Chapter 4: Assessment of AGT Research and Development

THE FEDERAL PROGRAM

The HUD new systems study of urban transportation, submitted to the Congress by the President in 1968, stated that the Federal role should be to address the broad problems of social welfare raised by urban transportation—equal access to service, reduction in urban lad areas consumed, elimination of noise and air pollution, and improved urban mobility. While application of some available technology could help address these problems in urban areas, more intensive, longer-range efforts were considered necessary to develop technology capable of meeting future demands for urban transportation.

1t was apparent that no local public agencies at the time, had the interest, capability or resources to sponsor and manage the research and development pro rams required to bring new transportation systems into being. or did private enterprise have the incentive or the experience to grapple with the complex issues of transit user needs and social costs. Without clearly identifiable market opportunities, large scale private investment in transit research could not be expected. Hence, it was concluded that the Federal Government should assume the role of a "catalyst)' both in stimulating research and development activities and in encouraging implementation of the results of such R & D by state and local governments. This philosophy has formed the basis for the research, development and demonstration programs undertaken by UMTA during the past seven years.

THE FEDERAL ROLE

In the area of urban mass transportation, the Federal Government is not the final consumer of hardware produced as a result of federally funded R & D programs, as is the case for defense and space hardware. On the contrary, the ultimate recipients of transit equipment are the local public agencies and private organizations providing transportation services, complicating the problems of deciding what R & D programs will contribute the most toward achieving long term transportation goals.

It has been UMTA'S olicy in the past several years to concentrate its R & D effort on hig{ risk areas, on the assumption that private industry will make the required investments for product improvement and pre-production engineering. Thus in the new systems area, which includes Automated Guideway Transit, the emphasis has been placed on the development of increasingly sophisticated systems such as hlorgantown and its successor the "HPPRT" project. Basic problems such as how to design cost effective unobtrusive guideways, how to insure continuous operation in ice and snow, and how to improve the reliability of mechanisms have received little attention. Institutional problems, such as how to implement AGT in the urban environment, have also been neglected.

FUNDING

As indicated by the following tabulation, amounts allocated for research and development constitute a small percentage of UMTA'S budget.

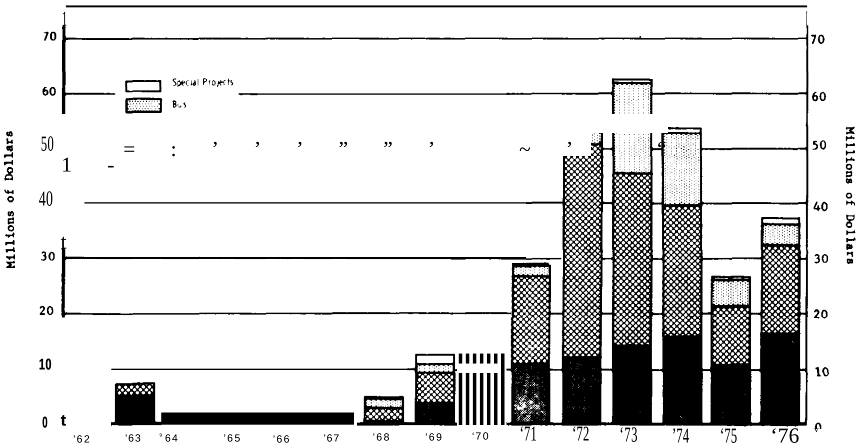
[Amounts in millions; fiscal years]

Research and development	1974 actual	1975 estimated	1976 estimated
Bus transit technology	$13,0	$4.8	$3.6
Rail transit	16.0	13.0	16.4
New systems and automation,.,	23.4	7.9	16.0
Special projects	.6	.8	1.0
Total R & D....	53.0	26.5	37.0
Total UMTA funding.	984.6	1,445.5	1,724.2
R & D as a percentage of total funding	5.4	1.8	2.1

By contrast, 10.6 percent of the Department of Defense budget for FY 76 is for R & D activity. Of the total Federal budget, R & D activity comprises 5.7 percent. Thus, in com arisen with other national programs, the current R & D funding level in the area of urban mass transportation is modest.

From fiscal year 1962 through fiscal year 1975, nearly $128.5 million has been allocated by UMTA to new systems development, phased over the years as indicated in the figure below.

UMTA R&D FUNDING BY PROGRAM AREA
1962-1976



Source: OM2A Fiscal 1976 Budget Estimates

Of this, a total of $95 million (including $64 million for Morgantown) has been spent on AGT systems development. To put this amount in perspective, $113 million was spent closing out the Supersonic Transport Program in the four years since its cancellation by the Congress.

INDUSTRY

Of the nine Shuttle-Loop Transit Systems currently serving the public in airports and recreational facihties, only two have benefited from any significant investment of research and development funds from the federal government.

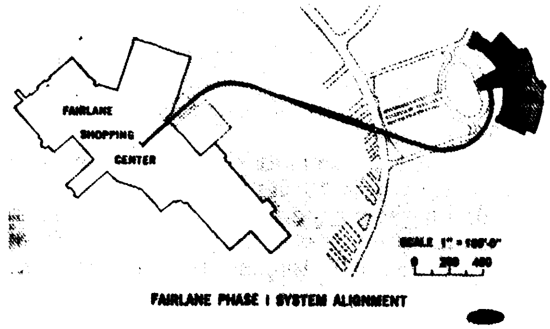
The two Westinghouse systems at the Tampa and Seattle-Tacoma airports can be directly traced to significant government involvement. Westinghouse built on their experience with the Transit Expressway development program which was initiated in 1963 with a two-thirds R & D grant from the Urban Transportation Administration of HUD, the forerunner of UMTA. Westinghouse reports that in the past twelve years they have s ent about $35 million of company funds on the follow-on Transit Expressway development. In addition, the Federal Government and local public agencies in the Pittsburgh area have spent about $7.5 million on this program.

The only GRT system thus far in revenue service is the AIRTRANS system at the Dallas/Fort Worth Airport. The system supplier, LTV Aerospace, entered the AGT field in 1971 after test tracks, funded in part by UMTA, had been built by VARO, Monocab and Dashaveyor. Thus, to all practical purposes, the AIRTRANS system, which was selected on the basis of competitive biddin , did not benefit from any Federal involvement. The system which exists at the airport is essentially the result of industry efforts.

TRANSPO STIMULATED ACTION BY INDUSTRY

Of the six SLT systems which are now under construction, the two being built by the Ford Motor Company at Fairlane in Dearborn, Michigan, (see illustration, next page) and at Bradley Airport, Hartford, Connecticut, are direct outqowths of the demonstration facility built at Dunes International Awport for Transpo 72. UMTA awarded four contracts to selected system suppliers m amounts of $1.5 million each. Ford and the other manufacturers—Bendix-Dashave or, Rohr-Monocab and Otis-Transportation Technology-contrit uted substantial com any funds to supplement the federal R & D investment. Thereafter, ! ord built its own test track at Cherry Hill, west of Dearborn, to test and evaluate follow-on designs.

FAIRLANE TOWN CENTER PROJECT, DEARBORN, MICHIGAN



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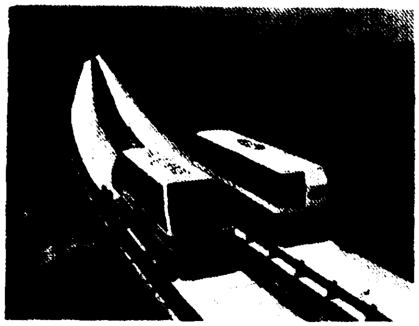


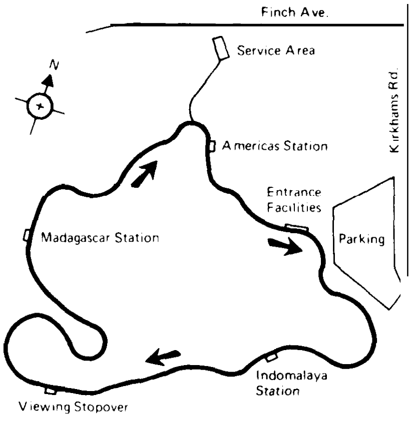
Fairlane and Transpo '72 Prototype
Vehicles on Cherry Hill Test Track

Two of the three other manufacturers that participated in Transpo-72 have also built test tracks near their plant facilities and continued an aggressive development program. Rohr-Monocab has developed a magnetically levitated version (ROMAG) of their suspended monorail system and Otis-Transportation Technology Division is actively advancing its technological capabilities, including evaluation of alternatives to air cushion suspension. Only Bendix-Dashaveyor has decided to withdraw from active competition for the AGT systems market. Before this decision was reached, however, Bendix devoted much effort and in-house funding to improving the hardware system which was demonstrated at Transpo-72. They are currently completing

TORONTO ZOO ANIMAL DOMAIN RIDE

Bendix-Dashaveyor

Forty-Passenger Vehicle Operates on Test Track at Ann Arbor, Michigan



Three-mile Guideway Layout Conforms to the Terrain Within 700-acre Zoological Park

Prototype Vehicle is Assembled at Ann Arbor, Michigan

24 vehicles for transport service at the Toronto **Zoo. (See** illustration, page 63.) A guide rides each vehicle to describe the activities of the animals along the way. Because he also doubles as an operator, full automation is not necessary in this system.

MARKET UNCERTAINTY INHIBITS INITIATIVE

Most of the manufacturers contacted during the course of this assessment reported uncertainty about the market for AGT systems. Whereas there are a number of airports, recreational facilities and commercial centers where SLT systems are being given serious consideration, current prospects for urban application are at best uncertain. There are several reasons for this situation.

- UMTA has thus far given little encouragement to communities interested in applying for capital grants for AGT systems.
- The requirement that the transit mode selected be demonstrated to be the most cost-effective places AGT alternatives at a disadvantage. This is because significant development costs incurred by manufacturers must be spread over the first few rejects.
- Unfavorable publicity on a few conspicuous projects involving automation, notably BART, Morgantown and AIRTRAh~S, has prompted a wait-and-see attitude on the part of potential buyers of Automated Guideway Transit systems.
- R;alistic cost estimates are difficult to make in lixht of the major cost overruns experienced on several project~ Furthermore, no generally accepted formula has been developed to quantify such benefits as lower pollution, less congestion, better service, etc.

The manufacturers which have been active in the development of AGT systems report that they have spent company funds totalling ap~roximately $100 million on R & D thus far, Although muck of this private R & D investment can be attributed to UhITA's spending 'fseed money," most of these companies have indicated a reluctance to invest additional funds on development until the present uncertainties about the potential market are resolved.

COMMENTARY

Unfortunately, the Federal AGT R & D program to date has not produced the chrect results which could reasonably be expected from an ex enditure of $95 million. One measure of the effectiveness of this 2 & D effort is the number of AGT revenue systems that have ant assistance. On this basis, results have been : : j : : l . c ? i a l he Fransit Expressway Revenue Line has received capital ant fundin for right of way acquisition and engineering design. Bowever, enteavors to implement this project in Pittsburgh with federal capital assistance have met with considerable local opposition and the final outcome of these discussions is uncertain.

The Dallas/Ft. Worth Airport also received capital assistance of about $7.5 million for construction of the AIRTRANS system. This installation is having difficulty satisfying airline requirements. In short, despite seven years of effort and the expenditure of $95 million in Federal R & D funds, supplemented by $100 million from private industry, there is at present not one AGT system in revenue service in an urban setting.

To identify some of the factors which have contributed to this lack, it is perhaps advisable to begin by distinguishing basic and applied research. Basic research exists for its own sake, mostly unfettered by considerations of need or application. Applied research is closel~" coupled to development and real-world applications. Although all organizations which do research generally do some of each of these types, an agency can be characterized as primarily supporting basic or primarily supporting applied research. Because UMTA is organized to deal with mass transportation problems, its orientation must necessarily' be to applied research. In developing new urban mass transportation systems and technology, the systems must be evaluated in the urban environment. If they prove effective solutions, some means for fostering their implementation should be found. Thus an important step in the evolution of innovative transit hardware is operational evaluation through real-life demonstrations. It is not enough to build a sophisticated system at a test facility and run the hardware under controlled conditions. Before volume production or large-scale urban deployment are undertaken, an operational demonstration under typical urban conditions is essential, Such a demonstration should evaluate the overall public acceptance of the system and provide for the identification and correction of its faults and shortcomings, It also would serve to reassure city officials and transit operators that the full system will perform as planned.

Besides the lack of attention to urban application, another characteristic of the UMTA program is its orientation toward high technology, new sy'stems. Thus, many socio-economic issues remain unresolved, as do many immediate hardware problems.

It is clear from the above that a number of questions remain to be resolved.

- How much support should UMTA give to urban demonstration of new systems and what should be the source of funds for any support provided (the New Systems R & D Program, Service and Methods Demonstrations, or the capital Facilities and Formula Grants Pro ares)?
- Within the UMTA &# D program, what is the proper mix of (1) high technology, long-range, hardware-oriented work, (2) solution of immediate hardware problems and (3) conduct of studies in such soft areas as public acceptance and cost-benefit analysis?
- What is the relationship between AGT and other solutions to urban transit problem?

To assist in the resolution of these issues, the im lications of some courses of action and some alternatives are indicatd in the remainder of this chapter.

SCENARIOS FOR DEVELOPING MARKET-READY SYSTEMS

As indicated, there is resently no generally accepted procedure for converting the results o R& D tomarket-ready systems. If it were decided that a major commitment to develop market-ready systems should be made, a number of steps would be required. To illustrate these steps, the time frame and approximate cost, three scenarios are set forth, one for each of the three classes of AGT discussed in this report.

SCENARIO FOR DEPLOYING SLT SYSTEMS IN URBAN ACTIVITY CENTERS

As has been pointed out, five manufacturers have built SLT systems at 15 locations in the United States. None are in service in urban communities and no clear procedure exists for achieving urban deployment of cost-effective systems. To correct this problem, while at the same time accomplishing product improvement, reduced system costs, and a sufficient number of competitive suppliers, the following steps might be considered.

- In consultation with SLT system owners, manufacturers, urban communities and consultants, UMTA initiates a program of near-term development and product improvement to reduce costs and improve reliability. This development can be accomplished in conjunction with a demonstration installation in an urban activity center.
- Criteria are developed and standards are set by UMTA, possibly supported by APTA, which qualify SLT systems for capital grant funding. These standards would include the extent of operational testing of actual hardware necessary to insure that erformance specifications can be met.
- k conomies in production are achieved through standardization of performance criteria, vehicle sizes (possibly two or three sizes to. suit different applications) and guideway shape.
- Guidehnes are issued covering cost-effectiveness analyses and other procedures which public agencies must follow in justif ying a ca~ltal grant project covering an SLT system.
- Apphcations for capital grants are submitted, processed, and, if found acceptable, approved. Contracts would be awarded, based on competitive bidding, for procurement and installation of SLT systems.

It is estimated that this scenario would require from two to four years and would cost about $10 million. The costs of product engineering, product improvement and tooling would be shared by private industry.

SCENARIO FOR DEVELOPING AND DEPLOYING GRT SYSTEMS IN METROPOLITAN AREAS

This scenario begins with the technology available from Morgantown and AIRTRANS, and extends the state of the art of GRT systems. For purposes of this example, the UMTA "HPPRT" program is the point of departure.

- Test vehicles, a control system, guideway and supporting facilities are build on a government site as proposed in the "HPPRT" program. A case can be made for continuing more than one candidate system through the prototype testing phase, but this scenario assumes that only one hardware concept will emerge from the proving-ground phase. Parallel urban deployment studies define the control system logic and methodology necessary for simulating an urban installation.
- To determine public acceptance and assess how well GRT meets urban transportation needs. UMTA arranges a demonstration project in a willing city. The site should be one in which planmng suggests a full revenue system could eventually be worthwhile.
- A 100 vehicle demonstration system with 10 to 15 miles of one-way guideway is built with costs shared among participants. The design of the guideway and other fixed facilities would overlap the final phase of prototype testing. Construction would be b~: competitive bidding. The previously selected vehicle suppher would incorporate all changes and improvements resulting from prototype testing in the vehicles supplied. He would serve as demonstration system manager and would be required to use competitive procurement to the maximum extent feasible for all subsystems.
- The demonstration system would be operated for three years with meticulous records kept on all aspects of performance, safety, reliability, maintainability, and costs as well as social consequences. Transit operators, planners, city administrators, legislators, and the general public would be afforded an opportunity to use the s}:stem with thorough records kept of their attitudes towards possible use of the system in their communities.
- At the end of the demonstration, under UMTA'S supervision the system manager incorporates all design changes and improvements into a comprehensive set of performance and system specifications which competent suppliers could respond to. The local public agency could apply to extend the demonstrated s~'stem under provisions of the capital grant program.
- Thereafter, local public agencies could decide whether to apply to install the demonstrated system in their communities under provisions of the UMTA capital grant program.

This scenario will take eight to 10 years to accomplish and is estimated to cost about $150 million to complete. These costs include a two-phase prototype design and test program, an urban demonstration, and preproduction engineering, tooling and product improvement for a revenue installation. Private industry could be expected to share the cost of this work.

SCENARIO FOR DEVELOPING AND DEPLOYING PRT SYSTEMS IN METROPOLITAN AREAS

This scenario assumes a long-range commitment to PRT with intermediate check points such that development can be stopped if progress slips, costs are drastically overrun, analyses indicate there are no apreciable benefits, or if development does not prove technically feasitle. Based on these assumptions, several scenarios are possible but one approach is outlined below.

- Establish an in-house project team or select a s ~tem development contractor from among the non-hardware, L gh technology organizations to manage the project.
- Conduct two iterative analyses:
  - Systems analyses to formulate representative networks, estimate performance characteristics, establish ran es of modal sphts, estimate patronage and fare levels, ah conduct sensitivity analysls on hypothetical systems.
  - Market analyses to estimate potential applications, estimate cost effectiveness, verify usefulness of performance characteristics identified in the systems analysis, and test the hypothetical systems.
- If the prior analyses warrant, proceed with preliminary design studies. These studies would include: alternative methods of suspension, guidance, control and propulsion; evaluation of available components or improvements needed; development of necessary components; synthesis of the best design elements; and preparation of a preliminary systems design.
- Design and develop a prototype system including the vehicles, guideway, stations, controls, and other supporting features;
- On government test facilities, construct a test track with vehicles and su porting features to permit the test, evaluation, redesign, retrozt, and stabilization of the system design;
- Deplo a small demonstration system in an urban area. The proce Jures are comparable to those discussed above for demonstrating a GRT system.
- Estabhsh uidelines and criteria governing both the standardization of PRT system performance and the conditions under which federal financial assistance would be available for revenue installations.
- Process planning and capital grants which meet the guidelines and. are qtherwise eligible. Execute grant contracts for planning, engmeermg and procuring PRT systems.

This scenario could take from 10 to 15 years to complete and is estimated to cost about $250 million.

ALTERNATIVE INSTITUTIONAL ARRANGEMENTS

The limited accomplishments of government, industry and transit operators since 1968 in devising effective ways to develop and deploy new urban transportation systems su gest that current roles and responsibilities should be reexamined. A ether a government bureaucracy is an appropriate mechanism for achieving improvements in urban mass transportation through innovation is open to question. As has been pointed out, funding for R & D programs has not kept pace with. the growth of UMTA'S resources for capital, operating, and planmng assistance funds. However, even if funding levels for R & D are increased to a level commensurate with the need to develop better solutions, the results will not contribute significantly to urban mobility unless a corresponding effort is made to devise effective means of applying the results of the R &D.

It appears appropriate at this time to reassess the federal role in urban transportation, particularly as regards the development and deployment of AGT systems, To this end, three possible alternative institutional arrangements are proposed for consideration.

GOVERNMENT CORPORATION

There are at least two relevant examples of government corporations established for conducting R & D and managing the application of results.

In the United States, the Communications Satellite Act of 1962 created a corporation for profit, not an agency of the United States Government, to develop and Implement a commercial communications satellite system. The corporation is authorized to:

- **Plan, initiate, construct, own, manage and operate by itself or in conjunction with foreign governments or business entities a commercial communications satellite system.**
- **Furnish, for hire, channels of communication to United States communications common carriers and to other authorized entities, foreign and domestic.**
- **Own and operate satellite terminal stations when licensed.**
- **Conduct or contract for research and development related to its mission.**
- **Acquire the physical facilities, equipment and devices necessary to its operations? including communications satellites and associated equipment and facilities, whether by construction, purchase, or gift.**
- **Purchase satellite launch and related services from the United States Government.**
- **Contract with authorized users, including the United States Government, for the services of the communications satellite system.**
- **Develop plans for the technical specifications of all elements of the com**munica~i&s satellite system.

In Canada, the Province of Ontario established the Urban Transportation Development Corporation in 1973. Other provinces and the Canadian federal government are expected to become share holders in this corporation.

The objectives of the Corporation are to:

- Acquire, develop, adapt, use and license patents, inventions, designs and systems for all or any part of transit systems related to pubhc transportation and rights and interests therein or thereto.
- Encourage and assist in the creation, development and diversification of Canadian businesses, resources, properties and research facilities related to public transportation.
- Undertake the design, development, construction, testing, operation, manufacture and sale of all or any part of transit systems related to public transportation.
- Test or operate and provide services and facilities for all or any part of transit systems related to public transportation and in connection therewith build, establish, maintain and operate, in Ontario or elsewhere, alone or in conjunction with others, either on its own behalf or as agent for others, all services and facilities expedient or useful for such purposes, using and adapting any improvement or invention for any means of **public** transportation.
- Manufacture vehicles and control, propulsion and guideway systems and their appurtenances and other instruments and plant used in connection with transit systems related to public transportation as the Corporation may consider advisable and acquire, purchase, sell, license or lease the same and rights relating thereto, and build, establish, construct, acquire, lease, maintain, operate, sell or let all or any part of transit systems related to public transportation in Ontario or elsewhere.
- Carry on any other trade or business that, in the opinion of the Board, can be carried on advantageously by the Corporation in connection with or as ancillary to the carrying out of the objectives of the Corporation set out above.

Both of these examples suggest means by which innovative transportation development and deployment could be achieved in the United States. Congressional action could establish a private, for profit corporation to undertake the development and installation of AGT systems.

TRANSIT DEVELOPMENT CORPORATION

One frequently heard complaint is that the operators, collectively, have had little to say about what research and development is conducted to meet their needs., When originally conceived, the UMTA demonstration program was intend~d to help transit operators experiment with their own ideas of service and equipment improvements. Over the years, demonstrations have largely become structured and directed by the Federal Government.

The Transit Development Corporation (TDC) was established in October, 1972 by the major transit operating agencies of the United States and Canada. TDC is registered as a non-profit, scientific and educational organization whose purpose is to pursue and foster research and development projec.ts relatlve to urban mass transportation systems and the commumtles they serve. TDC'S purpose is also to make its findings and information available to the ~ublic, governmental bodies, and the industry. Specifically, TDC is intended to:

- Focus on the research needs of the industry today to improve reliability and performance of public transport.
- Sponsor research and development of use to the transit operators for public benefit.
- Mobilize the talent in the industry to help conduct and supervise such research and development.
- Develop industry-wide support of such research and development, both directly through financial contributions and indirectly through the furnishing of materials, plant and personnel for research and experimentation.
- Channel and coordinate demands made upon individual pro erties and groups of properties for agency personnel and agency services for research and development activities.
- Insure the dissemination of research and experimental findings and operational experiences among the transit operators, governmental agencies and the public.

The transit operators participating in this corporation are having difficulty financing TDC'S major activities. A recent administrative ruling b-y DOT makes TDC ineligible for sole-source, R & D grant contracts. Reconsideration of this ruling, or identification of other sources of financing, could enable this representative of the transit industry to help develop and implement AGT systems. Procedures used in funding the National Cooperative Highway Research Program or independent research and development under defense and NASA contracts could be considered.

GOVERNMENT-INDUSTRY CONSORTIUM

While unprecedented in the United States, government-industry consortia are widely used throughout Europe and Japan as a means to accomplish research and development and to penetrate the commercial market. The arrangement has several advantages.

- The best talent of industry specialties can be concentrated on a particular development project.

- Scarce resources, including personnel, capital and facilities, can be conserved by avoiding competition between participants.
- Government expenditures are reduced through cost sharing with inclustry.
- Because the government is a participant, there is mutual interest in commercialization of the product. Both the government and industry stand to get a return on the initial investment.
- To strengthen the price advantage of the consortium in an initial foreign competition, the government can waive the recovery of cost provisions for the industry participants.

These advantages, available to foreign AGT system developers, have placed United States manufacturers at a competitive disadvantage.

The above alternfitive institutional arrangements offer opportunities to improve the efficiency of transit R & D and to accelerate the rate of transit innovation and improvement.

OTHER TRANSPORTATION ALTERNATIVES

There are other transportation options which are worthy of attention in addition to Automated Guideway Transit but which do not truly fall within the scope of this study. Some of the possible options for solving the variety of problems confronting urban communities, including pollution, congestion, mobility for the disadvantaged and energy conservation, are briefly described below.

BATTERY POWERED VEHICLES

Several versions of small automobiles powered by rechargeable batteries have been developed in the U.S. and abroad. In Washington, D. C,, the CitiCar is being marketed at a cost of approximately $3,000 for a 2-passenger vehicle which can travel about 4o miles at speeds of 35 miles per hour before requiring a recharge. The cost of electricity for recharging batteries is estimated at less than 1 per mile.

In Monchengladbach, Germany, the transit system uses battery-powered buses. Operating costs are reported comparable to those for diesel engines.

Battery powered vehicles offer several attractive advantages. They do not pollute the atmosphere, they do not consume petroleum fuels, though they would require more nuclear, coal or hydroelectric power sources if used in large numbers. Because of their restricted range and speeds, they are special purpose vehicles, limited to such uses as commuting and short neigborhood trips. This should not present a problem in urban areas where 90% of all trips are less than 10 miles long. However most of them have one serious drawback—the time required to recharge their batteries.

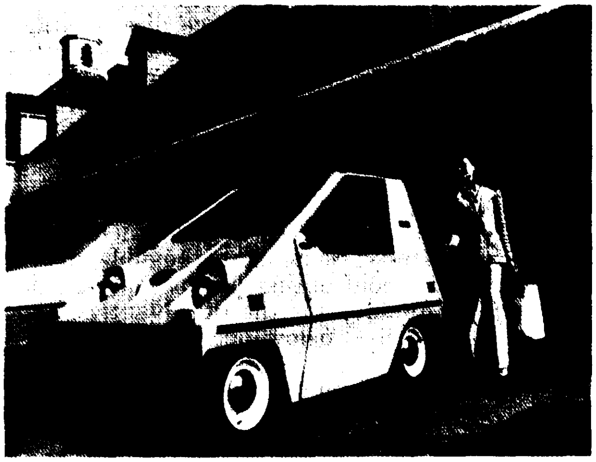
VEHICLES ADAPTED TO DENSE URBAN AREAS

In addition to energy and pollution, the size of the average automobile causes serious problems both in the form of congestion on the streets and the space required for parking when not in use. Encouraging the use of small vehicles in cities and towns and for commutmg to built up areas from suburbia has been recommended by planners and consultants. The value of land in most urban areas is such that the

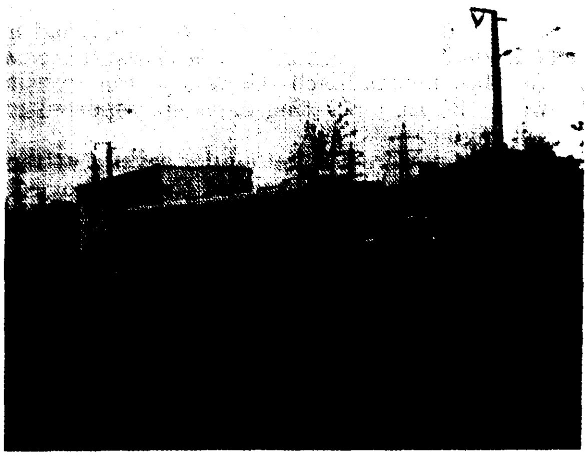
cost of structural and underground parking is about $3,5oo and $5,ooo respectively for a standard automobile parking space. Thus, there are significant economic advantages in reducing t e size of vehicles by a factor of 2 or 3. Conversely, the occupants of small vehicles are not as safe as those riding in big cars. Statistics indicate that, in mixed traffic, the risk and seriousness of injury increases as the weight of the vehicle decreases.

For most urban uses, low performance vehicles would be entirely satisfactory. They could use batteries or other low-power propulsion systems.

BATTERY POWERED VEHICLES



CitiCar Manufactured by Sebring Van-guard, Inc. Sebring, Florida



Electric Bus Monchengladbach, Germany

(Note the trailer for battery and the recharging station, in background.)

These vehicles will not fill the role of a family car on long trips. Such a car could be rented, or other forms of transportation used on such occasions. Neither will these small urban cars provide transportation for those who cannot afford or do not care to buy one, or who are unable to drive.

SPECIAL RENTAL VEHICLES

To obtain better utilization and to minimize storage problems, the rental of special small vehicles has been proposed. A variety of options are available, but essentially the vehicles would be rented by individuals from a private company or public agency for single trips or extended periods of time. Such an arrangement is in operation in Amsterdam, where one may rent at 4¢ per minute, small,! battery-powered vehicles not unlike golf carts, for transportation to various places within the city. Special parking places are set aside for these vehicles at recharging stations near major attractions. By the end of 1975, it is planned to have 15 stations and 125 cars in service.

A similar operation can be visualized as a demonstration in Washington, D. C., for transportation between the many tourist attractions along the Mall and elsewhere in the heart of the city. Remote parking for full-sized family cars could be provided at locations such as RF Stadium and the Pentagon (on weekends). Small vehicle rental and storage facilities available at these locations, selected metro stations, and the Visitor's Center at Union Station could provide a personal transportation service.

OTHER TRANSIT SERVICE POSSIBILITIES

Among other applications which offer interesting possibilities is the Company Van-Poo!, organized and operated by t! e 3M Corporation in Minneapolis, Minnesota. The company purchased 67 twelve-passenger vans and made them availabre to volunteer employees who drive them to and from work, stopping along the way for door-to-door service for fellow employees. A modest fare is charged, with an incentive arrangement for the driver which permits him to make money if he gets more than eight passengers.

After two years of operation the 3M program is reported to be very successful, averaging about 11 passengers per van. The average round trip is about **50 miles.** Other companies m the Twin Cities area are considering instituting similar service. Among the benefits resulting from such programs are:

- Less congestion on the roads.
- Less gasoline used and less pollution.
- Less employee parking space required.
- Less cost to employees for home to work transportation.
- N. government involvement, but privately financed **transportation with** cost shared by company and employees.

Shared use of taxi cabs also warrants consideration as an alternative for home to work transportation. Because of the cost of downtown parking and the cost of operating private cars, pooled taxi service is becoming increasinly popular, with groups of three or four people arranging to be ic ed up at their homes each morning by the same cab driver. In suburban San Diego, shared rides are subsidized by the cit .

The foregoing is but a partial listing of transportation o options which deserve continuing attention along with Automated Guieway Transit. While this list suggests alternatives to the large, family-owned automobile, it does not adequately address the needs of the transportation disadvantaged. Some modes, notably the private automobile, have created serious problems which comman urgent attention.

Better urban mobility is likely only to be achieved through the judicious blending of a broad range of techniques. Conventional modes of transportation no longer adequately satisfy the growing requirements in some commumties. The Federal Government, through a balanced program of R & D and financial assistance, can provide the leadership and the incentive? for innovation needed for improving urban moblhty without adding to the problems created by past solutions.