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Energy and Transportation Policy

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Abstract

Energy shortages of recent years suggest a re-examination of national transportation policy. The lack of a coordinated approach to the solution of urban cogestion inhibits potential short-run responses to gasoline shortfalls. Longer-range policy, particularly in the context of severe financial constraints, must be carefully integrated with demonstrated patterns of urban travel and population and employment densities. Given these considerations, metropolitan areas now planning or constructing rapid rail facilities may be selecting inappropriate responses to the problem of urban access.

1. INTRODUCTION

This paper is an analytical discussion of energy considerations in the planning of urban transportation systems. Recent developments in energy availabilities, federal funding programs, and actual system operations suggest that criteria have become particularly essential in the selection of viable candidate cities for future federal and local investment in high cost, fixed route technology.

Short-run energy impacts on transportation in major American cities were examined by the author in a recent paper[1] under these hypotheses:

(1) that the worker's place of employment and residence are fixed (in the short-run),

(2) that the availability of more energy efficient vehicles is extremely limited (in the short-run),

(3) that car pooling and the use of alternative transportation modes (i.e., buses, rapid rail transit, taxicabs, etc.) are only feasible to the experience at the top end of the interquartile range (i.e., seventy-fifth percentile) in an array of such cities.

The results attained indicate that, on average an eight to ten percent shortfall of energy would be resolved through increased public and private mass transit patronage, car pooling, and more efficient driving and engine operation.[2] Although any nationwide shortfall substantially in excess of ten percent would appear to result in a reduction of non-work trips such as shopping and vacation travel, the analysis for any particular city would have to proceed on the basis of the attributes of that city.[3]

It is the purpose of this study to discuss the implications of energy and federal policy constraints on longer-range transportation planning practice. Various researchers have concluded that mass transit is more efficient than the automobile by multiples ranging from about two to about ten, depending on the assumptions incorporated in the specific analysis (see Table 1). Given the overwhelming predominance of the automobile in urban travel,[4] predictions of tremendous energy savings have been made if this pattern could only be altered nationwide.[5] A more rational and successful approach to the analysis may be to determine factors of consumer demand for transportation energy and to develop economical responses in a finite number of locales. The methodology employed in this study is to examine journey-to-work patterns in three representative American cities, and to determine the appropriateness of highway, rail and bus solutions given the specific attributes of each.

Although the work trip constitutes the largest portion of urban passenger travel,[6] prior to the 1970 Census of Population little data had been systematically collected by any federal agency on work communtation habits or on other travel activities.[7] The recent publication of journey-to-work data[8] provides some basis for our analysis of urban travel demands, although it is acknowledged that non-work trips are excluded from the discussion. However, public transit use is primarily for commutation, and non-work purposes constitute only a small protion of such activity.[9] Thus, journey-to-work analysis is highly relevant to the question of transportation planning.

II. RECENT FEDERAL POLICY ON URBAN TRANSPORTATION

It is unnecessary for the purposes of this paper to review the lengthy history of federal participation in the development of urban transportation.[10] Briefly, city growth has been influenced by three major trends in transportation: the unimodal concept of funding, with the primary emphasis on highways; the deterioration of the railroads and public transit facilities; and, despite some local planning impetus initiated by the federal government,[11] a general inaction by local governments in innovative planning. Although one may hold that the national government should, logically, adopt the viewpoint of the interest of society as a whole,[12] it has become apparent that the complexity of the American economy will not permit this "public interest" to be generally understood and incorporated in the national transportation planning process.[13]

Thus, some federal policy initiatives have recently been considered for return to state and local control. For example, the Federal-aid Highway Act of 1973 and the National Mass Transportation Assistance Act of 1974 delivered major impetuses for a multimodal approach to planning, as cities are now permitted to divert a portion of their highway trust fund money to mass transit capital and operating expenditures. Of particular significance to this discussion has been the growing participation by local governments in the federal aid process fostered by the Urban Mass Transportation Administration (UMTA). Numerous cities have come to Washington with proposals for a portion of the limited bus and rapid transit funds, and criteria for approval or rejection appear to be either nonexistent or changing depending on the political vicissitudes of the moment.

The lure of eighty percent federal funding of the planning and capital costs of rapid transit induced the development of grandiose construction programs by several urban areas, including Baltimore, Los Angeles, Miami, Denver, Atlanta, and others. These actions were encouraged by frequent assurances from the past U.S. Department of Transportation Secretary, John A. Volpe, of governmental support, provided the local matching share of the money could be guaranteed. For example, Volpe told Denver officials on October 12, 1972, that the initial experimental work would be federally financed. Furthermore, if the local share were raised, "We stand ready at the Federal level to provide two-thirds of the cost. . ." for the initial phase of the system. Denver residents subsequently approved a transportation bond issue on the basis of this implied promise.[14]

The current U.S. Department of Transportation position is that limited UMTA funds require selective approval of recipient cities based on "cost effective" analysis of alternative transportation systems, and that past "promises" are not necessarily to be construed as definite commitments.[15] Federal officials cite as justification such disappointments as the recurring technological failures and cost overruns of San Francisco's Bay Area Rapid Transit (BART) and the Morgan-

town (West Virginia) experimental personal rapid transit (PRT) system, as well as the continued nationwide reduction in transit patronage despite the expenditure of some three billion dollars on programs of urban transportation assistance.

Local reaction to this changing federal posture has been, as expected, heated. Atlanta Mayor, Maynard Jackson, stated: "We stuck our necks out. . ." because the city received ". . . not only the go-ahead but actually the aggressive encouragement of the Federal Government. . ." to build a transit system. Now Atlanta is being told that aid may not be forthcoming, a situation tantamount to ". . . our being on a limb, and the Federal Government behind us sawing if off."[16]

Governor Marvin Mandel of Maryland, on learning of this apparent change in policy,[17] stated that ". . . all the indications . . ." point to a federal withdrawal from Baltimore rapid transit. ". . . [T]hey have led Baltimore city right down the dark alley again and . . . I think this is the most disgusting performance of bureaucracy I've ever seen . . . There is no way the City of Baltimore or the State of Maryland could make up these funds in order to keep the project going."[18]

III. CONSIDERATIONS OF POPULATION MOBILITY

The goal of any transportation system should be to provide a satisfactory level of movement for people (and goods) so that delays, congestion, pollution, and energy consumption are minimized. Too frequently, it appears that policy makers and government officials have sub-optimized the decision-making process; that is, they have failed to consider all factors in the selection of transportation systems and in the promise of funds for the construction of such systems. This is particularly apparent with regard to rapid rail transit, for as each new urban or energy crisis occurs, this magical solution is suggested.

The hard facts, however, are that rapid rail transit is:

(1) expensive (Baltimore's first two legs of a proposed six legged radial system, now costing over one and one-quarter billion dollars, inflated nearly one hundred percent in thirty months);[19]

(2) technologically imperfect (BART's trans-Bay run was long-delayed in receiving approval of the California Public Utilities Commission, due to various operating malfunctions);

(3) not self supporting (BART will never reach a self-supporting level of operations, even with 220,000 passangers per day);[20]

(4) not a limitation on congestion (the Montreal, Milan, and Stockholm systems have not removed traffic congestion, while ninety percent of Toronto's patrons are converts from the old bus system);[21] and,

(5) subject to rather rigid federal funding limitations.

Most important, fixed rail rapid transit assumes a relatively stable combination of jobs and population, which is not the typical situation in Twentieth Century America. Recent U.S. Bureau of the Census analysis confirms that population movement from the city and suburbs is continuing to sections further out in exurbia. Employment in metropolitan areas outside the central city is increasing faster than the population, and workers can therefore commute more easily from housing now developed beyond metropolitan-area boundaries.[22]

This continuing dispersion of population and jobs beyond the central city follows the trend begun following the Second World War with the availability of the automobile and improved highways. When planners decry the "irrationality" of urban commuters in choosing other than the most cost efficient transportation mode for their journey-to-work,[23] it must be remembered that the trip duration to work is considerably longer by transit than by auto.[24] Thus, with this great dispersion into exurbia, it becomes difficult to justify transit on the basis of projected patronage estimates.

Furthermore, this changing and mobile pattern does not suggest the implementation of high cost, long-run solutions, particularly given the social and aesthetic disruptions inherent in extensive right-of-way acquisition and construction of trackage and stations.[25] This is especially true considering the extremely long planning period prior to implementation; i.e., a ten to fifteen year period is typical in the state of California, whereas the city of Baltimore has been planning its system for more than a decade.

Finally, the potential for a reversal in this pattern of migration is rather unlikely, ". . . except by a degree of compulsion incompatible with a free society."[26] While the hopes of rapid transit proponents may be to halt the decay of the central city by increased suburban commutation,[27] the facts are that people, jobs, and shopping are increasingly oriented to locations outside of the central city. "The conventional concept of the urban community. . . has to be reconsidered. . . Increasingly the movement of people within urban complexes will be multidirectional on relatively low-density traffic corridors."[28]

IV. TOWARD FIXED RAIL CRITERIA

Despite these rather definite reasons against the indiscriminate use of fixed rapid rail, the lure of the federal money has proven irresistible to many cities. Given the limitation of funding, on what criteria should approval be based? Many schemes have been suggested for the integration of land use and transportation models for the selection of the optimal policies from a broad range of plans with varying economic and social effects.[29] However, existing practice still cannot incorporate axiomatic interrelationships between these sectors,[30] while newer modelling and computer technologies may only serve to permit predictions of distant years with a larger order of errors.[31]

Little else exists in the literature to provide guidance on the planning of transit systems. Comments do appear regarding suggested minimum densities, such as a central city of at least 10,000 persons per square mile,[32] or at least 40,000 patrons per day and metropolitan areas with a population of at least one million.[33] Thus, into this seeming vacuum comes the high cost, technologically complex solution: build everywhere, or at least until the money runs out.

The important consideration in this context should be the retention of mobility in the journey to the central city in those areas where future central city activity justifies fixed rapid rail transit. Of special significance in this determination, given our inability to forecast the future (despite simulation model builders' claims to the contrary), is the existing pattern of employment concentrations within the central city. The basic assumption, then, is that cities of highly dispersed employment are less able to justify commuter fixed rail tranist systems than are central cities of concentrated employment.

Table 2 presents data on the concentration of employment in the Standard Metropolitan Statistical Areas (SMSA's) and central city's of thirty major metropolitan areas, including the ratio of central city employment to SMSA employment and a ranking within the array. Table 3 presents data on the use of transit modes for the journey-to-work in each SMSA, including bus and streetcar patronage; the percentage of in the SMSA using these transit modes for the journey-to-work; and a ranking within the array.

For purposes of further analysis, it is necessary to select a limited number of these cities of varying attributes of worker concentration and transit use. From these tables three cities are selected to illustrate varying stages in economic-transportation development:

(1) Sharply reduced central city worker concentration with average transit ridership (characteristic of older urban areas with a declining central city base of dense work attractions): Baltimore, Maryland.

(2) Somewhat reduced central city work concentration with low transit ridership (characteristic of maturing urban areas with some loss of central city economic activities): Kansas City, Missouri.

(3) Continuing high central city worker concentration but low transit ridership (characteristic of newly developing urban areas with intact central cities): Phoenix, Arizona. Thus, in descending order is arrayed the oldest to the newest city forms, which is also consistent with the present magnitude of demand for fixed rapid rail transit from each city type (see Table 4).

V. BALTIMORE: TOO LATE FOR RAPID RAIL

The city of Baltimore, Maryland, responded to the urban decline of the Post-War period with the construction of downtown office buildings and shipping facilities, and the redevelopment of the Baltimore harbor area. However, the pattern of central city worker dispersion was not arrested, and was likely exacerbated by the substitution of "white-collar" employment for the more concentrated "blue-collar" factory work which was largely eliminated during the renewal process. Thus, the concentration of workers in 1960 in the central city of 64.8% (Table 5) had declined to 42.1% (Table 2) by 1970, as denser work "attractions" were systematically moved to outlying locations.

Planning began during this time for rapid transit to serve the central city commuter. The final suggested configuration was a six-legged steel wheel on steel rail system, with each leg extending from the center of Baltimore City (Charles Center), to population centers in the surrounding suburban areas. Final engineering grants for the Northwest and Southern lines were made in 1972, based on an estimated cost of $656 million (now estimated at $1.2 billion) with the local share of this expenditure guaranteed by the Maryland General Assembly. Total costs for the completed system are unknown, but may run to several billion dollars.

The bus system in the metropolitan area was absorbed by the Maryland Department of Transportation, and received renewed support through the multi-model funding authority of that agency. During the fiscal year of 1972, 370 new buses were delivered, reducing the average age of the bus fleet from fifteen to six years, while a two year rehabiliation program to repaint and repair 250 later model vehicles continued. This governmental interest, together with an apparent tradition of public transit patronage, resulted in 100 million riders for fiscal 1972, an increase of 1.1 percent over the preceding year.[34]

While the primary and secondary highway construction programs also continued during this period, a controversy developed surrounding the city's planned expressway system. At the present time, this "3A" system of interstate and commuting roadways is estimated to cost $1.25 billion (with a local contribution of twenty percent), while construction costs rise at a significant rate.[35] The existing expressway inventory in the entire SMSA is 144 miles, including the Baltimore Beltway (I-695), the Jones Falls Expressway (I-83), the Kennedy Memorial Highway (I-95 North), I-95 South (to Washington), and I-70 North (to Frederick), in addition to some expressway-standard construction on the primary system. Thus, a rather extensive highway system is planned, under construction, or in operation, accommodating in several places as many as 100,000 + vehicles of daily traffic.

The short-run impact of the energy crisis on journey-to-work trips in the Baltimore metropolitan area has previously been determined as a relatively low, five percent diversion to carpools and alternative transportation modes.[36] Any fuel shortfall greater than about five percent of demand will lead to a signifi-

cant reduction in non-work trips. However, this predicament does not support the planned rapid transit expenditures, but does seem to imply the wisdom of continued bus schedule expansion (and highway reconstruction). The reason for this paradox is that the finite amount of available federal transportation dollars delimits possible capital improvements to those projects more "cost effective"[37] in times of fuel shortages, and that a rapid transit system is not an appropriate investment given the residence-employment mix in the Baltimore area. Instead, the availability and flexibility of the bus and highway modes appear to make these the superior choices.

VI. KANSAS CITY: THE TIME FOR RAPID RAIL

The Kansas City, Missouri - Kansas area responded to the problems of urban decay later than did the city of Baltimore, with the "coerced" creation in 1966 of the Metropolitan Planning Commission - Kansas City Region (Metroplan) following the federal denial of Section 701 planning grant money. This delay may ultimately work to the advantage of Kansas City, as it has allowed sufficient time for the mistakes and wrong turns of other cities to have been examined and rejected. However, one expert has stated: "The city has not learned the lessons about growth that Eastern cities have. Industry is leaving the central city rapidly and the blacks are frozen out. There is no low-to-moderate income housing out there along I-435, the ring highway, and no rapid transit to take them out. . ."[38]

As in Baltimore, the concentration of workers in the central city had declined from 1960 to 1970, from 58.6% (Table 6) to 53.3% (Table 2), although the rate of decline was substantially slower. Thus, sufficient time may yet exist for a correction of this trend, provided appropriate action is taken by the planning officials of the region. Mechanisms do exist for such policy implementation, for Metroplan works concurrently with the Mid-American Council of Governments (MACOG), established in 1967, which has the more general perspective and political ability to implement such plans, and with the Kansas City Transportation Authority, established in 1965, which has jurisdiction over passenger transit.[39]

To this time transportation planning has been subordinate to land use planning, although the Kansas City Transportation Authority in 1969 did purchase and now operates the private Kansas City Transit Company, after threats of termination of service. However, the major thrusts of the past decade have been a constant flow of planning ideas from Metroplan oriented toward the control of urban sprawl,[40] and the development of such attractions as the Kansas International Airport, a new stadium, a sport arena, a downtown convention center, new shopping areas, and other civic attractions.

With only thirty-one percent of total metropolitan area mileage now traveled by Kansas City, Missouri-Kansas residents to Kansas City employment and a continuing pattern of horizontal growth spreading outward from the central core, specific plans are under consideration to direct investment toward more acceptible developmental patterns.[41] For example, the Metro/Center concept envisions a series of new towns of ". . . high activity core area(s) that would offer employment opportunities, retail outlets, services and recreational facilities necessary to serve about 200,000 people, all within 15 or 20 minutes of the Metro/Center core.[42]

Loci of these centers include the central business districts of Kansas City, Missouri and Kansas, the Plaza (a shopping-commercial center), and eight other sites chosen on the basis of origin and destination zonal projections.[43] Careful selection and land use controls could foster the building of corridors of sufficient travel demand to enable rapid rail transit, such as the Kansas City International Airport complex-to-downtown corridor which is expected to generate 125,000 + trips daily by 1990. Present access plans are for 70,000 to 90,000 average daily traffic on highways I-29 and U.S. 169, with the suggested purchase of rights-of-way for exclusive busways and, ultimately, rail rapid transit.[44]

The short-run impact of the energy crisis on journey-to-work trips in the Kansas City metropolitan area has previously been determined as about a fifteen percent diversion to carpools and alternative transportation modes.[45] This situation (an approximately average result) does not *per se* eliminate or support rail transit. The important consideration is that Kansas City has not suffered a permanent loss of central city employment and has begun efforts to define land use along specified corridors of potentially dense activity. This may be the very situation which justifies some rapid rail, in that the central city can be preserved while permitting the growth of selected radial corridors. Unfortunately, little support is thought to exist for such an undertaking from civic and business groups, although Mayor Charles B. Wheeler, Jr., is a strong advocate.[46] Perhaps Kansas City *is* doomed to repeat the mistakes of the older Eastern cities.

VII. PHOENIX: TOO EARLY FOR RAPID RAIL

Urban problems are rather new phenomena to the city of Phoenix, Arizona, and, consequently, recognition of the situation has come only recently. The central city was a small and charming desert "oasis" some thirty years ago, whereas today it services a metropolitan area containing several municipalities, more than one hundred shopping centers, and a population of nearly one million.[47]

This type of explosive development does not permit orderly land use control, and as a result, Phoenix ". . . is suffering the worst case of urban sprawl in the U.S. . . "[48] with no sign of correction in the near future. While environmentalists may decry the loss of a lifestyle based upon fresh, dry air and open land,[49] the virtually unrestricted economic potential does not suggest limitations on sprawl devleopment and urban decay. Employment concentration in the central city actually increased during the decade of the Sixties, from 60.4 percent (Table 7) to 62.5 percent (Table 2), an increase partially attributable to the sheer size of the city, 187.6 square miles, as compared to the cities under study: 130.3 square miles in Kansas City and 78.3 square miles in Baltimore. However, "leapfrog sprawl" now characterizes the metropolitan area and new communities appear on previously open land beyond the locational control of Maricopa County.[50]

An early return to central city development does not seem likely according to various Arizona observers.[51] Residents have resisted high density development as well as freeway construction, and appear to desire small town life in the big city. Some calls for controls on future growth are being made, but these may not occur for some time. "As we sit and talk about what to do with Arizona's increased population, the people still keep coming . . . People worry about this becoming another Los Angeles [or older Eastern city?] . . . the way we're going now, it won't be as good as L.A."[52]

Transportation planning in the Phoenix area has been oriented toward the existing highway system, and prevailing evidence is that downtown traffic is relatively stable and operating some forty percent under potential capacity.[53] Planning for rail rapid transit has never been attempted due to ". . . the lack of a series of traffic origins going to a common destination in any transportation corridor,"[54] and the low density of population resulting from urban sprawl.

The short-run impact of the energy crisis on journey-to-work trips in the Phoenix area was previously determined to be a twenty-four percent diversion to carpools and alternative transportation modes.[55] Given this extremely high opportunity for a compensatory response in times of fuel shortages, but particularly in the light of a continuing pattern of uncontrolled sprawl and an underutilized central city street system, rapid rail transit does not appear to be a justified expenditure in the forseeable future.

VIII. SOME CONCLUSIONS AND THOUGHTS ON TRANSPORTATION BALANCE

The study of three cities of varying development patterns leads to certain inductive conclusions. It is apparent that urban centers are not uniform in terms of economic and land-use problems, with the logical conclusion that transportation-energy solutions to those problems cannot be uniformly applied. Furthermore, it is clear that criteria are necessary to determine the appropriate mix of transportation investments for each type of metropolitan area, for purposes of both local planning and for federal policy.

Specific criteria do not easily fall out of these discussions. However, it may be concluded that older cities of low or falling worker concentration in the central city are not logical condidates for rail rapid transit but should be bus and highway oriented, whereas cities of substantial downtown employment may be more suitable choices for fixed route systems. Thus, the fourth column of Table 2, containing a ranking of the thirty cities selected for comparison, may be an appropriate guide, with cities in the first third being logical candidates, while those in the second third worthy of additional study. Furthermore, the planner would be advised to investigate local activity toward the termination of sprawl development, with the selection of specific radians or centers of denser industrial-commercial activity.

Given these criteria, some current rapid transit programs appear to be counter to good planning logic: the BART System, as San Francisco ranks 27th of 30 in central city worker concentration; the District of Columbia METRO System, as Washington ranks 25th of 30; and possibly, the MARTA System, as Atlanta ranks 19th of 30. Certainly these cities have congestion problems, but the dispersion of their populace can only mean that fixed rail rapid transit will not serve a sufficiently high percentage of metropolitan area workers to justify the enormous expenditures. Table 8 provides some evidence for this conclusion for the Baltimore region, in that only 496,000 miles of a total of nearly two million miles, or twenty-eight percent, are traveled by city dwellers to city employment. The remaining seventy-two percent of total mileage is traveled by city workers from outlying suburban counties, and thus many will not be attracted to a system whose nearest station is perhaps miles distant from their homes.

The indicated solutions in these cities are improvements in bus systems and continued highway construction. While the bus solution is not disagreeable from either the energy[56] or socio-economic[57] perspectives, frequent adverse commentary has been voiced regarding the automobile. While it is true that this latter mode is energy inefficient by a substantial factor,[58] it is likely that political and macroeconomic considerations alone will prevent any substantial reduction in automobile use.[59]

There is no reason that more efficient engines and lighter, more aerodynamic body design cannot significantly increase gasoline mileage, allowing full mobility within the context of the suburban orientation of our metropolitan areas. As petroleum grows scarcer and dearer to use for the private vehicle, it is completely reasonable to assume that the automobile will eventually be powered by other fuels, most notably, coal and atomic energy, through electric batteries or other storage methods.[60] These developments may be appropriate to considerations of environment and sociology, as well as energy and economics.

The policy and energy constraints now developing on planning for metropolitan areas demand the application of rational criteria to the selection of balanced transportation systems.[61] This paper has reviewed the present status of such constraints and has suggested a methodology for the planning of such systems. Energy crisis impacts vary depending on the specific situation within each region given the potential of carpooling and the availability of alternative travel modes. However, in the longer-run, the viability of the various transportation solutions to fuel shortages is closely related to developmental patterns and central city worker concentration.

ESTIMATES OF TRANSPORTATION ENERGY EFI ...NCIES

BTU's Consumed Per Passenger Mile

Mode	Rice[1]	Myers[2]	Hirst[3]
Bus	1090	600 - 800	3800*
Railroad	1700	400 - 700	3000*
Automobile	4250	5000 - 10000	8000*

*Estimated from Figure 1.

[1]R.A. Rice, "System Energy as a Factor in Considering Future Transportation," Proceedings of the American Society of Mechanical Engineers, December 1970.

[2]Phillip S. Myers, "The A's, B's and C's of Transportation in the 80's," Automotive Engineering, LXXIX (December 1971), pp. 26-28, at 27.

[3]Eric Hirst, "Transportation Energy Conservation: Opportunities and Policy Issues," Transportation Journal, XIII (Spring 1974), pp. 42-52, at 44.

FIGURE 1

Historical variation in energy-intensiveness of passenger modes.

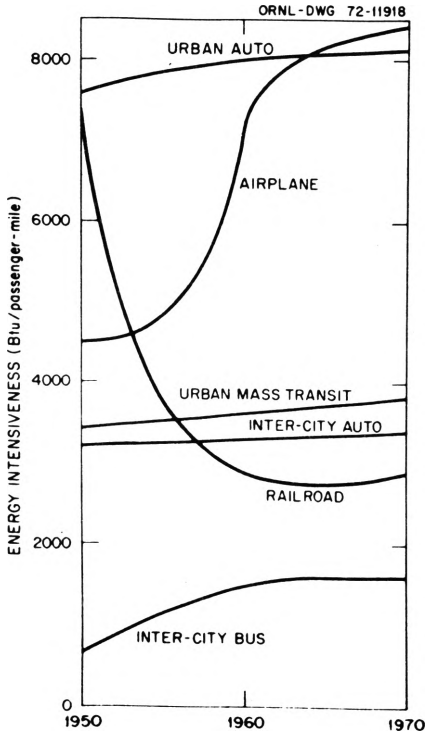

TABLE 2

EMPLOYMENT CONCENTRATION IN SELECTED SMSAs AND CENTRAL CITIES, 1970

	(1) No. of Workers in SMSA	(2) No. of Workers in Central City	(3) % of Worker Concentration in Central City (Col. 2 ÷ Col. 1)	(4) Ranking of Worker Concentration %s (from Col. 3)
Atlanta	580,960	205,104	35.3	19
Baltimore	819,597	344,801	42.1	14
Boston	1,122,516	259,781	23.1	28
Buffalo	495,141	164,952	33.3	23
Chicago	2,817,276	1,345,485	47.8	10
Cincinnati	514,216	171,832	33.4	22
Cleveland	806,222	278,983	34.6	21
Dallas	652,339	365,556	56.0	6
Denver	493,566	211,494	42.9	12
Detroit	1,525,548	537,724	35.2	20
Houston	786,106	507,193	64.5	3
Indianapolis	438,430	295,014	67.3	2
Kansas City	515,758	274,860	53.3	7
Los Angeles	2,757,759	1,267,714	46.0	11
Miami	504,345	144,597	28.7	24
Milwaukee	562,468	294,024	52.3	8
Minneapolis	741,326	315,885	42.6	13
Newark	744,421	130,698	17.6	30
New Orleans	363,821	205,022	56.4	5
New York	4,496,534	3,106,170	69.1	1
Philadelphia	1,863,897	741,907	39.8	16
Phoenix	365,896	228,509	62.5	4
Pittsburgh	853,151	187,994	22.0	29
Portland	393,331	153,429	39.0	18
St. Louis	883,200	224,899	25.5	26
San Diego	544,348	283,596	52.1	9
San Francisco	1,262,673	318,741	25.2	27
San Jose	402,230	157,179	39.1	17
Seattle	544,351	221,696	40.7	15
Washington	1,239,455	335,344	27.1	25

Note: Certain SMSAs are identified in the Census by a "two city" name, with the smaller city excluded in the above listing. These are: Los Angeles-Long Beach, Minneapolis-St. Paul, and San Fran-

Source: U.S., Bureau of the Census, Census of Population: 1970, Vol. 1, Characteristics of the Population; Table 82, Mobility, Commuting, and Veteran Status, for Areas and Places: 1970 (Washington: U.S. Government Printing Office, 1973).

TABLE 3

MASS TRANSIT COMMUTATION
IN SELECTED SMSAs, 1970

	(1) Bus and Streetcar Patronage	(2) Subway, Elevated Train, and Railroad Patronage	(3) % Using Mass Transit for Journey-to-Work in SMSA	(4) Ranking of Worker Concentration %s (from Col. 3)
Atlanta	51,805	156	8.9	14 (tie)
Baltimore	105,642	1,235	13.0	11
Boston	129,516	87,596	19.3	5
Buffalo	50,029	212	10.1	13
Chicago	389,821	254,289	22.9	2
Cincinnati	40,518	132	7.9	18
Cleveland	100,374	5,736	13.2	10
Dallas	39,847	334	6.2	21
Denver	20,228	447	4.2	27 (tie)
Detroit	120,520	1,269	8.0	17
Houston	40,279	347	5.2	25 (tie)
Indianapolis	23,847	122	5.5	23 (tie)
Kansas City	26,545	143	5.2	25 (tie)
Los Angeles	149,488	2,691	5.5	23 (tie)
Miami	44,080	399	8.8	16
Milwaukee	66,240	351	11.8	12
Minneapolis	65,647	128	8.9	14 (tie)
Newark	100,666	34,483	18.2	6
New Orleans	71,846	80	19.8	4
New York	513,292	1,596,681	46.9	1
Philadelphis	245,684	135,129	20.4	3
Phoenix	4,256	129	1.2	30
Pittsburgh	121,076	1,018	14.3	9
Portland	22,354	155	5.7	22
St. Louis	65,833	245	7.5	19
San Diego	13.069	9,694	4.2	27 (tie)
San Francisco	183,595	8,268	15.2	8
San Jose	4,640	4,414	2.3	29
Seattle	37,316	133	6.9	20
Washington	190,187	2,131	15.5	7

Source: U.S., Bureau of the Census, Census of Population: 1970, Subject Reports: Journey to Work, PC(2)-6D, Final Report; Table 2, Characteristics of Workers by Residence and Place of Work...(Washington: U.S. Government Printing Office, 1973).

TABLE 4

HIGHWAY AND TRANSIT CAPITAL
IMPROVEMENT PLANS, FOR SELECTED
CITIES, FOR THE PERIOD 1974-1990[1]

	Highway Expenditures (Millions of 1969 Dollars)[2]	Public Transportation Expenditures	
		Total (Millions of 1969 Dollars)	Rail (Percent)
Atlanta	1,110	798	92
Baltimore	2,080	1,838	93
Boston	2,058	1,157	66
Buffalo	687	173	81
Chicago	5,097	1,482	68
Cincinnati	491	231	0
Cleveland	1,216	709	82
Dallas	3,071	462	75
Denver	696	446	0
Detroit	3,764	848	0
Houston	2,548	494	70
Indianapolis	313	63	0
Kansas City	947	183	80
Los Angeles	7,063	1,319	50
Miami	940	197	90
Milwaukee	679	119	0
Minneapolis	1,419	898	95
Newark		NOT AVAILABLE	
New Orleans	1,189	117	69
New York	7,941	7,031	90
Philadelphia	2,783	1,914	93
Phoenix	796	33	0
Pittsburgh	1,100	841	86
Portland	812	155	0
St. Louis	1,248	638	92
San Diego	922	242	0
San Francisco	2,850	1,641	77
San Jose		NOT AVAILABLE	
Seattle	1,121	340	0
Washington	2,707	2,147	96

Notes:

[1] These estimates were developed by the various States in response to a U.S. Department of Transportation request for spending intentions under specified limits of federal aid ("Alternative III"). Therefore, particularly with reference to rail transit, they are not necessarily representative of actual plans.

[2] Not including local roads nor the costs of completing the Interestate System.

Source:

U.S. Department of Transportation, 1972 National Transportation Report, (Washington: U.S. Government Printing Office, 1972), p. 252.

Note:

The "Private Automobile, Drivers" and "Private Automobile, Passengers" categories of the 1970 Census were combined as above in the 1960 Census.

Source:

U.S., Bureau of the Census, Census of Population: 1960, Subject Reports: Journey to Work, PC (2)-6B; Table 2, Metropolitan Status and Location Relationships of Place of Residence and Place of Work of Workers During the Census Week (Washington: U.S. Government Printing Office, 1963).

EMPLOYMENT CONCENTRATION IN BALTIMORE, MARYLAND, CENTRAL CITY, 1960

Place of Residence	Automobile or Carpool	Bus Streetcar	Railroad
in Central City	147,455	92,211	79
in Surrounding SMSA Counties	87,522	13,874	127
Outside SMSA Counties	4,837	354	386
Total, Central City Workers		396,501	
Total, SMSA workers		611,918	
Percent, Central City Workers to SMSA Workers		64.8%	

TABLE 6

EMPLOYMENT CONCENTRATIONS IN KANSAS CITY, CENTRAL CITY, 1960

Place of Residence	Automobile or Carpool	Bus, Streetcar	Railroad
in Central City	100,756	33,463	37
in Surrounding SMSA Counties	73,997	6,925	12
outside SMSA Counties	9,131	336	185
Total, Central City Workers		224,842	
Total, SMSA workers		383,513	
Percent, Central City Workers to SMSA Workers		58.6%	

Notes and Sources: See Table 5.

TABLE 7

EMPLOYMENT CONCENTRATIONS IN
PHOENIX, CENTRAL CITY, 1960

Place of Residence	Automobile or Carpool	Bus, Streetcar	Railroad
in Central City	106,388	6,445	7
in Surrounding SMSA Counties	17,602	328	0
outside SMSA Counties	1,285	73	28
Total, Central City Workers	132,156		
Total, SMSA Workers	218,668		
Percent, Central City Workers to SMSA Workers	60.4%		

Notes and Sources: See Table 5.

TABLE 8

JOURNEY-TO-WORK TRIPS AND MILEAGE
IN BALTIMORE, MARYLAND, SMSA, 1970

County of Residence -County Seat	(1) No. of Workers in Central City -Drivers and Passengers	(2) Mileage, County Seat to Central City *	(3) Journey-to-Work Miles (Col 1 x Col. 2	(4) Car Pooling Ratio (Drivers ÷ Passengers ÷ Drivers)	(5) No. of Workers in Central City - Transit Patrons
Anne Arundel -Annapolis					
drivers	16,367	26	425,542	1.18	1,187
passengers	2,914				
Baltimore City					
drivers	99,330	5	496,650	1.32	64,894
passengers	32,202				
Baltimore County -Towson					
drivers	77,567	7	542,969	1.19	9,468
passengers	15.124				

TABLE 8
(continued)

Carroll -Westminister					
drivers	1,625	31	50,375	1.20	36
passengers	325				
Harford -Bel Air					
drivers	3,412	23	78,476	1.14	131
passengers	494				
Howard -Ellicott City					
drivers	3,182	9	28,638	1.11	166
passengers	346				
Outside SMSA	3,890	40	179,360	1.15	256
drivers	594				
passengers					
Total					
drivers	205,373				
passengers	51,999				
Journey-to-Work Miles			1,802,010		
Transit Patrons					76,138

Notes:

*The County Seat was selected as an approximation of commuter residences for each county. Baltimore City mileage to the central city was obtained based on the location of residential neighborhoods within the city. Mileage from outside the SMSA was based on estimates from major towns lying beyond the SMSA counties.

Sources:

Maryland Department of Transportation, State Highway System and Connections (State Map), 1972.

U.S., Bureau of the Census, Census of Population: 1970, Subject Reports: Journey to Work, PC(2)-6D, Final Report; Table 2, Characteristics of Workers by Residence and Place of Work... (Washington: U.S. Government Printing Office, 1973).

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4. From 1950 to 1970 automobile traffic in urban areas is estimated to have increased from 85% to 97% of all passenger traffic. Ibid., p. 45.

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