Chapter II

INTRODUCTION

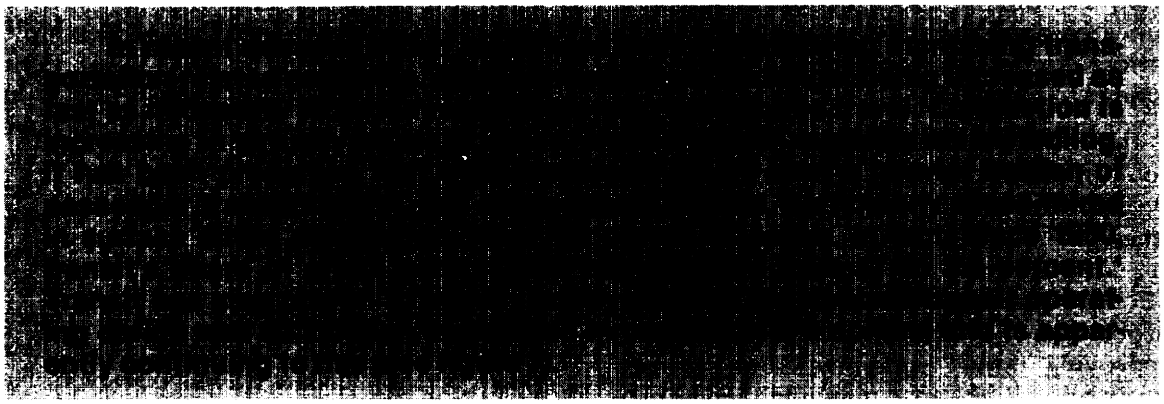
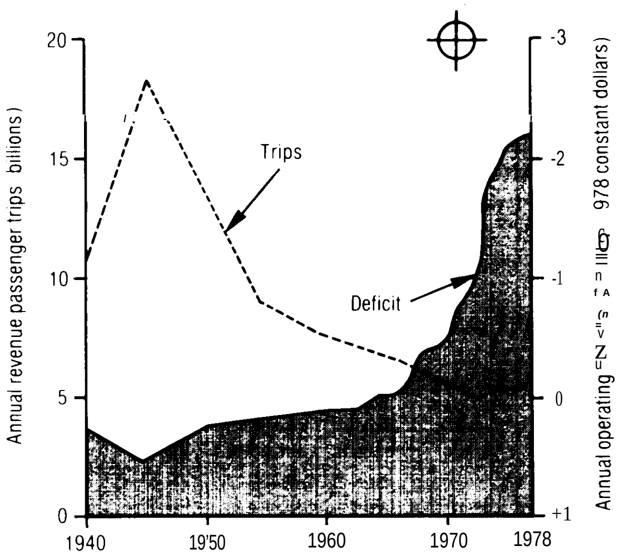


Figure 1.—U.S. Urban Mass Transit Trends (1940-78)



SOURCE American Public Transit Association

In hindsight, decline in the use of public transit is not only understandable but appears to have been an inevitable consequence of the changing growth patterns of U.S. cities. Since World War II, suburban areas have been growing nearly four times faster than central cities. Jobs and activities have followed people to these suburbs, decentralizing the functions once largely confined to a single central business district.

[1]Alan Altschuler, *The Changing Institutional Environment of Urban Transportation* (Cambridge, Mass.: MIT Center for Transportation Studies), March 1976.

Conventional transit—fixed-route bus, trolley, elevated, or subway—was introduced 80 or more years ago when most of the urban population lived in the high-density central city, where nearly all employment, shopping, and other activities were carried on. This basic fixed-route transit, running to and from the central business district, is becoming less compatible with the spatial distributions of modern cities with large multicentered suburbs and diffuse trip patterns.

Transit systems show very marked economies of scale. As the number of riders per mile decreases, the cost per rider increases—very rapidly. As cities have changed, the automobile has replaced transit as the basic urban transportation system. Although the decline in the total transit ridership bottomed out in 1972 and some growth has occurred since, costs have risen inexorably.

The goal of improved urban transportation is to make the urban area a better place to live; transportation attributes per se are important only as they contribute to this larger goal. The automobile is not space-efficient. Downtown areas, high-density suburban developments, and the principal arterials connecting them are choked throughout large parts of the day with automobile traffic. If existing cities are to become more pleasing places in which to work and live, more space-efficient modes of transportation must be developed both for circulation within high-density areas and along arterials. This may require a combination of some restrictions on automobile use at certain times or in certain areas and sufficiently attractive transportation alternatives to make such restrictions acceptable to the public.

By the early 1960's it became apparent that without immediate Federal intervention, a great many transit systems would have been unable to renew their equipment or maintain service levels. To deal with this rapidly deteriorating situation, Congress enacted the Urban Mass Transportation Act of 1964 for the purpose of: 1) improving transit equipment and services, 2) encouraging long-range planning, and 3) providing funds to acquire and preserve services.

Two of the three goals of the 1964 Act have been largely achieved. Federal funds have enabled local public agencies to provide support to troubled transit systems, thus preserving at least a minimum level of service for the captive rider. In addition, the quality of local transportation planning has improved significantly as a result of Federal support. Since 1964 a Federal investment of over $12 billion has gone into the purchase of equipment and extension of services. Although ridership continued to decline after 1964, it bottomed in 1972 and has shown an increase in each year since then. Ridership today is roughly equivalent to 1970 levels. Although the 1973-74 energy crisis is identified as having caused this reversal, other factors have undoubtedly contributed as well—the better service and equipment coming online as a result of the Urban Mass Transportation Administration's (UMTA) programs, subsidized fares, increasing urban congestion, and the decline in urban freeway construction, overall urban area growth, and central area rejuvenation. Transit's share of total urban travel, however, has not kept pace with the growth in urban population and person-trips.

Over the past 18 years, Federal funding for urban mass transportation has totaled $16.7 billion. As shown in table 1, 96 percent of these funds have been spent in the past 10 years.

Barring a major energy crisis which would dramatically curtail automobile usage, transit's market share is likely to drop further over the next 20 years. By the year 2000, urban auto-

Table 1.–Administrative Commitments by Fiscal Year and UMTA Activity (in millions of dollars)

Fiscal year	Capital facilities grants	Formula grants	RD&D	Technical studies grants	Managerial tralnlng grants	Unlverslty research & trainng grants	Interstate and urban systems grants	i x free demon-strations	Commuter rail operaflng subsidies	Non-urbanized formula . grants	Total
1962	$ 10 5	—	$ 02	—	—		—	—	—		$ 107
1963	—		193	—			—	—	—	—	193
1964	—		3 9	—		—	—	—	—		3 9
1 9 6 5	507	—	8 9	—		—	—	—			596
1966	1092	—	4 7				—	—	—		1139
1 9 6 7	1210	—	5 5	$ 31	$01	—	—	—	—		1297
1968	1220	—	6 5	36	—	—		—	—		132 1
1969	1483		183	50	—	$1.7	—	—		—	1733
1970	1327	—	163	80	—	3.0	—		—	—	1600
1971	3407	—	395	144	04	30	—	—			3980
1972	5100		614	250	0.5	25		—	—	—	5994
1 9 7 3	8637	—	71 5	335	04	25	—		—	—	9716
1974	8703	—	667	376	03	2.3	$ 95.6			—	1,0728
1975	1,1966	$ 1516	468	371	05	2.2	814		—	—	1,5162
1976	1,092.2	390.3	477	38 t	0,4	07	3376	—		—	1,9070
TQ	2470	521	177	96	03	14	2154	$03	$ 234		5672
1977	1,2500	6216	589	432	05	20	4094	07	55	—	2,3918
1978	1,3988	7424	681	550	03	20	6667	—	806		3,0139
1979	1,2250	1,3000	640	550	05	20	7000	05	750	$750	3,4970
Total	‘~~,{8~i	$3,2580	$6259	$3682	$42	$253	$2,5061	$15	$1845	$750	$16,7374

NOTE FY1962 through FY 1977 reflect ad-m! nistrative commitments FY 1978 and FY1979 reflect obligations

SOURCE Department of Transportation Urban Mass Transportation Administration Jan 22 1979 mobile vehicle-miles are expected to increase by over 80 percent, which would mean a more than twofold increase in traffic congestion and reduced mobility. [2] Meanwhile, transit operating deficits may soon exceed **$3** billion annually, and could continue to c1imb.[3]

[2]U.S. Congress, Office of Technology Assessment, *Changes in the Future Use and Characteristics of the Automobile Transportation System: Summary and Findings*, OTA-T-83 (Washington, D.C.: U.S. Government Printing Office, February 1979).
[3]U.S. Congress, Congressional Budget Office, *Urban Mass Transportation: Options for Federal Assistance* (Washington, D.C.: U.S. Government Printing Office, February 1977).

Clearly, the vast majority of the traveling public prefers the amenities offered by the automobile, and they are prepared to pay a heavy premium to retain these features. Continued deployment of bus and rail systems meeting current service standards shows little promise of being able to persuade significant numbers to abandon their automobiles in favor of public transit.

R&D: The Search for More Competitive Transit Options

Section 6 of the Urban Mass Transportation Act of 1964 authorized a program of research, development, and demons ration projects to pursue three goals:

1. assist in the reduction of urban transportation needs,
2. improve mass transit service, and
3. minimize cost.

The proportion of the UMTA budget devoted to the search for more competitive transit systems and services remains low in relation to the overall rate of Federal R&D spending. In FY 1979, 5.9 percent of the total Federal budget was allocated to R&D while only 1.8 percent of the UMTA budget was earmarked for the development of new and improved transit systems. In the defense sector, where the development of competitive products is given a high priority, 10 percent of the budget is set aside for R&D. Between 1975 and 1979, the total UMTA budget increased 133 percent while funding for R&D grew only 37 percent.

Currently UMTA devotes roughly two-thirds of its R&D funds to near-term product improvements and one-third to new systems development. Virtually all of the work on new systems is focused on the development of automated guideway transit. Almost no attention has been paid to one of the three objectives of R&D as spelled out in the authorizing legislation which is to explore ways to reduce the need to travel, such as through the use of telecommunications or land use policy changes.

Automated Guideway Transit

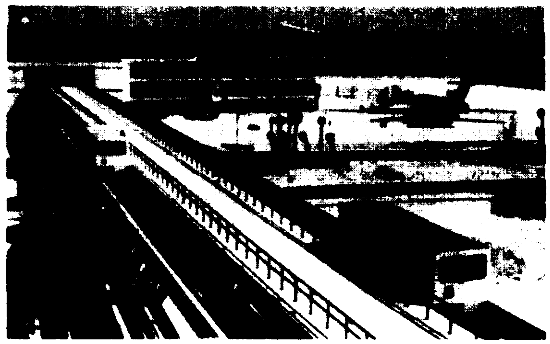
Automated guideway transit (AGT) is a class of transportation systems in which unmanned vehicles are operated on fixed guideways along a fixed right-of-way. About **20** such systems exist in the United States today, almost all of them in airports, zoos, or amusement parks. The various AGT classes are described more fully in OTA'S previous report on AGT[4] and are illustrated in figure 2. While the different types of AGT often are regarded as being distinct systems, they should be regarded as only discrete points in a multidimensional option space of system characteristics. UMTA is currently in the process of deploying demonstration automated guideway systems in the downtown sector of several cities to determine their public acceptability in general urban transit service.

Concurrently with the downtown people mover (DPM) demonstrations, UMTA is funding the development of a new AGT technology known as advanced group rapid transit (AGRT). The AGRT program, as defined by UMTA, encompasses several advances in technology including magnetic levitation, high-speed switching, and new command and control capabilities to permit short-headway operations

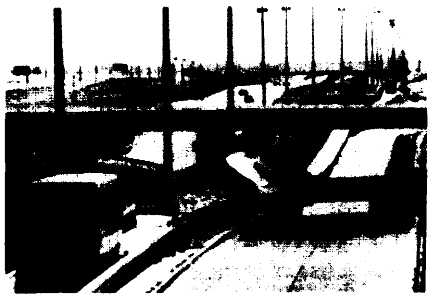
[4]U. S. Congress, Ott ice of Technology Assessmen t, *Al/ tomated Guideway Transit*, OTA-T-8 (Washington, D. C.: U.S. Government Printing Office, lune 1975).

Figure 2.–Classes of Automated Guideway Transit

Shuttle-Loop Transit
- simplest technology
- vehicle size varies
- little or no switching
- long headway—60 seconds or more



Passenger Shuttle–Tampa International Airport



Airtrans—Dallas/Ft. Worth Airport

Group Rapid Transit
- more than six riders
- switching to shorten en route delays
- Intermediate headway—3 to 60 seconds

Personal Rapid Transit
- one to six riders
- no en route delays or transfers
- short headway—less than 3 seconds

Cabintaxl–Hagen, W, Germany

SOURCE Off Ice of Technology Assessment, *Automated Guideway Transit*, June 1975

in complex networks. The design goals established by UMTA[5] specify the following features:

- automated driverless vehicles,
- guaranteed seating,
- full climate-control,
- 5-minute maximum wait time for vehicles,
- no transfers necessary on the system,
- limit of two or three intermediate stops,
- 40-mph top speed,
- 12-passenger vehicles,
- single- or two-car trains,
- elevated guideway,
- 3-second headway,
- 14,400 seats/hour/lane (theoretical), and
- electrical power.

It should be noted that these are UMTA'S design goals and should be subject to modifica-

[5] U.S. Department of Transportation, Urban Mass Transportation Administration, "Request for Proposal (RFP) DOT-UT-30014 High performance Personal Rapid Transit (HPPRT) System," Feb. 20, 1974.

tion to meet the specific needs of particular applications. A city could, as an example, conclude that its needs are best met by an AGRT system with lower line speeds, longer headways, and smaller vehicles, These kinds of modifications would not involve major changes in technology. Potential applications for systems incorporating AGRT capabilities include activity center circulation, radial trunklines, outlying collection/distribution, and regional networks.

History of AGRT

The AGRT program was conceived in the wake of TRANSPO '72, a Department of Transportation (DOT) sponsored transportation exhibition held at Dunes Airport. Promoted as a showcase for new transportation technology, four AGT concepts were displayed under UMTA sponsorship. The AGRT program, as announced in February 1974, was to consist of two phases—a 7-month preliminary design phase followed by a 36- to 40-month prototype development phase. The entire project was scheduled to be completed in 1978.

Three contractors, Boeing, Otis, and Rohr were selected during the Phase I competition to prepare preliminary designs. Proposals for Phase 11 work *were* submitted in September 1975 following completion of the preliminary designs. Figure 3 lists the technologies that each of the contractors proposed to meet the system specifications.

At this juncture, the program underwent the first of several major modifications. Responding to recommendations contained in the FY 1976 DOT Appropriations Conference Report, UMTA restructured the program. Instead of selecting one of the three contractors to proceed with a test track development, a decision was made to split Phase II into two parts, thus extending the completion date to the first part of 1981.

All three contractors were invited to continue design refinements and laboratory testing of key components during an 18-month Phase 11A. This work got underway in June 1976. As a part of Phase IIB, a single design was to be chosen for full-scale prototype testing at the DOT test center near Pueblo, Colo. During the fall of 1977, as Phase 11A was nearing completion, a task force was formed within DOT's Office of the Secretary, once again to review the AGRT program and to chart a course of further activity. The DOT review led to the following recommended program redirection:

- maintain competition by funding both the Otis air-cushion and Boeing wheeled-vehicle technologies in Phase IIB;
- continue technology development on the Romag magnetic levitation system but at a lower level than the other two systems;
- fund Boeing and Otis to conduct a facility commonality study with the aim of achieving a common test track at Pueblo;
- continue study and development of operating vehicles in trains; and
- conduct a departmental review of proposals for construction of the test facility at Pueblo following the detailed design activity period.

As a result of these recommended changes and adjustments for inflation, the total cost of the AGRT program increased from $43.5 million to $110.9 million. Tables 2 and 3 provide a

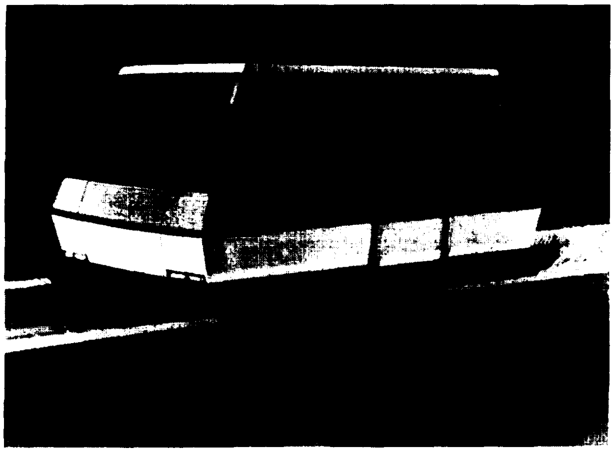
Table 2.–AGRT Funding (in millions of dollars)

Budget proposal. Submission to Congress– FY 1979	cost
Prime contractors	
AGRT development?	$800
Trained system design	4 0
Romag development	5 0
Prime contractor tolal	890
Technical support	79
Total	969– "
Prior expenditures	
Phase I planning	9
Phase I	
Prime contractors	15
Support	4
Total Phase I	2.8
Phase 11A Planning	.4
Phase 11A	
Prime contractors	6.3
Support	1.7
Total Phase 11A	8.4
Phase IIB Inltlatlon	
Prime contractors	2.0
Support	.8
Total Phase IIB	28
Total expenditures (through 3/31 /79)	140
GRAND TOTAL	$110.9

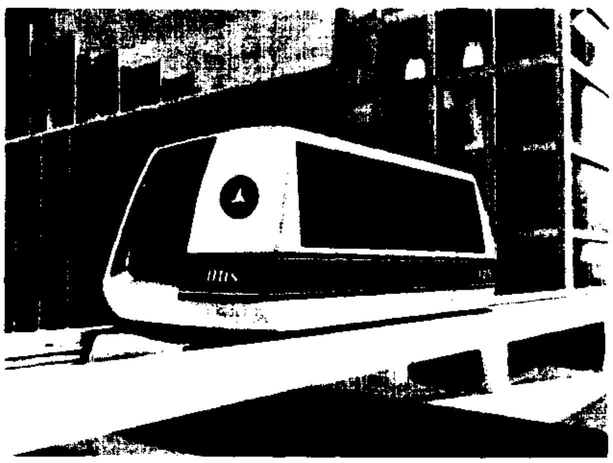
[a]See table 3 for breakdown

SOURCE Urban Mass Transportation Administration

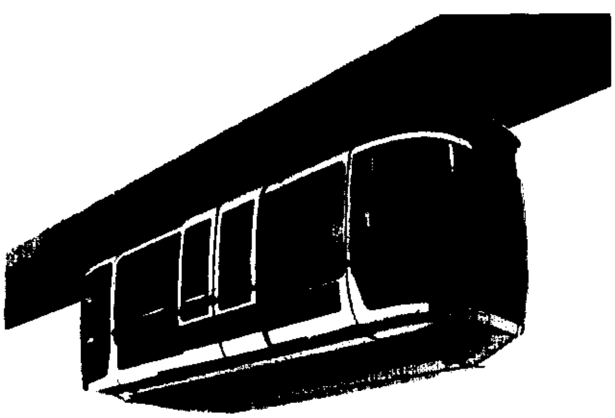
Figure 3.–Summary of AGRT Technology Options



Contractor: Boeing.
Suspension: Wheeled, rubber tires.
Propulsion: d,c. electric motors
Guideway: 8-ft. wide, bottom-supported U channel,
Command & control: Moving block, colllslon avoidance radar,
Switching. High speed, on vehicle,



Contractor: Otis.
Suspension: Alr Ievltatlon,
Propulsion. Linear Induction motors.
Guldeway: 8-ft. wide, bottom-supported channel guldeway
Command & control: Mowng block.
Switching. High speed, on vehicle



Contractor, Boeing (formerly Rohr),
Suspension. Magnetic Iewtatlon,
Propulsion Linear Inductlon motors
Guldeway 4-ft. wide, top-supported monorail beam
Command & control: Moving block.
Swdchlng High speed, on vehicle

Pholo credits U S Department 01 Transportation

Table 3.–AGRT Engineering Prototype Development (cost per contractor in millions of dollars)

	Vehicles	Command & control	Gu!deway stations	Total
Englneenng design	$3	$ 6	$4	$13
Fabricatlon	3	5	4	12
Integration	—	3	–	3
Test	—	4	—	4
Totals	$6	$18	$8	32
Englneerlng prototype upgrading	—	—	—	8
Total	—	—	—	$40

SOURCE Urban Mass TransportationAdministration

listing of projected program costs broken down by category of activity. The program then took another turn, when in early 1979 UMTA scaled down the scope of Phase IIB work. Instead of testing prototypes of the Boeing wheeled-vehicle and Otis air-cushion system at the DOT test facility near Pueblo, Colo., the test is now to be carried out at each of the contractor's plants, using engineering vehicles. Program costs through Phase IIB now total approximately $73 mill ion.

Following completion of the Phase 11A contract, Rohr decided to abandon work on urban transit systems and on February **3, 1978,** signed a licensing agreement with Boeing for rights to the Romag technology. Numerous Phase IIB proposals were being submitted by the two remaining contractors in response to changing UMTA requirements, but contracts were not signed until June 1979. A lapse of 18 months occurred between the time Phase 11A work was completed and Phase IIB contracts were signed. These frequent alterations in the program, coupled with the lack of continuity in funding, have led the contractors to question the depth of UMTA commitment to advanced systems development.

Issues Addressed in the Assessment of AGRT

The House Appropriations Committee report on the FY 1979 Department of Transportation Appropriations Bill states in part:

> . . . as a result of a departmental reevaluation, the number of (AGRT) systems to be developed has been increased from one to two or more and the total estimated cost of the project has increased from **$43,.500,000** to approximately $110,000,000. In view of this substantial cost increase, the committee intends to request an Office of Technology Assessment review of the project.

In a letter dated July 17, 1978, the Committee requested that the Technology Assessment Board authorize an assessment of this project to "determine the project's feasibility as well as its relationship to the overall goals of the Department's mass transportation program. " In November 1978, OTA initiated a preliminary issue analysis pending Board approval to proceed with technology assessment.

Three principal issues were addressed in this report:

1. Will AGRT offer significantly lower cost and superior service than other types of urban transit?
2. Do the benefits to be gained from building more than one prototype technology justify the additional costs?
3. What role should Government and industry play in the development of advanced AGT?

This study partially updates a major assessment of "Automated Guideway Transit" published by OTA in June 1975. During the course of the current study, OTA staff members visited

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the Otis and Boeing test facilities as well as AGT systems at the Miami, Seattle-Tacoma, Houston, and Dallas-Fort Worth airports and the Wedway system at Disneyland. Public participation meetings were held in eight cities: Baltimore, Dallas, Denver, Houston, Jacksonville, Los Angeles, Miami, and Seattle. Meetings were also held with transportation planners in several cities where AGT deployments have been or are currently under consideration. An advisory panel and a separate public participation working group have met throughout the course of this project to assist in the study design and to comment ori the work in progress.

Both the AGRT contractors and numerous officials in DOT cooperated fully in providing useful background information.

In succeeding chapters the potential impacts of AGRT are examined in the light of urban transportation needs and currently available transit options. Alternative patterns of Government/ industry relations are explored, with particular attention paid to practices in Europe and Japan. The concluding chapter outlines several options for future AGT development, analyzes the pros and cons of each option, and provides a range of costs for each approach.