-life year--leads to two biases that have distorted infrastructure choices.

First, looking only at projections for a single year distorts the apparent relative importance of capital and operating effects. A proposal to reduce transit deficits by investing in new transit network, for example, may seem attractive. But for the investment to be worthwhile, the cumulative cost savings over the service life of the assets being considered must be enough to offset the investment. The final Environmental Impact Statement for the proposed rapid rail project in Los Angeles, for example, showed that construction of an 18-mile rail subway would reduce the city's annual transit system deficit from $279 million under improved operation of the bus system to $113 million, while constructing a "minimum operable" rail line of 8.8 miles would reduce the city's annual transit deficit to $169 million. [11/] When compared over a 30-year operating life for the system, however, the apparent preference for rail development reverses. Discounting investment and net operating costs over the life of the assets shows that the cumulative costs for the city's "preferred" option would have been $3.6 billion, and that the minimum segment would have cost $3.2 billion, compared with $2.7 billion for improved traffic management under the current bus-based system. Reducing the city's annual deficit through rail development would thus require a commitment to provide between $500 million and $900 million in additional resources to the transit system over and above those needed under improved management for the current network.

Second, looking at distant future effects without a near-term perspective distracts decisionmakers from questioning the implementation strategies for the different options. It also raises difficulties for assessing the credibility of assumptions and forecasts used to project effects. In Pittsburgh and Miami, for example, new rail transit systems have recently opened with large but unexpected operating deficits, and thus no assured source of financing for operations and maintenance. In Miami, daily ridership was initially only one-tenth that predicted in the federally accepted "feasibility" study. In Pittsburgh, initial use was only 20 percent of that applied in comparing project options. After opening new lines such as these, local officials find themselves having to provide large new public subsidies or to close the new systems down.

Managing Lifetime Impacts--The Highway 4R Program

The life-cycle approach is also important--but rarely used--in managing programs that provide both capital and operating subsidies. Prime examples are to be found in transit and highways. Currently, divisions of federal aid between these two categories are not based on assessments of the appropriate balance of capital and operating projects that will achieve the program goals. The following assessment of highway spending for resurfacing, restoration, rehabilitation and reconstruction (termed "4R") shows how this has affected the amount and quality of roadworks.

Observers often cite a capital bias in federal infrastructure programs, arguing that the federal policies for assisting investment have caused nonfederal agencies to neglect operations and maintenance. Broadening the aid to encompass operations and maintenance activities, they hold, can correct this capital bias and make the programs more efficient.

To show capital bias, however, capital spending would have to be more than needed, and that for maintenance and operations less. To date,

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11. U.S. Department of Transportation, *Final Environmental Impact Statement, Los Angeles Rail Rapid Transit Project,* Southern California Rapid Transit District (December 1983). Dollar amounts are in 1983 prices.

thorough reviews of the adequacy of highway investments have been made only for the Interstate network.[12] These reviews tend to show mixed results--in general, overinvestments on rural segments and underconstruction in urban areas. But the reviews do not lead to firm, broadly based conclusions as to whether or not there has been overinvestment in the federal aid system. The broadening of the highway program to include 4R does, however, offer some insight. Monitoring pavement condition shows that, overall, maintenance spending has been sufficient to keep the highway network in generally good shape. The allocation of maintenance among subnetworks, however, does not ensure that the highway transportation system is as efficient as it could be for the amount spent. A detailed review of these findings follows.

Rather than the neglected condition that would tend to confirm less-than-adequate maintenance on the federally aided highways, pavement ratings are consistent with higher-than-routine maintenance budgets. In other words, limiting highway assistance to capital programs until the mid-1970s caused neither neglected maintenance nor increased deterioration. What emerges from the comparison is that states have spent enough to keep ahead of age-related highway deterioration. Nationally, the federal aid highway system is in much better condition, as reflected by the Federal Highway Administration's (FHWA) pavement-rating system, than its age would indicate. Estimated roughly on the basis of road mileage put in service each year since the mid-1950s and standard deterioration rates under routine maintenance programs, about 40 percent of highways (those built most recently) would be in "good" or "very good" condition, but more than half of the highway mileage would be in "poor" or "very poor" condition. In contrast, the FHWA's 1985 Status Report for the highway system reports nearly 50 percent of the network as good or very good, with only 15 percent rated poor or very poor.[13] Further, the proportions of good roads are generally higher and poor roads generally lower for Interstate segments than for other categories of the federal-aid network. *(These comparisons are shown in Table 3.)*

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12. See, for example, Ann Fetter Friedlaender, *The Interstate Highway System, A Study in Public Investment*, Contributions to Economic Analysis No. 38 (Amsterdam: North Holland Publishing Co., 1965).

13. Report of the Secretary of Transportation to the United States Congress, *The Status of the Nation's Highways: Conditions and Performance*, June 1985. The terms "very poor," "poor," "fair," and "good" for road conditions conform to those used by federal and state highway authorities, and to the sufficiency rating classes illustrated in Table 3.

TABLE 3. CONDITION OF THE FEDERAL AID HIGHWAY NETWORK COMPARED WITH ITS AGE

Condition: Present Serviceability Rating a/	Condition: Rating	Percentage of Federal-Aid Network: Age-Based Estimate 1983 b/	Reported Condition 1983: Interstates	Reported Condition 1983: All Federal Aid
Four or Better	Very Good	30	31	17
Three to Four	Good	9	41	30
Two to Three	Fair	10	14	38
Below Two	Poor and Very Poor	51	14	15
Network Total	--	100	100	100

SOURCE: Congressional Budget Office and data provided by the Department of Transportation.

a. A grading system routinely used by highway agencies to assess pavement condition.

b. Estimate of age-based condition is based on data on road mileage put in service each year since the 1950s, and standard road deterioration rates under routine maintenance.

But it is not self-evident that keeping all roads in excellent condition is a worthwhile investment. This is broadly confirmed by the Department of Transportation's recent study which estimated the effects of different levels of highway investment.[14/] The study found that broad positive effects would result from maintaining highways at 1978 standards. At the same time, though, it found that the extra investment needed to repair all deficiencies, averaging around $3.6 billion a year, would provide no appreciable return. Whether in fact highway maintenance has been too much or too

14. See U.S. Department of Transportation, Transportation Systems Center, *Highways and the Economy, FHWA/PL/33/014, DOT-TSC-FHWA-83-1* (November 1983). The amount quoted is expressed in 1980 prices.

little depends on the costs that road conditions impose on users. The extent of traffic use and the condition of sub-networks of the federally aided system indicate a poor allocation of highway budgets for major maintenance that detracts from goals for transport efficiency.

Improvement in a road from poor to good condition means less wear and tear on vehicles and tires, better fuel economy, lower risk of accidents, and shorter journey times. These can add up to a saving in vehicle costs of up to 25 percent. Improvement from fair to good, however, costs roughly the same, but it saves only 8 percent to 10 percent in journey costs. Thus, at current cost levels and allowing for an average volume and mix of traffic, investments to improve roads in poor or very poor condition would have rates of return over the life of the improvements of around 20 percent, while improvements to roads in fair condition would return only around 8 percent to 10 percent, barely equal to the cost of raising funds for the work.[15] A highway program manager maximizing returns (assuming traffic to be equally distributed over road types) would therefore prefer to use additional maintenance resources to upgrade the 15 percent of federal-aid highways in poor or worse condition before correcting the relatively minor defects in fair or good roads. Accordingly, budgetary requests for road rehabilitation and maintenance could be allocated among highway segments to minimize the costs of the road transport system (maintenance plus vehicle operations) for prospective traffic. This process--comparing road improvement costs with resulting reductions in road service costs over the duration of the improvements--would tend to direct funds to those road sections in worst condition and those with heaviest traffic.[16]

Without such a process of comparison, projects to repair fairly minor deficiencies on lightly trafficked corridors drain off resources. As a result, pavement conditions in poor sections and those where deficiencies are highly visible--in cities and on other high-traffic corridors--continue to deteriorate even with an augmented rehabilitation program. The 1985 Status Report confirms that such draining-off is happening. Since 1975, pavement conditions on the most densely traveled routes--urban segments of the Interstate network--have declined, with the proportion in poor or very poor

15. Based on Federal Highway Administration, *Vehicle Operating Costs, Fuel Consumption, and Pavement Type and Condition Factors*, Final Report (June 1982), and *Highway Statistics 1983*.

16. Improving roads in the worst conditions would give relatively high returns because they provide large reductions in transport costs per journey; improving busy roads provides large total benefits through smaller cost savings for a larger traffic volume.

condition doubling (see Table 4), and that in each of the good and very good categories declining. In contrast, on rural collector routes, which have the least traffic, road conditions improved overall, with drops in the share of the network in poor or fair condition, and increases in the extent of good and very good roads. On other low-density networks--non-Interstate rural arteries and urban collector routes--the major change has been a lessening of the extent of the network in fair condition in favor of more pavement in good or very good condition. For routes of medium-density, the record is mixed. For both Interstate rural segments and non-Interstate urban arteries, the proportion of the network in the poorest condition has grown since 1975. But whereas the principal change in urban areas has been in improvements of good roads to very good condition, on the main Interstate network, very good segments have deteriorated to fair and only good condition.

Major highway maintenance to date must then be judged as both too much and too little--too much on the relatively lightly traveled rural networks in fair or better condition, and too little on Interstate segments in fair shape or worse. Reassigning priorities for highway programs so that projects are undertaken in order of the value of the benefits they offer over their useful lives would overcome such misallocation in the current program.

Using life-cycle costing for road transport in determining and allocating highway budgets would thus allow simultaneous consideration of which construction projects to undertake and at what standard to maintain the existing network. Candidate projects could be compared according to their effects on transport efficiency and the extent to which they could reduce transport system costs. Spending could be directed to those parts of the network and to those missing links that would make the greatest contribution to national goals. At the same time, though, it would be diverted from those parts that offer little improvement or none at all.

THE USE OF "HURDLES" *VERSUS* RANKINGS

Though many local governments rank options to compare the spending bids of different agencies, no federal program now formally queues proposals in the order in which they might promote national goals. (*Examples of local practices are described in Box 5.*) In those federal programs that make some use of evaluations, federal managers apply "hurdle," or threshold, values for measures of merit and admit all projects that can pass the test. Water resources project lists, for example, include all investment projects with positive ratios between discounted benefits and costs (treated in detail

TABLE 4. HIGHWAY PAVEMENT CONDITION BY SYSTEM IN 1975, 1978, AND 1983

			Pavement Rating								
			Poor and Very Poor		Fair		Good		Very Good		
Functional System and Year	Total Miles	Traffic Density	Miles	Per-cent	Miles	Per-cent	Miles	Per-cent	Miles	Per-cent	Average Rating
Interstate--Rural											
1975	29,938	3.9	3,113	10.4	2,342	7.8	9,596	32.1	14,887	49.7	3.4
1978	31,161	4.4	3,116	10.0	4,487	14.4	10,219	32.8	13,339	42.8	3.3
1983	32,788	4.4	4,295	13.1	4,263	13.0	13,803	42.1	10,427	31.8	3.2
Interstate--Urban											
1975	8,671	14.8	746	8.6	1,186	13.7	3,222	37.2	3,517	40.6	3.4
1978	9,048	17.4	986	10.9	1,475	16.3	3,167	35.0	3,420	37.8	3.3
1983	10,240	18.7	1,792	17.5	1,679	16.4	3,687	36.0	3,082	30.1	3.0
Other Arterials--Rural											
1975	234,705	1.1	26,052	11.1	80,286	34.2	75,613	32.2	52,754	22.5	3.0
1978	232,096	1.2	23,906	10.3	88,893	38.3	63,130	27.2	56,167	24.2	3.0
1983	228,770	1.2	24,250	10.6	75,524	33.0	83,013	36.3	45,983	20.1	3.0
Other Arterials--Urban											
1975	115,511	3.7	10,396	9.0	44,341	38.4	40,494	35.1	20,280	17.6	3.0
1978	117,559	3.7	11,521	9.8	48,317	41.1	32,446	27.6	25,275	21.5	3.0
1983	123,462	4.1	12,470	10.1	47,533	38.5	36,791	29.8	26,668	21.6	3.0

(Continued)

TABLE 4. (Continued)

Functional System and Year	Total Miles	Traffic Density	Pavement Rating: Poor and Very Poor		Fair		Good		Very Good		Average Rating
			Miles	Percent	Miles	Percent	Miles	Percent	Miles	Percent	
Collectors--Rural											
1975	737,748	0.2	132,057	17.9	346,646	47.0	178,048	24.1	80,997	11.0	2.6
1978	734,678	0.2	130,038	17.7	349,707	47.6	174,118	23.7	80,815	11.0	2.6
1983	734,338	0.2	126,306	17.2	291,532	39.7	204,881	27.9	111,619	15.2	2.7
Collectors--Urban											
1975	65,209	1.0	8,477	13.0	31,365	48.1	18,423	28.3	6,944	10.6	2.7
1978	67,292	1.1	12,381	18.4	32,435	48.2	14,536	21.6	7,940	11.8	2.6
1983	72,513	0.9	11,530	15.9	30,600	42.2	18,708	25.8	11,675	16.1	2.8
All Systems											
1975	1,191,782	1.1	180,841	15.2	506,166	42.5	325,396	27.3	179,379	15.1	2.8
1978	1,191,834	1.1	181,948	15.3	525,314	44.1	297,616	25.0	186,956	15.7	2.8
1983	1,202,111	1.1	180,643	15.0	451,131	37.5	360,883	30.0	209,454	17.4	2.8
Estimated Age-Based Condition											
1983	1,199,559	1.1	611,775	51.0	119,956	10.0	107,960	9.0	359,868	30.0	2.3

SOURCE: Department of Transportation and Congressional Budget Office estimates.

a. In millions of vehicle miles of travel per mile per year.

below). The process for rating new transit starts is based on arbitrarily chosen levels of "cost effectiveness." These reflect not how much a new transit project will improve the system's productivity, but a maximum additional cost per passenger that can be imposed by the project under review. Further, federal managers do not consistently channel financing to the most cost-effective projects discovered through the evaluation procedures they oversee.

Project comparisons under sound management practice must usually span differences in engineering and technical disciplines, as well as differences in purposes, goals, and outcomes. Formal ranking systems help these comparisons by summarizing the evaluations of project options and exposing where projects proposed in different programs have similar prospects in type or amount and where effects differ. Comparing rankings in different areas of effect--measured benefits and costs, intangibles of different sorts, and risks--provides qualitative information important to choices. Aspects of equity and fairness can be reflected in ranking criteria and taken into

BOX 5
RANKING CHOICES TO SET CITY PRIORITIES

In the ranking procedures many local governments follow, sponsors submit ratings of how each project promises to satisfy a number of criteria. These usually cover a wide list of economic and social effects, but ratings are commonly subjective. Dayton, Ohio, for example, rates projects on 18 criteria, but only according to broad categories of major, minor, or no effect. Ranking criteria also often overlap. Minneapolis rates projects on 14 criteria, including closely related categories of environmental quality, quality of life, health, safety, general welfare, and public benefit. Weights assigned to each category are combined to produce an overall summary score for each project. In Nashville, Tennessee, the weights are adjusted by specific values reflecting priority for projects in low-income areas. Hence, though more careful measurements of projects' outcomes would correct much of the subjectivity in these systems (overlapping ratings, if anything, help in this by providing extra information aiding interpretation of very general effects), the ranking procedures nevertheless assist cities in making trade-offs among goals, and in making those trade-offs apparent to both responsible agencies and citizens for whom services are intended.

SOURCE: For further information, see Harry P. Hatry, *Maintaining the Existing Infrastructure Current "State-of-the-Art-and-Practice" of Local Government Planning*, (Washington, D.C.: Urban Consortium, 1981).

account in making budgetary choices. Program ranking, based on the relative worth of marginal projects in different system programs, would advise multi-system managers about where to apply additional resources or where to make cutbacks.

Ranking options after evaluation avoids the rigidities inherent in procedures that simply admit all projects passing over some pre-set hurdle. First, such hurdles cannot adequately reflect qualitative differences. Hurdles are most commonly set in terms of benefit/cost measures, so that those projects for which measurements are more easily or more assuredly made will always appear more attractive. Second, any hurdle value would have to reflect decision criteria not of the day budgetary choices are made but over the period during which budgetary choices will be implemented, which in turn will be somewhat influenced by those choices.

Third, hurdle values are easy to simulate. Analysts may be pressured to vary forecasts or other estimates to produce results that pass known tests of acceptability. Thus, more than one-third of water resources construction projects proposed by the Army Corps of Engineers pass the Corps' "acceptability test" with minimum of benefit/cost ratios of less than two-to-one. Further, seven of the water resources projects proposed to begin in 1986 meet the minimum standard only by using a discount rate only little more than one-third of the 8.375 percent rate applied in evaluating other proposed new starts. Similarly, forecasts of demand for aviation and rail projects are frequently overoptimistic, often exaggerating achievable gains many times over. 17/

CONCLUSION

Effective management of public works infrastructure requires that dissimilar and competing program and project options be evaluated in consistent terms that allow comparison. (*Box 6 describes the evaluation procedures under the federal Highway Bridge Replacement and Rehabilitation Program.*) Once evaluated, the options must be ranked so that those promising the greater contributions to the program's goals are the more likely to be selected. Together, the evaluation and ranking processes must

17. These problems are not unique to U.S. studies. The World Bank, for example, finding overoptimism and over-ambitiousness common in railway planning, has specified "realistic traffic forecasts" as the first of six criteria for railway projects proposed for financing. See *The Railways Problem*, Transportation, Water and Telecommunications Department (Washington, D.C.: World Bank, January 28, 1982).

BOX 6
EVALUATING OPTIONS--
THE BRIDGE REPLACEMENT PROGRAM

The Department of Transportation's Highway Bridge Replacement and Rehabilitaiton Program uses a comprehensive and consistent system to guide project selection. Though not a benefit/cost ranking, the system's Sufficiency Rating scale combines measures of physical condition of bridge structure, limits imposed on traffic, volume of traffic affected, extent of detours needed, and such special features as importance for defense.

The selections are based on biennial inspections of all bridges to identify those with inadequate load-bearing strength and those that no longer meet other federal design standards. A wide range of remedial actions is tested. The program has found that, with proper maximum-load posting and enforcement, structurally deficient bridges can continue to handle most traffic. Measures such as pavement and obstruction marking and traffic signals are also used to minimize the hazards in design faults. Such operational changes are estimated to provide acceptable long-term solutions for about one out of five below-standard bridges.

Eligibility for capital improvements is determined by a sufficiency rating combining engineering and impact assessments. Bridges are rated on a scale of zero (worst) to 100 (best). A heavily trafficked bridge with moderate deficiencies may be rated lower and receive a higher priority for capital improvements than a bridge with more severe faults but only occasional and light traffic. Bridges rating 80 percent "sufficient" or better are not eligible for capital improvements. Below this, two cutoffs are used to encourage comparisons of different capital solutions. If ranked in the lowest category, a bridge will be eligible for replacement, but only if this course is more cost effective than rehabilitation. In the middle category, only rehabilitation projects attract federal aid.

The ratings are used to prepare selection lists for bridges eligible for rehabilitation and replacement, from which states (taking account of such local issues as school bus routes) choose projects for implementation. States' apportionment factors are revised regularly to reflect changes in the list of aid-eligible projects and construction costs. Thus the selection process is comprehensive, consistent, and fair. A wide range of solutions and their effects are explored. National standards are applied to all bridge proposals to determine eligibility, modified in the final stage by local preferences. And each state's access to aid is proportionate to program aims.

provide consistent information about the consequences of choices involving actions with different effects over time, and with different uncertainties and risks. The process must permit comparisons of operating and capital solutions, and it must allow actions that might be taken under one program to be weighed against those under others.

Though a long range view is essential, many federal programs do not consider the effects of choices over the expected lives of facilities to be provided, and those few that do often fail to provide comparable measures of costs and benefits. These limitations result from several practices. Costs and benefits not accruing to public agencies, or sometimes accruing to agencies not party to the current project choice, are often disregarded, even when the costs and benefits are part of complementary investments or services critical to the project's success. Moreover, discount rates sometimes reflect historical, rather than expected, borrowing costs; thus, future benefits appear much more valuable than in fact they are. As a result, well justified new projects are delayed, while poorer choices with lower benefits that were selected in earlier periods are implemented.

CHAPTER IV

EVALUATING OPTIONS: CHOOSING A BASELINE

A separate class of problems concerning evaluating infrastructure program options concerns the choice of a basis for comparison. A project such as a dam, for example, may have a "rate of return" of 15 percent, or may lead to "discounted net benefits" of $100 million, which represent society's gain when one compares an imagined future world that contains the dam in question to an imagined world without it. But what would exist in the absence of such a dam? How would the resulting pattern of economic activity change? This chapter examines this issue.

THE "NOTHING HAPPENS" BASELINE

The prevailing assumption underlying most federally supported feasibility studies and much federal infrastructure policy is that, without federal intervention, no infrastructure development would occur. In other words, the main basis for comparison is a "nothing happens" baseline. Evaluation of a public transit project, for example, takes as its comparative basis a traffic management option. This assumes that the city in question will not continue to invest in improved transportation systems (which, realistically, include roads) unless the federal-level project under study is undertaken. A more appropriate base case would be the best plan for improving urban mobility that the city could finance without the federal project.

Using a "nothing happens" basis for comparison fails to adjust demand for the project's services to the no-investment case. Plans for a water resources project, for example, typically enumerate benefits as though, if the project were not to be carried out, people would continue to settle in flood plains or to farm deserts, and shippers would contend with shallow ports. A more rational prediction of the without-project case would attempt to show how settlers, farmers, and shippers would react to a different set of cost or pricing incentives.

The choice serving as a comparative baseline should be a careful projection of how infrastructure systems would develop under current policy with the guidance of sound management. Thus savings in operating costs from new techniques, say, should be measured not against a baseline of current productivity rates, but against a projection of productivity changes both apparent and achievable through ordinary application of good management practices. Forecasts of "with project" impacts must similarly be carefully developed as best estimates of likely, rather than optimistic, outcomes. The following analysis of the transit program shows how the management of city transport systems might function if analysis of the likely evolution of transit had guided policy.

Choosing a Basis for Comparison--The Example of Transit Modernization

Both the cost structure and the regulatory pattern of current policy on transit aid follow from the perception of nearly 25 years ago that federal intervention was needed to avert widespread abandonment of transit services. Testimony presented at hearings on the 1964 Act emphasized the consequences of such abandonments, including effects on urban development and such traffic results as congestion as well as additional highway construction and vehicle purchases. Estimates were presented that, if commuter rail services were abandoned in Boston, Chicago, Cleveland, Philadelphia, and New York, the replacement highways needed would cost $31 billion. Abandoning the mass transit system in Chicago was estimated to add to the city's transport system 600,000 automobiles, 160 new expressway lanes, and extensive parking areas. Annual costs of $5 billion a year for lost time, fuel, and other costs of traffic congestion were cited. 1/ The first priority of the Urban Mass Transit Administration in administering the transit capital grants program was "preservation of existing transit systems which would otherwise be abandoned" with efforts to improve and extend transit services receiving only second- or third-level attention. 2/

Rather than seek the best "without assistance" plan for improving mass transit, federal transit aid has derived from the assumption that subsidies are at all times and under all circumstances needed to retain the transit services critical to reducing urban congestion and conserving fuel. Without subsidies, according to this assumption, high fares would divert riders to automobiles, and public services needed for special groups--including both those people without the use of private autos and those, such as the disabled, with special transit needs--could not be provided.

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1. U.S. House of Representatives Banking and Currency Committee, House Report-No. 204 (to accompany H.R. 3881), *The Urban Mass Transportation Act of 1964* (April 9, 1963).

2. George W. Hilton, Federal Transit Subsidies, The Urban Mass Transportation Assistance Program, American Enterprise Institute Evaluation Studies, No. 17 (June 1974).

The federal transit program has pursued modernization and preservation of existing systems through subsidies at the expense of other options for improving urban mobility. A look at UMTA's program, however, shows that the subsidies themselves may have caused a gap to grow between the networks of transit services available and the patterns of demand for urban travel. A result of that gap has been the marked diminution of the importance of transit services, except within finite downtown areas. Growth of major metropolitan and other urban areas during the 1950s fast outpaced the development of urban transport systems. With declining transit ridership during the decade came a general deterioration of bus services. Deliveries of new buses during the second half of the 1950s were fewer than one-third of the total ten years earlier. Failures and near failures of transit companies generated concern that even large cities could be left with no public transit. Modernization and coordinated planning were the solutions adopted, with emphasis concentrated on making up the backlog of deferred investments and little attention paid to the reconfigurations evolving in urban areas themselves.

The stress on preserving existing networks obscured the importance of efficiency-oriented changes that might have made mass transit competitive in modern metropolitan areas. Bus services are most efficient when waiting times are short, routes offer (as nearly as possible) direct door-to-door service, and necessary connections are easy. Today, with focuses for trip making in modern cities split among many suburban and downtown centers-- for living, shopping, work, and entertainment-- transit services that would maintain short service intervals over wide route coverage would use small vehicles: small buses, vans, jitneys, and even taxis. Over very wide ranges of costs, the higher frequencies that bus companies could profitably offer with vehicles smaller than those most transit fleets use would reduce the costs of waiting time to riders by more than the increase in costs for vehicle operations for the more numerous services. As a result, the overall cost of commuter operations would decline. [3]

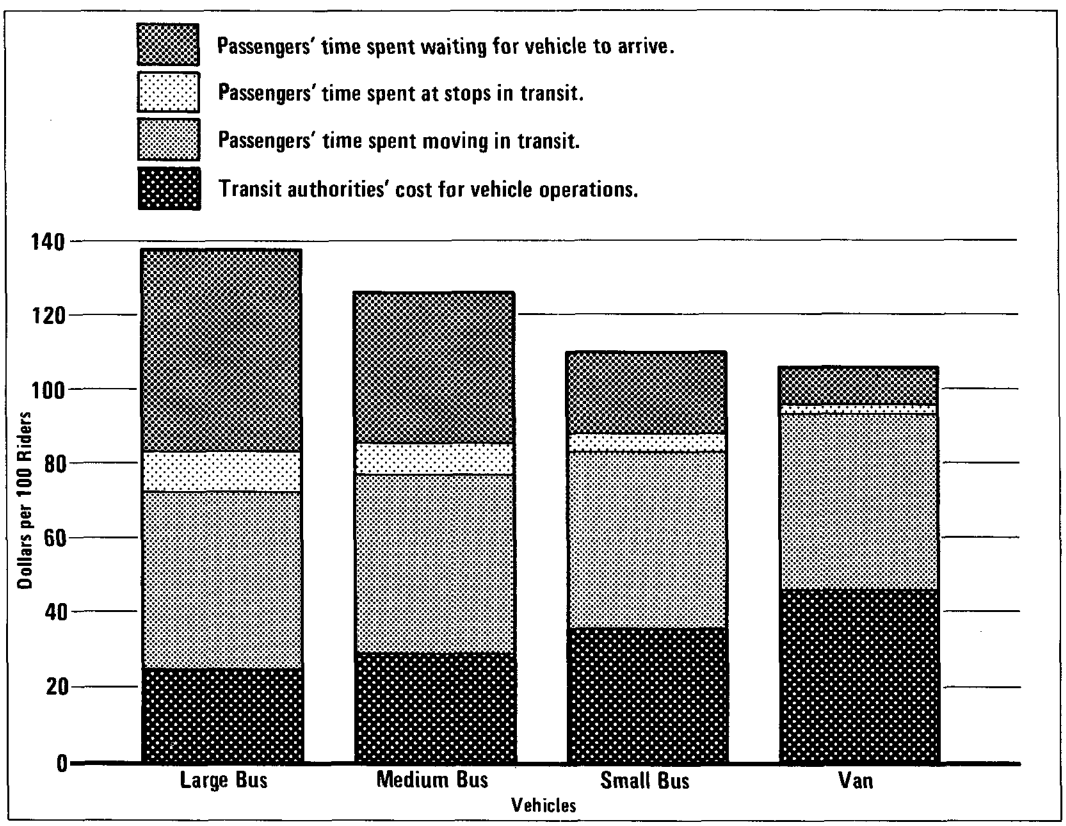
Under prevailing U.S. transit costs, the cost reduction when a typical system switches from the largest type of bus to small buses or vans might be in the range of 20 percent to 25 percent. (*Figure 3 displays UMTA's data on the costs of providing transit service with four vehicles.*) In each case, the cost reflects vehicle and commuters' time costs for 100 riders, and trip frequencies are adjusted to maintain average loadings of 60 percent of typical capacity (including standees). Thus the large bus, with capacity for

3. See A.A. Walters, "Externalities in Urban Buses," *Journal of Urban Economics*, Volume 11, January 1982.

62 riders, is assumed to carry an average of 37 commuters, and a bus company would make 2.7 trips an hour for each 100 riders. On the other hand, vans have 12 seats and an average load of seven riders, and operators would offer 14.3 services an hour per 100 commuters. Passengers arriving at bus stops randomly would then wait an average of 11 minutes for a large bus (half the interval between bus arrivals) or two minutes for a van. Time at stops would also be lower for smaller vehicles simply because fewer passengers would board or get off. Transit time would be similar for all cases, because the disruptions caused by large buses' pulling into and away from curbs roughly offset the effects on traffic of the numerical increase of

Figure 3.

Comparison of 1984 Public Transit Costs for Four Vehicle Types (Costs in 1984 dollars)



SOURCE: Congressional Budget Office.

NOTES: Based on data from Urban Mass Transportation Administration, *National Urban Mass Transportation Statistics 1983, Section 15 Annual Report,* (December 1984). Costs are in 1984 prices. "Large Bus" represents UMTA's Class A bus with more than 35 seats; "Medium Bus" represents Class B bus, with 25 to 35 seats; "Small Bus" represents Class C bus, with fewer than 25 seats. Vans have 12 seats. Time is valued at $3 an hour. The average trip is four miles. Vehicles are operated, on average, 60 percent full. Speed is 25 miles an hour.