CHAPTER I

Summary

CONTENTS

The Decisionmaking Framework 3
Issues . . . .*., . . 5
Maglev and High-Speed Rail Systems 5
Tiltrotor Systems. 7
Findings and Options 8
Technical Feasibility, ... 9
Federal Financing 9
Technology Leadership 11
Improved Mobility 11
Federal Responsibilities 12

Table

Table *Page*
l-1. Steps Still Needed for Operational Maglev or Tiltrotor System 10

Summary

On almost any journey between major cities in the United States, travelers encounter traffic jams on busy roads and at airports. Magnetically levitated (maglev) vehicles and tiltrotor aircraft are among the technologies that could improve passenger mobility at large terminals and in the most crowded intercity corridors in the United States in the long term. However, like all new transportation systems, both tiltrotor and maglev will be expensive to develop and establish, and some form of Federal support will be necessary if either one is to have a substantial role in intercity passenger service. Furthermore, complementary Federal policies, programs, and standards must be developed and implemented, if these technologies are to help resolve any of the congestion problems besetting transportation. Budget constraints and the uncertainties inherent in deciding how much and what type of additional Federal investment to make in these two technologies confront Congress with difficult decisions. At the request of the House Committee on Appropriations, OTA has assessed what is currently known about tiltrotor and maglev and laid out findings and options for Congress to consider.

The Decisionmaking Framework

Maglev vehicles, which resemble either monorail cars or sleek trains, are lifted and propelled above special guideways by magnetic forces (see photos) and are probably capable of traveling at top speeds of close to 300 miles per hour. The maglev propulsion and guideway are quite unlike those of steel-wheel trains, which are mechanically driven along rails, and a maglev system would require entirely new infrastructure, as well as new vehicles. In contrast, high-speed rail technology is well developed in other countries and could be implemented relatively quickly in this country on existing railroad rights-of-way if tracks are upgraded appropriately. However, proponents assert that maglev systems are the most promising and exciting new technology for making intercity travel faster and more comfortable and energy efficient in the more distant future.

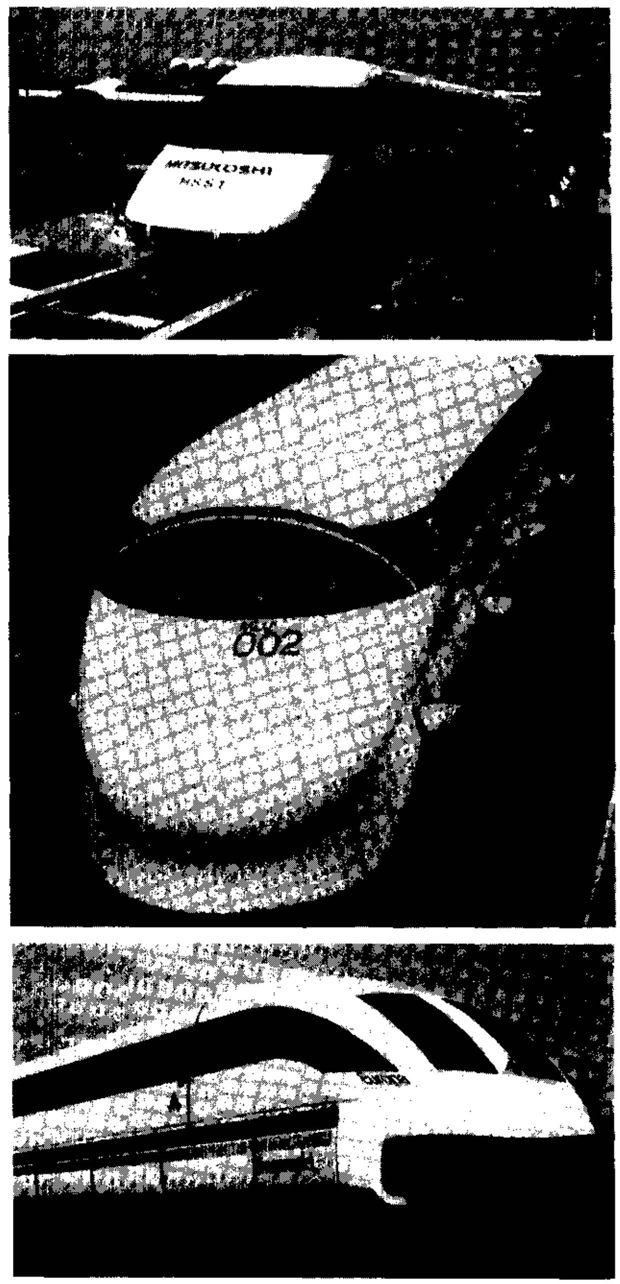

Photo credit: Magnetschnellbahn AG, Railway Technical Research Institute, HSST Corp.

Three major maglev systems are being developed: the high-speed German Transrapid and Japanese MLU, and the low-speed Japanese HSST.

Photo credit: Bell Helicopter Textron, Inc. and Boeing **Helicopters**

The V-22 Osprey tiltrotor can fly with its rotors in any position from vertical to horizontal.

Tiltrotor aircraft, developed and tested for a variety of missions by the National Aeronautics and Space Administration (NASA) and the Department of Defense (DOD), can fly like both a helicopter and an airplane. Pivoting engine/rotor assemblies, mounted on each wingtip, permit a tiltrotor to takeoff and land like a helicopter at sites as small as the roof of a parking garage when the rotor thrust is vertical. When the rotors are tilted forward 90 degrees, the tiltrotor can cruise as fast as a propeller-driven commuter airplane (see photos). Supporters claim that these characteristics would allow commercial tiltrotors to offer significant door-to-door time savings compared with similar trips on jetliners and to add capacity to congested airports because tiltrotors do not require runways to operate.

Although distinctly different, maglev and tiltrotor systems have several common policy and market issues, including the following:

- The busiest travel corridors over distances between 100 and 500 miles are the primary target markets for each. Time-sensitive service would be their initial niches in these markets.

- Tiltrotor and maglev systems would expand domestic transportation capacity, and might help relieve congestion in other modes.

- Western European and Japanese companies are developing commercial maglev and tiltrotor-like systems, and see the United States as a key market.

- Additional public support for research, development, and demonstration is necessary, if U.S. industry is to seriously consider producing commercial maglev or tiltrotor technology in the next decade. The amount of new funding required would exceed $200 million for commercial tiltrotor and substantially more for maglev.

- Regardless of where the technology is developed, each system must overcome institutional hurdles to succeed commercially in the United States—difficulty in financing, Federal safety regulations that are not yet established, local community objections to the impacts of new transportation operations and infrastructure, and the need to compete with established transport modes.

Despite these commonalities, tiltrotor and maglev differ in many ways. For instance, although they would compete directly in some market areas, each would be likely to develop its own specialty markets. Landing facilities designed for tiltrotors are relatively inexpensive to build;[1] however, tiltrotors, with their vertical flight capabilities, cost more to produce, operate, and maintain than comparable conventional airplanes (but cost substantially less than helicopters). A tiltrotor network's key advantage is avoiding airport and some road congestion. The aircraft's strength is providing fast point-to-point service between relatively small transportation market points and independent of runway locations. In contrast, guideway right-of-way, materials, and construction for high-speed trains, whether maglev or rail, will generate most of the costs, while operating expenses per passenger are (or might be, in the case of maglev) lower than those for aircraft for short trips. Maglev (and high-speed trains) are best suited for routes with large passenger volumes, where frequent departures would allow them to compete with airlines and possibly attract time-sensitive travelers from other modes.

While tiltrotor and maglev could both seine intercity commercial travel, each has the potential for other, differing applications. Existing tiltrotors have been developed primarily for military missions, and similar aircraft could fill other public roles, such as emergency evacuation, or serve industry needs-offshore oil rig support, for example. maglev trains already carry passengers on short, low-speed transit lines in Germany and England, and regional transit, commuter, and light parcel service might be feasible if maglev's potential for low maintenance costs cart be realized.

The U.S. technical base is also distinctly different for each of these technologies. The United States has had Federal programs to develop and test tiltrotor and other advanced vertical takeoff and landing (VTOL) aircraft for decades. Although the military tiltrotor (V-22 Osprey) design is unsuitable for most commercial transport applications, civilian tiltrotor development would benefit from the engineering and operational experience of the military program. The support of these Federal programs has provided U.S. industry with a 5-year lead worldwide in being able to produce commercial tiltrotors, if a Federal decision is made to pursue such a goal. On the other hand, the Federal Government has invested little in high-speed ground transportation research during the past 15 years. (A decade-long Federal high-speed ground transportation research and development (R&D) program ended in 1975.) Western European and Japanese industries have roughly a 5- to 10-year lead in bringing maglev to the market. They have also been producing and operating high-speed rail systems for years.

Issues

tiltrotors and maglevs are each a part of broader transport categories, VTOL aircraft and high-speed ground transport, respectively. Neither category is used much in commercial passenger service in the United States, although high-speed trains are widely used in Europe and Japan, where these systems are expanding. Moreover, both tiltrotors and maglevs have technical development requirements that must be met before a commercial system could be implemented.[2] While both new technologies are likely to have performance advantages over other types of VTOL or high-speed rail, this promise alone is not enough to assure their success in competition with other forms of transportation. Potential operators and entrepreneurs for each must also face and overcome the significant institutional and community barriers to establishing new transportation systems. To cite just one example, tiltrotors and maglevs have significantly different design and performance characteristics than conventional aircraft and rail systems, and current Federal safety regulations must be developed or changed to address each of these new technologies.

maglev and High-Speed Rail Systems

Across the country, States, local authorities, and private groups have seriously investigated the potential of high-speed ground vehicles, both maglev and rail, to meet their transportation needs. In each case, the investigating group has planned on purchasing currently available foreign vehicle technology and using U.S. expertise for guideway development and construction. However, because public programs have not been available to fund infrastructure development, an

1 A metropolitan vertiport capable of handling 1 million passengers annually would cost around $40 million to establish.

2 In the context of ground transportation, speeds above 150 miles per hour (mph) are considered "high." Amtrak's Metroliner operates at 125 mph on certain track segments between Washington, DC, and New York City.

intercity, high-speed ground corridor has yet to be successfully financed in the United States.

Technology Development

maglev technology is being developed primarily in Japan and Germany, where major, long-term, government-supported research programs are under way. A German consortium, formerly known as Transrapid International,[3] has developed a maglev system to the preproduction prototype stage and tested it extensively at a facility in Northwest Germany at a cost of over $1 billion. The first U.S. commercial use of maglev, scheduled for Orlando, Florida, beginning in 1995, will use Transrapid technology. The Japanese Railway Technical Research Institute, supported by the recently privatized Japanese Railways, has invested $1 billion in developing a maglev system. A 27-mile test facility is under development for possible inclusion in a future revenue line between Tokyo and Osaka. An extensive 4-year test of the system is expected to commence in 1993 at a total cost of around $3 billion with earliest commercial service feasible by 2000. The other major Japanese system is the HSST, originally sponsored by Japan Airlines, but now a separate, private enterprise. Somewhat similar to the German Transrapid design,Q the HSST has been demonstrated extensively, but only on tracks shorter than 1 mile. The HSST uses a lighter and less costly guideway than other maglev concepts, but the maximum design speed is less than 200 mph.

These efforts overseas have raised concerns that the United States is falling further behind in an important new technology. In 1990 the National maglev Initiative (NMI) was created—a 2-year, $30 million program now in its first phase, to evaluate the engineering, economic, environmental, and safety research needs for a U.S. maglev system. The three-organization NMI team—comprised of staff from the Department of Transportation (DOT), the U.S. Army Corps of Engineers, and the Department of Energy-is slated to report its findings in fall 1992 and to include among them a recommendation on whether to pursue future maglev development domestically. The results of NMI investigations will help in evaluating foreign maglev performance and in deciding whether or not to commit major public funds for a U.S. maglev program. In conjunction with NMI, DOT is also examining high-speed rail technologies for their potential contributions to mobility in the United States.

Sustained funding through completion of NMI's initial phase will be needed if the team is to develop the information Congress must have to decide how much and what kinds of future support it wishes to provide. The NMI study findings are not likely to be available in time for fiscal year 1993 transportation appropriations deliberations. Consequently, Congress may wish to provide follow-on funding for a transition year for the most promising Federal efforts, while the near-term Federal role in maglev technology development is debated.

Research efforts to reduce the costs of materials and construction, address the health effects, and limit the environmental impacts are critical to the future of maglev. Communication, automation, and passenger safety investigations would benefit a variety of maglev designs, and understanding the health effects of electromagnetic fields is important for the future of all electrically powered transportation systems.

maglev Implementation

Both maglev and high-speed rail will need new, grade-separated guideways for high-speed service, but steel-wheel trains could also operate at low speeds on existing tracks that are in good condition. maglev vehicles and guideways are intrinsically linked, and the German and Japanese prototype maglev vehicles each have unique, incompatible guideways. While it is too early to establish standards for maglev, uniform guideways will be crucial to bring costs down if intercity maglev is ever to be established on a nationwide scale. Intermodal connections and adequate access to stations from other modes of transportation are also important for success.

The relative intercity market potential of maglev and high-speed rail will depend on factors specific to

3 The consortium has been expanded and renamed Magnetschnellbahn AG.

4 The HSST uses a suspension concept similar to Transrapid's, but uses a different propulsion system.

5 Grade-separated refers to elevating or depressing tracks or a guideway above or below roads, bridges, or other structures.

each route, such as right-of-way alignment, number of stops, real estate costs, and projected ridership. However, only high-speed rail technology is proven and ready for intercity service now. For the future, maglev promises faster speeds, quicker acceleration, the ability to ascend steeper grades, less noise, and better energy efficiency than rail at similar high speeds.

maglev and high-speed trains would generate a variety of social advantages and costs that must be considered in public policies for these technologies. High-speed trains operating on grade-separated tracks are very safe; no passengers have been fatally injured in either Japanese or French rail systems in high-speed service. High-speed rail and maglev are relatively energy efficient at their operating speeds and, because they use electricity for power, are not dependent on petroleum and do not degrade the air quality in the areas where they operate.[6] These are societal benefits, however, and do not at present constitute substantial economic incentives to a potential operator other than direct costs for fuel. maglev proposals, like those for any new infrastructure, will encounter environmental permitting requirements and are likely to generate concern over noise under some conditions.

At this point, then, the largest cost difficulty for maglev implementation lies in financing rights-of-way and guideway construction. Revenues received on bonds issued for some high-speed, intercity rail facilities are exempted from Federal income tax, but because State laws limit many types of tax-exempt bonds,[7] tax incentives have so far not made a difference for would-be high-speed rail or maglev developers.[8] Tax-exempt bonds for other purposes are readily available to investors, and these circumstances are likely to continue to make private sector financing difficult unless **State** laws are changed. Proposed highway reauthorization legislation for 1991 would make it easier for States to make highway rights-of-way available to other surface transportation systems, including high-speed rail and maglev, and would permit funding from the Highway Trust Fund under certain circumstances.

Tiltrotor Systems

tiltrotor's commercial strengths are its abilities to avoid ground access or airport congestion by providing point-to-point service to conveniently located landing facilities, feeder flights into airports where runway capacity is saturated, and service to new points as necessary without the need for runways. tiltrotor passengers and some aspects of the aviation system could benefit from these services. Individual airlines, however, see mostly risks and no additional profits over the status quo and have expressed little interest in pushing for commercial tiltrotor development.

Technology Development

NASA and DOD have investigated a wide range of advanced VTOL aircraft designs over the past four decades, and have concluded that tiltrotors hold strong promise for a variety of missions. The Federal Government has spent over $2.5 billion for XV-15 and V-22 tiltrotor development programs,[9] and private industry has invested another $200 million to $300 million on military tiltrotor technology.[10] Experts estimate that U.S. industry would have to inject around $1 billion to $1.5 billion more to produce a commercial tiltrotor.[11]

Given the market and implementation uncertainties for commercial tiltrotors, private industry and

6 **Coal** is the **primary fuel for U.S. electric powerplants,** providing 57 percent of all electricity generated in 1987. Nuclear power is the **source** of 18 **percent** of U.S. electricity. Coal and nuclear fuel raise other environmental concerns. See U.S. Congress, Office **Technology** Assessment, ***Electric Power Wheeling and Dealing: Technology Considerations for Increasing Competition OTA-E-409*** (Washington, DC: U. S. Government Printing Office, May 1989).

7 U.S. **Congress, Office** of Technology Assessment, ***Rebuilding the*** Foundations: ***A Special Report on*** State ***and Local Public Works Financing and Management,*** OTA-SET-447 (Washington, DC: U.S. Government Printing Office, March 1990), p. 58.

8 **Robert Cox, attorney, remarks at** OTA Workshop on maglevand tiltrotor Transportation: System Concepts, **Economics, and Regulatory Issues,** Apr. 18,1991.

9 **Boeing Commercial Airplane** Group **et al.,** ***Civil*** tiltrotorM~io~ ***and Applications Phase II: The Commercial Passenger Market,*** prepared for National Aeronautics and Space Administration and Federal Aviation Administration, NASA CR 177576 (Seattle, **WA:** Boeing Commercial Airplane Group, February 1991).

10 **Federal** Aviation Administration, **Research, Engineering, and Development Advisory Committee,** tiltrotor Technology **Subcommittee,** ***Report*** (Washington, DC: June 26, 1990), p. 12.

11 **Philip C. Norwine, vice president, Commercial Market Development, Bell Helicopter Textron, remarks** at OTA Workshop on maglev and **Tiltrotor** Technologies: Research, Development, and Testing Needs and the Federal Role, Feb. 6,1991.

investors are not yet willing to commit the substantial funds needed to develop a commercial tiltrotor. The NASA/Federal Aviation Administration (FAA) civil tiltrotor missions and applications study[12] was completed to outline the actions necessary before such development could occur. The study report recommended an intensive l-year planning effort followed by a 3-year tiltrotor research and technology demonstration program to enable industry and public authorities to decide". . . whether creating a commercial tiltrotor system is technically feasible, economically attractive, and in the national interest."[13]

If funding is available, the most important technology development priorities for a commercial tiltrotor program are improving rotor designs to reduce noise, ensuring appropriate cockpit equipment and procedures, and developing flight tests and any necessary equipment (such as a low-speed, air speed indicator) to permit steep flight paths to and from landing facilities. However, without an assured financing stream, larger tasks, such as quiet rotor design and flight testing, will not be undertaken.

Eurofar (a consortium of five European helicopter manufacturers) has completed design studies and anticipates funding for development of a civil tiltrotor demonstrator. Regardless of U.S. Federal and industry decisions regarding tiltrotor, Ishida, a Japanese company, may sell the first high-speed VTOL in the civil market. However, the aircraft Ishida is developing uses a tiltwing, rather than a tiltrotor, and development and production are occurring in the United States.

tiltrotor Implementation

The timesaving of tiltrotor service, which could be substantial, hinge on well-situated vertiports. Since tiltrotors do not need runways, 5-acre or smaller vertiports might be built at industrial areas, on waterfronts, and above freeways or railyards, where locating a conventional airport would be impossible. (Vertiports can also accommodate helicopters that meet noise standards.) Federal Airport Improvement Program grants could be available for planning and building vertiports. FAA has awarded around $3 million to State and local authorities for civil tiltrotor and vertiport feasibility studies, and the first public heliport designed to vertiport standards is being constructed with some Federal financing at the Dallas Convention Center in Texas.

A tiltrotor network would change local noise patterns, consume more energy, and increase the amount of air traffic relative to comparable service on conventional aircraft. Aircraft noise is a serious problem for airport operators and airlines, and is the leading obstacle to community acceptance of vertiports. On the other hand, knowledgeable engineers claim that less noise will reach the ground from tiltrotors than from conventional airplanes or helicopters. If tiltrotors make inroads into the busiest intercity travel corridors, they will increase substantially the number of daily flights in the air traffic control (ATC) system. For each shuttle jetliner flight replaced, three to five 40-seat tiltrotors would enter the airspace, and appropriate ATC facilities and staffing levels must be ensured, lest tiltrotors overcome runway congestion, but overcrowd segments of the airspace.

Findings and Options

Major findings and options that emerged from this study are as follows:

- maglev and tiltrotor concepts are technically feasible. Prototype U.S. or foreign vehicles have operated for more than a decade. Once installed, these new modes could operate at speeds and intervals that would provide door-to-door trip times competitive with conventional air transport at distances up to 500 miles.

- Some form of Federal financing will be required if commercial maglev or tiltrotor technologies are to be developed by U.S. industry in the next decade. The options for Congress to consider range from not funding future work on either tiltrotor or maglev, to very large programs, costing as much as $2 billion or more over a 10-year period. Congress will need to clarify its objectives for supporting these technologies before it can

[12] Boeing Commercial Airplane Group et al., op. cit., footnote 9.

[13] 1 bid., p. i.

make wise decisions about Federal investment levels.

- If improved mobility, new transportation alternatives using U.S. technologies, and international competitiveness are the goals, Federal demonstration and implementation assistance programs must be established. Federal funding commitments of $800 million to $1 billion are likely to be necessary to develop a full-scale U.S. maglev prototype over the next decade. About $300 million in Federal funds will be required for civil tiltrotor technology development and testing. While these technologies would improve mobility for their users, it is not clear that they would make a measurable impact on traffic congestion levels for the general public.

- If maintaining technological options for future U.S. maglev and tiltrotor programs is **important,** Federal **R&D** funding should be continued at levels of at least $5 million to $10 million annually for each area.

- Federal agencies will face additional oversight and regulatory responsibilities—safety, environmental, and economic—that must be supported if maglev, tiltrotor, or other similar systems are placed in service.

Technical Feasibility

Foreign high-speed rail technology is available now for U.S. markets, and German maglev will be ready by late 1992. The technical feasibility of safely carrying passengers with tiltrotors is not seriously in doubt. Once in operation, maglevs and tiltrotors could avoid airport ground access and runway delays and offer terminals closer to population or industrial centers. If the maglev or tiltrotor vehicles departed as frequently as airliners, they could save time compared with travel by conventional air on particular short- to mid-distance routes.

Federal Financing

Developing tiltrotor or next generation maglev systems to the point of being established and commercially viable would cost billions of dollars. Without Federal management and financial support for infrastructure and precommercial tiltrotor technology development and testing, U.S. industry will not produce either commercial tiltrotors or maglevs in this decade. Public support for infrastructure—rights-of-way for maglev and specific ATC and landing facilities for tiltrotor—will also be necessary, regardless of who advances and sells the technology. OTA assumed that Congress would choose to continue some level of Federal effort for each and has set some guidelines for consideration on that basis. (Table 1-1 shows the steps still necessary for an operational maglev or tiltrotor system.)

tiltrotor

If Congress decides to continue the V-22 program, enough engineering and operational experience might be gained for industry and investors to make firm decisions, either pro or con, regarding commercial tiltrotor production. R&D that would make tiltrotors and other VTOL aircraft and infrastructure more attractive to communities and airlines could be conducted over the next few years at present funding levels of about $5 million per year.

If a higher priority is given to civil tiltrotor R&D than at present, Federal options range from increasing the percentage of vertical flight research funds devoted to high-speed VTOL concepts to committing funding of $60 million to $90 million per year for developing and testing precommercial tiltrotor technology. The 3-year program suggested in the NASA/FAA report would cost this amount annually, two or three times the amount currently allocated for all NASA and FAA vertical flight programs--and enough to enable U.S. industry to decide on further investment.

maglev

Unlike the situation with tiltrotor, no established U.S. military technology base exists for maglev development. Consequently, any research program for maglev must be crafted carefully so that a range of components and concepts can be studied at modest expense through the prototype stage. Without a "standard" maglev guideway, technology testing will require separate facilities for each maglev configuration considered; conversely, establishing a standard too early would limit the concepts that could be tested. Significant further investment related to infrastructure needs would be necessary to test and demonstrate

Table I-I-Steps Still Needed for Operational maglev or tiltrotor System

	Commercial tiltrotor	maglev
Technolcgy development	Military V-22 program engineering and operating experience; noise, flight path, and cockpit research.	Debate revolves around whether to develop new U.S. designs or develop or buy foreign concepts. low-cost guideways and reliable switches are desirable.
Infrastructure	Conveniently located vertiports; terminal airspace, routes, and procedures; air traffic control (ATC) and navigation facilities.	Available and affordable rights-of-way; dedicated guideways, bridges, grade separations, electrification, communication and control systems, and stations.
Technology and safety demonstration	ATC compatibility; community noise levels; economic data; airline and passenger acceptance.	Construction methods; construction, operating, and maintenance cost data; community and passenger acceptance.
Federal regulatory structure	Mostly exists--specific airworthiness and operating standards for tiltrotors are being developed. Initial vertiport standards have been published.	Not yet developed-some maglev design and performance characteristics conflict with current Federal Railroad Administration (FRA) regulations. FRA is assessing the applicability of current statutes and regulations to the Orlando maglev and developing waivers, guidelines, and possibly new regulations for the project. The Orlando project will be the basis for future maglev regulations.
Legal and environmental concerns	Noise standards; local zoning.	Noise during very high speeds; tight-of-way agreements; health effects of electromagnetic fields.
Financing	Under existing policies, Federal support for infrastructure possible but not for aircraft development.	No Federal policy for funding maglev or high-speed rail technology development or infrastructure.
Competitive framework	Airline cooperation is essential for tiltrotors to operate. Individual airlines have well-established operations in highly competitive short-haul markets and see mostly risks and no additional profits in employing tiltrotors. The higher direct operating costs of tiltrotor service might have to be underwritten if tiltrotors are to provide public benefits of expanded airport capacity and reduced delays and congestion.	Airline marketing power and large, established route structure could be strong assets or formidable opponents to intercity maglev. Amtrak has operating authority for most routes proposed for passenger-carrying maglev or high-speed rail.

SOURCE: Office of Technology Assessment, 1991.

vehicle operations under any concept. Federal options range from follow-on funding for the NMI for a few years at levels of about $5 million to $10 million per year, to full-scale development of new maglev technology, which is likely to total more than $750 million.

Additionally, available and affordable rights-of-way and financing for infrastructure are essential to maglev operational feasibility. In fact, a Federal decision for large-scale testing and demonstration might not lead to wide implementation of a U.S. maglev technology without a complementary policy to help establish maglev infrastructure.

Other Decision Factors

Maintaining a broad Federal transportation research base in these and other promising technologies along with extensive data on passenger travel patterns would assist in deciding on and gearing up for a larger scale development effort if conditions warrant it. Increasing concerns over environmental quality and U.S. dependence on foreign petroleum might ultimately require radically different domestic transportation systems, and high-speed, energy efficient maglev has strong potential in this context. tiltrotors, on the other hand, are heavy energy consumers, and offer less potential than maglevs for surface congestion relief. Both maglevs and tiltrotors would diversify transportation options and might lessen airport ground and air congestion, if passengers can be diverted from conventional air travel.

The most directly related issues are whether (or when) intercity traffic congestion, petroleum consumption, or related environmental concerns will reach unbearable levels, and whether alternative transport modes are viable solutions to these problems. Although dependence on petroleum as an energy source is a recognized issue, there is no consensus on the extent of future congestion, environmental or land-use concerns, nor on the appropriate public policies for addressing these problems. Thus, at present, no clear-cut guidance for choosing among the more costly tiltrotor or maglev options emerges, using these criteria.

Technology Leadership

The national trade benefits and industrial competitiveness implications stemming from commercial development for both maglev and tiltrotor need further study, especially if significant Federal support for a U.S.-produced vehicle or the accelerated development of infrastructure is considered. Currently, the United States has about a 5-year development lead worldwide in tiltrotor technology, and over one-half the potential demand for commercial tiltrotors lies overseas, suggesting a possibly favorable trade position. maglev is undeniably an exciting new surface transportation alternative, although the world market for U.S.-produced maglev is uncertain. Most locations that could consider investing in maglev systems in the next two decades-Western European countries and Japan—have strong commitments to home-grown technologies. However, regardless of where maglev technology originates, 75 to 90 percent of the expenditures for a maglev system would go to construction and engineering firms that prepare the right-of-way and put the infrastructure—guideways and stations—in place.

Improved Mobility

Each technology, if established, could improve domestic mobility. Congress may wish to give long-term support or encouragement to either or both of these technologies if improved mobility alone is a satisfactory goal. Implementing high-speed rail in selected congested intercity corridors is a near-term way to meet this objective.

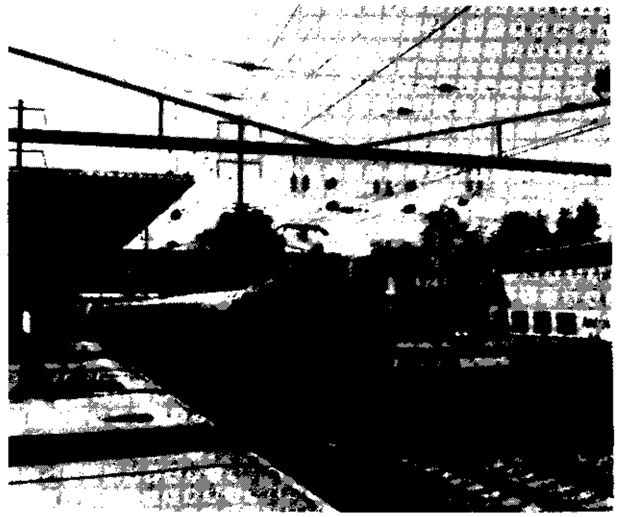

Photo credit: National ***Railroad Passenger Corp.***

The Amtrak Metroliner is the fastest train in North America, reaching speeds of 125 miler per hour.

Neither maglev nor tiltrotor technology has yet been demonstrated as practical for intercity passenger service, and the potential markets for these technologies are difficult to predict with much confidence. The key to commercial success for both tiltrotor and maglev is shifting passengers from other modes, although a very high-speed maglev is likely to attract some additional discretionary travel. Though detailed demand studies are under way, cost and performance projections currently appear insufficient to ensure economic success. Some potential maglev routes, such as Los Angeles to San Diego and Boston to Washington, might eventually be profitable.

Potential entrepreneurs will face significant community and institutional barriers to establishing new transportation systems (see table 1-1 again), and such issues are time consuming and potentially costly to resolve. Moreover, if an intercity maglev, tiltrotor, or high-speed rail system is put into place, their operators will have to compete with the marketing power and pricing flexibility of Amtrak and the large airlines. tiltrotors would cost more per seat to purchase and operate than conventional airplanes, and maglev routes would need 3 to 5 million passengers per year just to cover a 20-year amortization cost of the guideway at typical air travel fares. Time-sensitive service, such as business travel, is likely to be the initial market for maglev and tiltrotor, if tickets are priced to recover most of the capital and operating costs.

It is not clear from studies to date that either of these new technologies will provide substantial relief for intercity congestion and delays, making them questionable Federal investments solely for that purpose. Moreover, without public willingness to finance infrastructure, neither transportation alternative will be realized.

Federal Responsibilities

Additional research and FAA certification are needed for civil tiltrotor. FAA is well positioned to certify a V-22 for civilian test and demonstration purposes by 1995 if a sponsor requests it and aircraft are available, because it has worked closely with DOD to collect data from the military V-22 flight test program. FAA has low-level programs in place to develop and establish operating regulations, airspace requirements, and technology for advanced vertical flight that could be accelerated if made a priority. Noise standards for tiltrotor have to be finalized to aid in vertiport planning.[14]

The present Federal Railroad Administration (FRA) safety and regulatory framework for conventional railroads cannot be applied directly to maglev or high-speed rail, and FRA's technical and regulatory expertise in these areas needs further bolstering. FRA is working with foreign authorities and developing guidelines for maglev and high-speed rail. However, a separate safety evaluation for different types of technologies, including a total system safety approach for maglev and high-speed rail, is also warranted. FRA's ongoing efforts need expansion and additional support if a thorough system safety program is to be developed. Issues related to the health consequences of electromagnetic fields also require investigation and standard setting. Congress will want to ensure that programmatic support is available to explore these questions, if it decides to pursue implementation of U.S. or foreign technologies.

[14] Noise standards are established for helicopters (14 CFR 36) and heliport planning (14 CFR 150).