



**HIGH SPEED GROUND TRANSPORTATION:
FEDERAL AND STATE ROLE IN RESEARCH, DEVELOPMENT, AND
DEPLOYMENT**

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1998 Washington Internships for Students of Engineering
August 1998

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THE AUTHOR

Daniel Stiles is a senior in the Civil Engineering Department of the College of Engineering at Colorado State University. This paper is the result of his research conducted during the Washington Internships for Students of Engineering (WISE) Program of 1998. His internship was sponsored by the American Society of Civil Engineers (ASCE). His interest in public policy and engineering has been greatly enhanced through research of High-Speed Ground Transportation systems.

WASHINGTON INTERNSHIPS FOR STUDENTS OF ENGINEERING PROGRAM

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ACKNOWLEDGEMENTS

The author would like to express his thanks to the members and officers of ASCE for their support of the WISE program. It is the author's opinion that programs such as WISE provide an invaluable educational link between academia and society. Through ASCE's support of the WISE program, they have impacted the life of future engineers and introduced them to the experience of serving as an engineering public policy advocate.

Special thanks go to the WISE program administrators and in particular to the 1998 faculty-member-in-residence, Dr. Wolf Yeigh, for his leadership, support, and professional advice. Thanks also to the staff of ASCE's Washington, D.C. office and especially Elizabeth Clarke for being a mentor and a friend for the summer.

Thanks also go to the many members of Congress, their staff, and various federal and private sector individuals who contributed to my research. In particular, Robert McCown, P.E. with the Federal Railroad Administration (FRA), for serving as an invaluable resource and enhancing my educational experiences this summer.

EXECUTIVE SUMMARY

High-Speed Ground Transportation (HSGT) is a mode of transportation that has been used worldwide for the past couple of decades. It includes upgrading existing railroad infrastructure to supporting passenger train-set speeds in excess of 125 miles per hour. Developing the necessary infrastructure to support the deployment of magnetic levitation technology that propels passenger vehicles to speeds greater than 240 miles per hour is also a critical component of HSGT. Past research and development has produced both electric and non-electric HSGT technologies that can be applicable to high-density travel corridors throughout the United States. HSGT is intended to provide an alternative mode of transportation for travel between densely populated cities 100 to 500 miles apart. It is also designed to be competitive with existing congested modes of transportation, such as the automobile and airline industries.

U.S. investment in surface transportation research has led to many improvements in infrastructure and has provided tremendous benefits to users through the development of safer, faster, and more efficient modes of transportation. Congressional interest in HSGT research and development investment began in 1965 with the passage of the High-Speed Ground Transportation Act. The development of public policies that facilitate the research, development, and deployment of HSGT has been incremental and slow ever since 1965. The United States continues to remain far behind other nations in deployment of HSGT.

The funding of HSGT research and development programs has been a highly debated issue among policymakers. While many areas of the nation are in need of an additional mode of transportation to augment their current transportation infrastructure, states that compose much of the nation's mid-section or that do not harbor a large metropolis have no evident need for HSGT systems. To these states, the federal role in funding HSGT research and development is of concern.

As states across the nation approach possible deployment of HSGT, it is vital that the issue of defining the state and federal role in the research, development, and deployment of HSGT be addressed. Members of the transportation community agree that the federal government should lead research efforts. Federal support is necessary for innovation. However, states paying disproportionately higher taxes to the federal Highway Trust Fund believe that states interested in HSGT should hold the sole responsibility for the research, development, and implementation of HSGT.

Building HSGT infrastructure can cost from less than \$2 million to \$50 million per route mile.¹ For all HSGT technologies, additional support for new technologies will help reduce the initial capital costs. Policies defining the federal and state role in the research, development, and deployment of these technologies are essential.

¹ U.S. Department of Transportation. Federal Railroad Administration, *High-Speed Ground Transportation for America*. Washington, D.C., September 1997.

Some recommended policies include:

- A federal government focus on applied research that adopts and enhances the worldwide technologies that exist for use in the United States.
- Federal focus on the development of technologies that reduce the overall capital costs of HSGT.
- Emphasis placed on federal development of Accelerail and New High-Speed Rail.
- States focus on applied research and development of technologic needs specific to their region.
- States focus more on the economic, political, and social aspects of introducing HSGT.
- States conduct comprehensive public/private partnership studies of HSGT in their area.

In addition, it is recommended that the state and federal role in HSGT deployment be defined. Construction support should take place through federal loans that can be repaid by the self-supporting HSGT systems. Together, these recommendations will help facilitate the introduction of HSGT to America's intermodal transportation network.

INTRODUCTION

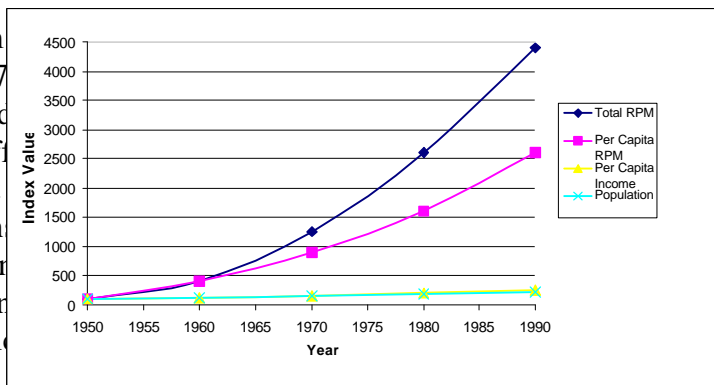
Transportation Today

Spending on passenger and freight transportation exceeds \$1 trillion annually or about 11% of the gross domestic product.² Transportation plays a key role in the United States economy. Americans depend on smooth-flowing, seamless transportation networks to go where they need to go and get the goods and services that they need when they need them. Without the vital link that the existing modes of transportation currently serve between industry and the consumer our nation's economy would suffer.

Our highways and airport facilities in essential intercity corridors are suffering unacceptable congestion with growing travel demand. Congestion costs the nation an estimated \$3-\$5 billion daily in lost time and wages.³ Expansion of highway and air transportation systems is vital to meeting the growth predicted by the Federal Aviation Administration (FAA) and the Federal Highway Administration (FHWA). Many cities have begun to increase their highway capacity by constructing limited access highways costing up to \$40 million per lane mile. Between 1983 and 1991, total highway travel increased at an annual rate of 3.5 percent, while population grew at approximately 1 percent.⁴ The FHWA forecasts that the average annual rate of growth in highway travel will decline and only grow at a rate of 2.5 percent per year. This forecast is based upon the assumption that mass transit usage will increase substantially and compliment the need for highways. As shown in Figure 1 domestic intercity air travel has grown much faster than population and income since 1950.⁵ What mass transit infrastructure will support this increase in travel?

Figure 1
Domestic Air Travel: Long-Term Trends in Revenue Passenger Miles, Population, and Income

Source: Data from
D.C., 1997
Over the past decade
capacity. While eff
acknowledged that
by these expansion
capacity problem in
Speed Ground Tran
short-haul air traffi



a, Washington,
sion of airport
illion, FAA has
adequately improved
tial aviation
elopment of High
the pressure on

² General Accounting Office, *Surface Transportation: Research Funding, Federal Role, and Emerging Issues*, Washington, D.C., September 1997, p 17.

³ U.S. Department of Transportation. Federal Highway Administration, *Technology to Keep America Moving: Surface Transportation Research and Development*. Washington, D.C., April 1997.

⁴ Report of the Secretary of Transportation to the U.S. Congress, *The Status of the Nation's Highways, Bridges, and Transit Conditions and Performance*, 1993, p 19.

⁵ U.S. Department of Transportation. Federal Railroad Administration, *High-Speed Ground Transportation for America*. Washington, D.C., September 1997.

⁶ U.S. Department of Transportation. Federal Railroad Administration, *High-Speed Ground Transportation for America*. Washington, D.C., September 1997.

Recent studies show that there is an increasing demand to develop and implement another mode of transportation in the United States to reduce the strain on the existing transportation infrastructure system. In his testimony before the U.S. House Science Subcommittee on Technology, ASCE’s Transportation Policy Committee Chair, Dr. Michael Walton, P.E., recommended that "National transportation policies encourage new intermodal and multi-modal (i.e. highway, mass transit, and rail) research programs."⁷ The most recent demand for research and development programs has come from the states themselves rather than the federal government.

High-Speed Ground Transportation

HSGT, a family of technologies ranging from upgraded existing railroads to magnetically levitated vehicles, is a mode of transportation that can best link cities 100 to 500 miles apart.⁸ HSGT is competitive with other modes of transportation such as air and auto, when applied within the previously mentioned range. It has long been a highly used and respected mode of travel for many European and Asian nations. The Amtrak Northeast Corridor (NEC) currently provides the only high-speed rail service in the United States.

Current Technologies

There has been a considerable amount of research and development of HSGT technologies. The HSGT options can be organized in three groups: accelerated rail service, new high-speed rail systems, and magnetic levitation. Table 1 shows the various types of Accelerail options being explored. These groups are arranged in order of increasing performance capabilities and initial cost. Accelerail represents systems that can be implemented by upgrading existing railroad rights-of-way. While Accelerail technology does not represent a mode of transportation that requires entirely new infrastructure, it still presents many challenges.

Table 1:
Accelerail Options

<i>Speed (mph)</i>	<i>Non-electrified</i>	<i>Electrified</i>
90	"Accelerail 90"	[not addressed]
110	"Accelerail 110"	[not addressed]
125	"Accelerail 125F"	"Accelerail 125E"
150	"Accelerail 150F"	"Accelerail 150E"

⁷ U.S. House of Representatives. Committee on Science, Subcommittee on Technology, Testimony of Dr. C. Michael Walton, P.E. April 23, 1997.

⁸ Federal Railroad Administration, "What is High-Speed Ground Transportation," High-Speed Ground Transportation, n.d., <<http://www.fra.gov/hsgt/>> (June 2, 1998).

Source: Data from U.S. Department of Transportation, HSGT for America, Washington, D.C.,1997.

There are also two other forms of HSGT systems, New HSR and Maglev. New HSR constitutes advanced steel-wheel-on-rail passenger systems on completely new rights-of-way.⁹ The trains are able to operate on both existing and new rail infrastructures. New HSR systems can provide transportation for speeds up to 200 mph. Several New HSR trains are operating in the world including the Japanese Shinkansen and the German Intercity Express. The third, Maglev, is a high-speed transport technology that uses magnetic forces to lift, propel, and guide a vehicle over a specially designed guideway. By eliminating wheels and other moving parts the amount of friction is greatly reduced permitting the vehicle to move at speeds in excess of 300 mph.¹⁰

Public Perception

Although there is interest in maintaining passenger rail in the United States, support for HSGT by the general public is lacking. The support for research and development of HSGT mainly comes from those who have had the opportunity to experience HSGT in other countries. One of the largest non-technical problems facing HSGT is that the American public is not aware of the benefits.¹¹ In fact, understandably a lack of general knowledge or personal experience exists in the United States with regard to HSGT.¹² It is difficult to rally support for a new mode of transport such as HSGT when there is little example of its operational capabilities within the United States.

National Railroad Passenger Corporation (Amtrak) provides a good example of how the American public perceives steel wheel rail transportation. Since the creation of Amtrak in 1971, it has been difficult to ensure a continued operation of an intercity rail passenger network in the United States. Congress has and continues to attempt to close the railroad unless it becomes self-sustaining. However, their constituents have pointed out that even though rail transportation does not meet their personal daily transportation needs, they want to have the option of using it.¹³

Congressional Viewpoint

⁹ U.S. Department of Transportation. Federal Railroad Administration, *High-Speed Ground Transportation for America*. Washington, D.C., September 1997.

¹⁰ Maglev Technology Advisory Committee, *Benefits of Magnetically Levitated High-Speed Transportation for the United States*. Bethpage, NY, June 1989.

¹¹ Robert J. McCown, P.E., Federal Railroad Administration Technology Development: High Speed Rail, Conversation, July 10, 1998.

¹² Jeffrey H. Grove, Professional Staff Member of the U.S. House of Representatives Committee on Science, Conversation, July 2, 1998.

¹³ Robert J. McCown, P.E., Federal Railroad Administration Technology Development: High Speed Rail, Conversation, July 10, 1998.

For many policymakers and their constituents alike, there is no great sense of urgency to develop a comprehensive national policy on HSGT research and development. The short-term outlook for transportation infrastructure is not perilous. Interest in long-term investment by Congress and other policy makers has been declining over the past decade. Policymakers tend to be more concerned with the short term benefits of their investment. They are looking for results to show their constituents how their tax dollars are having a tangible impact. This creates a visible strain on the long-term requirements of HSGT research and development. Policymakers are aware that there are financial investment risks associated with research and development. Since there is no pressing transportation crisis, Congress is not willing to take many risks.

The progression in the development of HSGT systems has been cumbersome and slow. Since Congress committed their interests in developing other modes of transportation such as air and highway decades ago, there has only been limited, localized interest in HSGT systems. As staff from Senator Campbell's (R-CO.) office pointed out, "With low oil costs and a booming economy, highway funds receive the most attention."¹⁴ Financial investment in mass transportation is traditionally low. It is difficult to convince society to move from their convenient personal vehicles to mass transportation when the cost of fuel is so low. Overall, there is a lack of financial focus on investment to modes of transportation that the American public are not accustomed.

Over the past several years, there has been increased state interest in the development of HSGT. However, this has not been coupled with an increase in national interest. Many policymakers feel that research, development, and deployment of HSGT should be supported by individual states.¹⁵ Because of the high variability of application of HSGT nationwide, the federal government's role in its development is a highly debated issue.

BACKGROUND

From the canals and rough roadways that linked the first colonial communities, to the railroads and highways that linked the various regions of the United States, to the mass transit systems that developed our urban centers, surface transportation has expanded our ability to transport both people and goods that drive our nation's economy.¹⁶ Surface transportation has served as the backbone of development for the U.S. The expansion of railroads during the early 1900s gave Americans the opportunity to travel greater distances than ever before. With the development of the airline industry, Americans saw a gradual decline in nationwide passenger rail services. While our national network of passenger rail has deteriorated, there has been much interest in bringing a new high-speed mode of ground transportation to densely populated cities.

¹⁴ Matthew J. Downs, Legislative Assistant/ Attorney for U.S. Senator Ben Nighthorse Campbell (R-CO.), Conversation, June 22, 1998.

¹⁵ Douglas H. Benevento, Senior Legislative Assistant for U.S. Senator Wayne Allard (R-CO.), Conversation, June 26, 1998.

¹⁶ U.S. Department of Transportation. Federal Railroad Administration, *High-Speed Ground Transportation for America*. Washington, D.C., September 1997.

Development of Public Policy

There has been congressional interest in HSGT since 1965. The development of HSGT as official policy occurred with the passage of the High Speed Ground Transportation Act of 1965. Representing a national interest in HSGT, this legislation initially authorized \$90 million for the development and demonstration of HSGT technologies. Four years later, the Federal Railroad Administration (FRA) introduced the self-propelled Metroliner cars and the Turbotrain in the Northeast. At the same time the new services were being introduced, interest grew in continuing developing technologies that focused on meeting the long-term needs of the Northeast.

When the HSGT Act appropriations ended in 1975, congressional focus moved from research and development of HSGT systems to improving the services along the Northeast rail corridor.¹⁷ Although the focus for development of HSGT shifted to the Northeast corridor, through the corridors improvements, the marketplace success of the high-speed rail system lead to increased Federal interest in achieving similar services in other Northeastern cities.

Just as important as the development of HSGT rail technology was the development of cooperative private/public partnerships between the freight railroads, the states, and FRA. Based on the success of partnerships in the automotive and airline industries, similar ones were formed in the railroad industry. These partnerships lead to the enhancement of corporate/public policy of shared freight and passenger rail use.

Emerging HSGT at the State Level

Not until the 1980's did the emphasis on HSGT shift from the Northeast to federally sponsored studies of other high traffic corridors. Until the birth of other high-speed rail entities in California, Texas, Florida, Ohio, and Nevada federally sponsored HSGT research and development had been increasingly scrutinized. These stateability of cost effective upgrades to high speed service, relying on proven technologies, in the range of \$2 million to \$3 million per mile by the year 2000._ The program is based upon partnerships with state governments, suppliers of technology, and railroads. Funding for the Next Generation program was divided between the FRA's research and development budget and the NGHSR budget. The high-risk, more futuristic development of technology was supported by the FRA's research and development office, while the lower risk demonstration was supported through the NGHSR budget. The program seeks to make available new technologies and devices that are tž æ• "such of the uncertainty and unreliability of both current air and highway travel, which are both susceptible to extreme ground fog and other climatic conditions unique to the California valleys. The Pennsylvania high-speed rail commission

¹⁷ U.S. Department of Transportation. Federal Railroad Administration, *High-Speed Ground Transportation for America*. Washington, D.C., September 1997.

¹⁸ California Intercity High-Speed Rail Commission, "Stability Through Diversity," [The Case for High-Speed Rail in California](http://www.transitinfo.org/HSR/ex_sum.html), n.d., <http://www.transitinfo.org/HSR/ex_sum.html> (June 8, 1998).

released a study that suggested a Maglev system would be the most feasible form of HSGT in their region. Today, more than 15 States have passed enabling legislation facilitating HSGT activities.¹⁹ Many of these states have demonstrated why there is a need for state participation in development and research of HSGT.

In depth statewide studies have also lead many states to propose or enact legislation. One study has lead to the Governor of California’s support of placing a major initiative to fund high-speed rail in the California ballot in 2000.²⁰ A Pennsylvania study lead to the inclusion of a \$350,000 comprehensive rail passenger strategic planning study and authorization for development of a \$26 million Maglev guideway assembly facility in the state’s capitol budget. Pennsylvania has also taken the initiative at the state level to upgrade its passenger rail to greater speeds by investing in new track. A total of \$150 million has also been authorized to purchase four new train sets to allow 110-mph service to link them with the existing northeastern high-speed rail corridor.²¹ Table 2 below shows some of the various states that have formed HSGT research and development groups and their top speed goals for upgrading their rail services for high-speed service.

Table 2
Existing High Speed Rail Development Efforts

State	Current Top Speed (mph)	Target Speed (mph)
California	90	125
Florida	79	125+
Illinois	79	120-125
Michigan	79	125
New York	110	125
Pacific NW	79	110
VA & NC	79	125

Source: Federal Railroad Administration, Federal Assistance NGHSR, Washington, D.C.

The Intermodal Surface Transportation Efficiency Act of 1991

As the definition for “railroad” was broadened, so was Congress’s interest in development of MAGLEV technology in the early 1990’s. The development of HSGT, specifically MAGLEV, became a cooperative effort of the U.S. Department of Transportation, the U.S. Army Corp of Engineers, and the Department of Energy.²² Only a year later, in 1991, the passage of the Intermodal Surface Transportation Efficiency Act (ISTEA) Public Law 102-

¹⁹ U.S. Department of Transportation. Federal Railroad Administration, *High-Speed Ground Transportation for America*. Washington, D.C., September 1997.

²⁰ Aileen Cho, “Keeping on Track,” *Engineering News Record* August 3, 1998: 44-47.

²¹ High-Speed Ground Transportation Association, “Steel Wheel,” Pennsylvania High-Speed Rail-Update, n.d., <<http://www.hsgt.org/newsletter.htm#report>> (June 8, 1998).

²² U.S. Department of Transportation. Federal Railroad Administration, *High-Speed Ground Transportation for America*. Washington, D.C., September 1997.

240 played a major part in the development of public policy towards research and development of HSGT.²³ Section 1036 of ISTEA authorized a National High-Speed Ground Transportation Program at \$800 million, including \$725 million for the development of a U.S. designed MAGLEV prototype, \$50 million for demonstration of new HSGT technologies, and \$25 million for research and development.²⁴ Although ISTEA also authorized up to \$1 billion in government-guaranteed loans to assist in the construction of HSGT systems, there have been no appropriations for construction.

Federally assisted research and development of HSGT progressed with the passage of ISTEA. Over a period of seven years of financial support from ISTEA there have been several areas of research and development of HSGT systems. Through section 1036 (c) FRA was able to award funds to various state departments of transportation for technology demonstration to support the development of HSGT systems. Due to the nature of research and development, not all projects that received funding were completed or successful. Awards were made to departments organizing research covering HSGT safety concerns, such as railroad crossings, to the development of new locomotive technologies. For example, the New York DOT retrofitted a turbo train to be used in the Empire Corridor at 125 mph. It is now in a revenue generating service on that same corridor operating at 110 mph.

Research and Development Programs

The FRA has an ongoing research program, instigated in 1994 to advance HSGT, called the Next Generation High-Speed Rail (NGHSR) Technology Development program. This program was authorized through the Swift Rail Act that calls for “improvement, adaptation, and integration of proven technologies for commercial application in high-speed rail service in the United States.” The specific objective of the program was to support the availability of cost effective upgrades to high speed service, relying on proven technologies, in the range of \$2 million to \$3 million per mile by the year 2000.²⁵ The program is based upon partnerships with state governments, suppliers of technology, and railroads. Funding for the Next Generation program was divided between the FRA’s research and development budget and the NGHSR budget. The high-risk, more futuristic development of technology was supported by the FRA’s research and development office, while the lower risk demonstration was supported through the NGHSR budget. The program seeks to make available new technologies and devices that are tailored to U.S. applications for near future implementation of high-speed rail by individual states. The NGHSR program has conducted research in specific areas of concern for application of high-speed rail. These activities include development of Advance Train Control systems that integrate high speed trains with freight trains on existing rail infrastructure, non-electric locomotives that reduce the costs associated with electrification of lines, and grade crossing hazard elimination that create barrier systems and advance warning devices. By working with states and railroad partners, the program will

²³ Public Law. 102-240

²⁴ U.S. Department of Transportation. Federal Railroad Administration, *High-Speed Ground Transportation for America*. Washington, D.C., September 1997.

²⁵ Federal Railroad Administration, “Program Objective,” Federal Assistance NGHSR, n.d., <<http://www.fra.dot/hsgt/fedassist/techdev/>> (June 8, 1998).

accomplish the necessary research and development to provide a smooth introduction of high-speed rail when the states are ready to deploy their systems.

Past Federal Role in Research and Development

In the past decade the Federal government has taken a stronger role in the research and development of HSGT systems. The research has, however, been focused more on the “hardware” or technological aspects of HSGT. Section 1036 of ISTEA changed this by requiring that the Secretary of Transportation perform a commercial feasibility study of HSGT. This study was completed and provided a good resource as to the potential of deploying and operating HSGT systems in high populous areas of the United States. The commercial feasibility study reiterates the DOT’s high regard for safety. This concern could influence the capitol costs of research and development of safety for the new HSGT technologies, whereas at the same time, the research and development of HSGT technologies could reduce the amount of investment. The committee for an Assessment of Federal High-Speed Ground Transportation Research and Development established under the Transportation Research Board (TRB) reiterated its support for HSR as a critical research initiative. In the TRB’s report referring to HSGT research they state that “a case could be made for significantly greater funding.”²⁶

Funding Policies

Research and development funding policy for surface transportation at the federal level was established through ISTEA. Since its enactment in 1991, surface transportation research has totaled nearly \$2.9 billion between fiscal year 1992 and 1996, which accounts for only two percent of the U.S. DOT budget.²⁷ ISTEA requires that states spend more on research, but typically federal spending far exceeds state spending on research. ISTEA money was used by the various agencies of the U.S. DOT; however, much of it went to support the Federal Highway Administration’s (FHWA) Intelligent Transportation Systems (ITS) program. Emphasis for research and funding spending has been placed on FHWA programs in the past. In fact, FHWA received seventy five percent of the total funding for surface transportation research through fiscal year 1996. Funding in the ISTEA era for transportation research and development came from the Highway Trust Fund (federal fuel tax revenue) and the general fund (general tax revenue). Figure 2 shows the distribution of surface transportation research funds in the past on a percentage basis. Close to seventy-five percent of the funding goes to FHWA, including research of ITS.

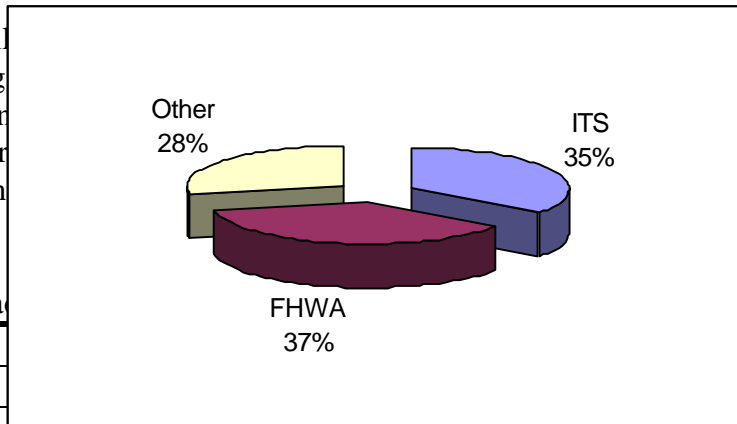
²⁶ National Research Council, Letter, < <http://www.nas.edu/trb/about/hsgt1297.html> > (June 8, 1998).

²⁷ General Accounting Office, *Surface Transportation: Research Funding, Federal Role, and Emerging Issues*, Washington, D.C., September 1997, p 17.

Figure 2

Distribution of Transportation Research Funds Throughout the DOT

Table 3 on the following page shows the distribution of transportation research funds among the DOT agencies. As shown by the chart, the majority of funds were distributed to FHWA, ITS, and FTA.



unds were \$21 million of the total. As shown by the chart, ISTEA promoted

Table 3
Funding for Surface Transportation Research

Agency					96	Total
FHWA					1,357	\$2,146,644
FRA	22,551	23,205	26,505	40,007	48,266	164,434
FTA	94,670	49,881	48,263	51,290	45,914	290,018
NHTSA	43,016	49,041	42,628	56,270	55,290	246,605
RSPA	2,521	2,384	2,739	8,220	7,008	22,872
Total	\$608,454	\$512,256	\$565,215	\$583,813	\$600.84	\$2,870,573

Source: General Accounting Office, Surface Transportation: Research Funding, Federal Role, and Emerging Issues, September 1996.

CURRENT POLICIES AND CONCERNS

The implementation of HSGT in the United States continues to present many challenges. According to the American Society of Civil Engineers, “North America has lagged in the development and implementation of efficient, relatively non-polluting, and high-capacity HSGT systems.”²⁸ Implementation of such systems in the United States has been prevented by high costs, difficulties in acquiring new rights of way, basic public perception of HSGT, and many other issues. The underlying concern often is the need for a definition of the state and federal role in research, development, and deployment of HSGT. Most transportation experts agree that the federal government should maintain a strong role in research and development of transportation systems. On the other hand, many members of Congress believe that only states that are interested in HSGT should fund research and development programs. Certainly a case may be made for both arguments.

Concerns

The Transportation Research Board (TRB) has expressed concern over the state-focused nature of the Next Generation High-Speed Rail program. They feel, rather than producing more generic results from research activities that can be adapted by individual states, the cost-sharing nature of the program between the federal government and the states is producing

²⁸ 1998 ASCE Policy Statement #402

fragmented, state focused results. The intent of the legislation in both ISTEA and the Transportation Equity Act of the 21st Century (TEA-21) is to promote a national research and development program. Policy makers have expressed their concern about the federal government's role in developing HSGT for what appears to be a more regional or commuter mode of transportation, not a national one.

TRB also expressed concern about establishing a definition between what are research and development activities versus deployment and construction activities; responsibilities that can be separated between the state and federal government. A great deal of division of opinion comes with a discussion of the federal role in the deployment of HSGT. There is an evident "gap" in support for applying and deploying the HSGT technologies that have been researched and developed. There is a need for a new policy that defines the state and federal role in the deployment of HSGT in the U.S.

The fact that HSGT is most economically feasible for distances between 100 and 500 miles, does not demonstrate the financial competitiveness of developing a coast to coast HSGT infrastructure.²⁹ Thus, this is one of the concerns expressed by many congressmen about a federal role. Research and Development of HSGT is not seen by many policy makers as an area of national interest. Many argue that the United States should focus on upgrading its existing road, rail, and airport transportation infrastructure. Many congressmen scrutinize federal support of research and development of HSGT. This scrutiny leads some policy makers to suggest that it is time for the states to bear the burden.

Federal HSGT research has provided a good model of how research may be applied in the U.S. It has also uncovered some obstacles that need to be addressed through further research and development. This includes concern over the political implications of implementing HSGT in the U. S. Because HSGT presents a long-term solution to transportation infrastructure congestion problems, it is difficult to win support from congressmen who desire short-term results for their constituents. Several key policy makers that have a role in transportation policy such as Senator Daniel Patrick Moynihan (D-NY) and Congressman Jim Oberstar (D-NM) have pledged their support for greater federal leadership in HSGT.

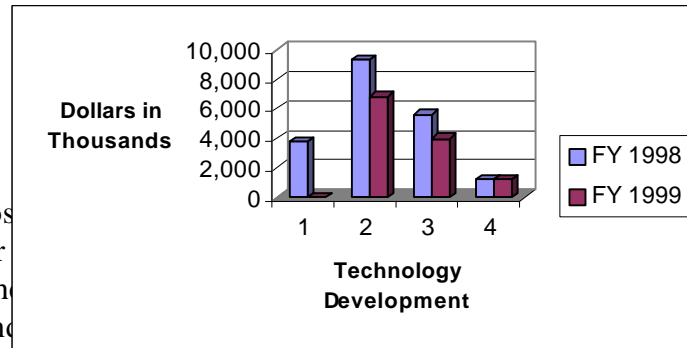
Policies

While the federal government has provided funding for support of research and development for national issues of HSGT, there has also been interest from many states in adapting HSGT for their respective regions. Many states have established organizations that are responsible for developing a specialized knowledge of local conditions and priorities. This knowledge will assist states in determining what applied research and development of federally developed technologies is needed. In many cases it is essential that applied research and development of HSGT systems be conducted on a state by state basis

²⁹ U.S. Department of Transportation. Federal Railroad Administration, *High-Speed Ground Transportation for America*. Washington, D.C., September 1997.

Unfortunately, while the need for integrating an additional mode of transportation into our urban cities across the nation increases, the funding for research and development of such additional modes is slated to decrease. Many of the research activities aimed at resolving conflicts mentioned earlier are targeted for decreases. The President's budget request for fiscal year 1999 to Congress reflects a \$7.801 million decrease in funding for HSGT technology development.³⁰ Figure 3 shown, highlights the technological victims of these cuts.

Figure 3
President's Budget Request to Congress Fiscal Year 1999



As shown above, Pos Council as a number the general fund. The a part of the track and

ional Research ive any support from tive train control as funding.

The decrease in funding for research and development is not inherent to HSGT alone. There is concern, even with TEA-21 signed into public law, that highways still dominate the surface transportation agenda.³¹ Although TEA-21 has made surface transportation funding more flexible and has provided a 40 percent increase in spending over six years from current levels, a majority of the spending will go to highway construction programs.

³⁰ President's Fiscal Year 1999 Budget Request to Congress

³¹ Matthew J. Downs, Legislative Assistant/ Attorney for U.S. Senator Ben Nighthorse Campbell (R-CO.), Conversation, June 22, 1998.

High Speed Rail Development

TEA-21 reauthorized the Swift Rail Development Act for fiscal year’s 1998-2001 at \$10 million per year for corridor planning and \$25 million per year for technological improvements.³² The Swift Rail Development Act supports the FRA’s NGHSR program. These authorizations are made from the general fund, not the highway fund as during ISTEA. They authorize the secretary to provide financial assistance to public agencies for high-speed rail corridor planning and other pre-construction activities including right-of-way acquisition. It also allows for financial support of high-speed rail technology improvements.³³ Table 4 below shows the distribution of authorized funding for high-speed rail through the year 2003.

Table 4
TEA-21 High-Speed Rail Authorizations

Year	1998	1999	2000	2001	2002	2003
Authorization						
Planning	\$10M	\$10M	\$10M	\$10M	0	0
Technology	\$25M	\$25M	\$25M	\$25M	0	0

Magnetic Transportation Technology Deployment

TEA-21 also gives contract authority totaling \$60 million for fiscal year’s 1999-2001 for demonstration projects that will determine the feasibility and safety of transportation systems employing magnetic levitation technology. A total of \$5 million is available for research and development grants related to low-speed magnetic levitation technology for application in urban areas. In addition, \$950 million is also authorized, but is subject to appropriation by Congress. Specific uses of the funds includes preconstruction activities (preparation of feasibility studies, major investment studies, environmental impact statements), final design, engineering and construction activities for one high-speed maglev system, and research and development of low-speed superconductivity magnetic levitation technology.³⁴ These appropriations communicate an increasing interest in implementing magnetic levitation transportation technologies in the U.S.

Table 5
TEA-21 Magnetic Transportation Technology Deployment Program

Year	1998	1999	2000	2001	2002	2003
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³² U.S. Department of Transportation, “High Speed Rail Development,” Transportation Equity Act for the 21st Century, n.d., <<http://www.dot.gov>> (June 10, 1998).

³³ Federal Highway Administration, “Fact Sheet,” High-Speed Rail, n.d., <<http://www.fhwa.dot.gov/tea21/factsheets/r-hghspd.htm>> (July 31, 1998).

³⁴ Federal Highway Administration, “Fact Sheet,” Maglev, n.d., <<http://www.fhwa.dot.gov/tea21/factsheets/r-maglev.htm>> (July 28, 1998).

Contract Authority	0	\$15M	\$20M	\$25M	0	0
Authorization (subject to appropriation)	0	0	\$200M	\$200M	\$250M	\$300M

Transportation Finance and Infrastructure Act (TFIA)

Included in the new TEA-21 legislation is a provision allowing for solicitation of federal funds for the construction of new projects. The Transportation Finance and Infrastructure Act creates a \$10 billion credit enhancement loan program for states to use for new projects of at least \$100 million.³⁵ This new policy provides for a long-term loan repayment program for the states, which is ideal for the expensive construction of HSGT projects. This policy is one of the first policies that could help define the state and federal role in research, development, and deployment of HSGT.

National Research and Development Needs

While it appears that HSGT is closer to being implemented in various corridors across the United States, there are many technologies that are in need of research and development that are necessary for implementation in any region. These needs have been outlined by federally funded research programs such as the FRA’s NGHSR program. In order for the States to begin their applied research and development, the federal government needs to increase its support of HSGT research and development and establish its role as providing the key technological requirements necessary for the states to consider introducing HSGT in their regions.

This support should be focused as recommended by the Transportation Research Board and the FRA. The TRB sponsors an HSR program, HSR Innovations Deserving Exploratory Analysis (IDEA), that solicits proposals for innovative concepts and technologies that will support attaining the goal of a cost-effective upgrade of current rail systems for high-speed passenger travel. The program is funded by the FRA and U.S. DOT. It has recommended five areas of focus to support HSGT development.³⁶ The five areas are:

- Advanced ITS Communications and Control for Train Operations.
- Railroad Crossing Safety.
- Track, Bridge, and Tunnel Infrastructure Upgrades.
- Rolling Stock Improvements.
- Reducing Environmental and Operational Impact.

This federally funded research will be conducted to address a variety of issues facing HSGT such as improving the revenue-generating capabilities by attracting additional customers

³⁵ Aileen Cho, “Keeping on Track,” Engineering News Record August 3, 1998: 44-47.

³⁶ National Research Council, Transportation Research Board, *Innovations Deserving Exploratory Analysis Programs*, Washington, D.C., 1998 and 1999.

through reduction of trip times and increasing reliability. The research hopes to address safety issues pertaining to HSGT, reducing operating costs through more efficient operations, reducing capital construction costs, and enhancing the social/ environmental benefits of high-speed rail. These proposed efforts are intended to help facilitate the deployment of HSGT systems. Without federal support of NGHSR, it might not be possible to expect the states to develop such comprehensive technological advancements.

The development of the research areas mentioned above serve as an integral part of the deployment of HSGT nationwide. They are also areas that many state and private research entities are not willing or able to support financially. Advanced ITS communications and control and positive train control technology provide a good example of how federal research will save tax payers millions of dollars by integrating freight and high-speed passenger rail service.

During the development of our highway and air transportation infrastructure over the last fifty years, there has been little consideration for ensuring right-of-way for mass transit as is done in many other countries. To overcome this mass transit planning “handicap,” we need to invest large amounts of money in purchasing new right-of-way or develop technology that will allow us to run high-speed trains safely on lines with slow moving freight trains. Fortunately, with federal support of research in positive train control systems the latter remains a foreseeable option. Development of a positive train control system is seen as a number one priority for the successful development of high-speed passenger services on freight railroads.³⁷

DEPLOYMENT AND POLICY ALTERNATIVES FOR THE FUTURE

HSGT for the Future

There is a call from transportation experts for the U.S. Department of Transportation to take a leadership role in developing a transportation research and development strategic plan for HSGT. HSGT will not be implemented in the United States until the federal government and the states establish their respective roles in the process. This will help promote developing the technologies that are needed; not ones that studies have shown are inapplicable to the United States. A strategic plan is necessary before new technologies, that are unveiled through research and development programs, may be integrated into society.

HSGT has been analyzed and researched more thoroughly than any other mode of transportation before being implemented. California’s Intercity High-Speed Rail commission, which was established by the governor and state legislature, stressed their study of HSR that “no other transportation project in California has undergone such an extensive feasibility investigation as has this high-speed rail project.”³⁸

³⁷ National Research Council, Letter, <<http://www.nas.edu/trb/about/hsgt1297.html>> (June 8, 1998).

³⁸ California Intercity High-Speed Rail Commission, “Stability Through Diversity,” The Case for High-Speed Rail in California, n.d., <http://www.transitinfo.org/HSR/ex_sum.html> (June 8, 1998).

HSGT in the United States still faces many challenges. Some of these challenges include finding specific corridors where passenger demand is high enough to minimize the need for subsidy of a HSGT program and integrating both higher speeds for existing passenger service and new high-speed technologies in corridors where slower moving freight trains already make heavy use of the system.³⁹ The extensive research and study conducted on HSGT at both the federal and state level has led to some technological advancement and has provided a reasonable approach to adapting HSGT for use in the United States.

DOT has demonstrated the need for HSGT in many corridors through studies at the state and federal level. The United States needs to develop a policy for the federal and state role in implementing HSGT now in order to provide an avenue for progression. The following policy alternatives were examined to provide insight into future policy decisions facing HSGT.

Eliminating Federal Support

If federal research and development efforts were eliminated, it would make the adoption of international technologies difficult. Over the last several years the FRA has entered into study agreements with other nations to exchange information concerning HSGT technology. Agreements between the United States and other countries maximize our use of taxpayer dollars for research and development of HSGT. Rather than recreating HSGT for America, as would be highly possible if research were performed solely at a state level, we should use federal research to learn how it serves the needs of people of other regions such as in Europe and Asia. Without a federal role in the research and development of HSGT systems, states would have difficulty in incorporating existing international technologies.

One of the key reasons one might consider the elimination of Federal research and development of HSGT is saving millions in federal taxpayer dollars. At least that is what supporters would lead the taxpayer to believe. While states that are not interested in HSGT would certainly benefit the most from not contributing to the development of HSGT systems, states that are interested would suffer. The lack of innovative and high-risk research that is produced through federal research and development programs would significantly raise the total costs of HSGT to the states. Federal research often results in new technologies that can reduce the system costs of HSGT. In fact, it is quite possible that the states would no longer be able to consider HSGT an economically feasible alternative.

Advocates of current transportation infrastructure, including representatives of the automotive and air industry, would like to convince policymakers that investment in a new mode of transportation is a wasted effort. By eliminating the federal HSGT research and development program, millions of dollars would be available to contribute to efforts such as developing ITS for the FHWA or perhaps investing in airport infrastructure. Perhaps it is important to also consider that the Federal Aviation Administration has recommended the deployment of

³⁹ National Research Council, Transportation Research Board, "Background," [Assessment of the Federal High-Speed Ground Transportation Research and Development Program](http://www.nas.edu/trb/about/hsgt1297.html), <<http://www.nas.edu/trb/about/hsgt1297.html>> (June 8, 1998).

HSGT in high-density travel corridors throughout the U.S. to relieve some of the pressure on the airline industry. While investment in current infrastructure, rather than in research and development of HSGT would likely provide needed results, it would paralyze the development of HSGT in America.

With the elimination of federally sponsored HSGT research and development, it would be difficult to ensure continuity in technologies across the U.S. Federal research and deployment activities can ensure that the various technologies employed by different states are compatible. It will be difficult to build a national HSGT infrastructure if the systems are privately developed or deployed by individual states.

Elimination is often a simple and effective policy changing measure. It also can lead to some significant consequences. It has been demonstrated through past research and development efforts that the national, state, and federal role in funding varies. While there are many clear focused research efforts by private corporations, they generally focus on applied research or low risk high success projects. Private corporations simply cannot afford to make the large investments necessary to develop innovative, high-risk technologies such as necessary to adapt HSGT for existing infrastructure. Private research is often of a proprietary nature and geared to developing new or increased markets for selling goods and services. States provide an enhanced, but similar approach to research and development approach to transportation technologies. States focus on research that is geared to solving specific transportation problems and addresses questions that are designated to result in the information needed to produce a certain technology or service.

In a broad sense, transportation experts agree that a federal role in transportation is necessary to ensure a broad scope of research and development activities. Through federally funded research programs, the United States can focus its research activities and maintain a structured or strategic approach to these activities. As discussed earlier, over the past few decades the federal government has lead efforts developing the innovative technologies necessary to adapt HSGT for application in the United States. The U.S. DOT found in a recent report that there is strong support from virtually all sectors for a continued federal role in surface transportation research and technology deployment.⁴⁰ It is recognized that because of the expertise required and the risk involved, the federal government needs to play a lead role in development of advanced long-term and high-risk research, standard setting, and deployment of new technologies. Many proponents of the federal government argue that private industry should also share responsibilities for these activities. The small size of most construction firms and the fragmented nature of private industry does not foster the capacity and motivation necessary to do such. An effective national research program ensures the continuity and focuses of new technology and ensures development of more generic technology that can be applied anywhere in the United States.

Taken together, these examples underscore why the federal government plays an important role in developing HSGT technologies. Without federal research and development activities,

⁴⁰ U.S. Department of Transportation. Federal Highway Administration, *Technology to Keep America Moving: Surface Transportation Research and Development*. Washington, D.C., April 1997.

the investment in HSGT technologies, whose public acceptance, market acceptance, and technical feasibility are uncertain, would be minimal. This makes elimination an unattractive option if the United States wishes to eventually introduce HSGT as a new mode of transportation.

Research of Private/ Public Partnerships

As the development of technologies for HSGT continue to progress, so does the need for policies to prepare us for the construction and deployment of HSGT in corridors across the United States. All modes of transportation in the United States- land, air, and sea- provide a distinct split of responsibilities for such essential functions as provision, maintenance, and operation of rights-of-way, terminals, and vehicles. Every mode of current transportation represents a private/public partnership that demonstrates governmental support and involvement. Thus it is unreasonable to expect HSGT systems to be a sole government or private venture. Neither sector can provide the financial or public support of such an enterprise. The development of a similar public policy based upon findings in the DOT's commercial feasibility study of HSGT is needed.

One of the most reasonable benefits to promoting public/private partnerships is that they are prevalent throughout the transportation industry. One example of an existing public/private partnership is how automotive companies provide cars for our highways and the taxpayers pay for their road infrastructure. Another example is how the government pays for the construction of new airports that are utilized by private airlines. Every other existing mode of transportation widely utilized in the U.S exhibits public/private partnerships.

Public/ Private partnerships provide an economically sound means of deploying HSGT. Rather than the federal or state governments or private industry carrying the costs for research, development, and deployment, they are shared. States and private corporations can determine their needs and make subsequent requests for assistance from the federal government. By holding more groups accountable, public/private partnerships will promote establishing a cost effective, non-government subsidized, HSGT system.

There are some drawbacks to establishing a public/private partnership. While effective at sharing research, development, and operational costs, a partnership would undoubtedly put most of the deployment construction costs on the taxpayer. As it is unreasonable to suggest that private companies can afford construction of state interstate systems, it is too expensive for them to cover the \$2-\$30 million dollar/ mile infrastructure construction costs. These high costs present another challenge to public/private partnerships. Extensive state lead cost benefit and analysis would be necessary to lure a private entity to develop interest in operating a HSGT system.

To exhibit partnership potential, HSGT must meet the following two criteria, as mentioned in the DOT's Commercial Feasibility study of HSGT. First, the HSGT system must be a self-sustaining entity that could be operated through private enterprise. Second, the total benefits of the corridor must equal or exceed the total costs. These two criteria should only be used as

an initial determinant for the partnership feasibility of a system. Partnership potential cannot be evaluated by broadly gauging the attractiveness of a HSGT project at a national level. HSGT corridors have unique technological, construction, service, and maintenance needs associated with each region. These needs are best determined by the states and could be used to create a partnership model that may be presented to the federal government.

The partnership model should address the total benefits and costs associated better with the federal and state government, private industry, and the user. States will be able to distinguish between what type of HSGT applies to them: Accelerail, New HSR, or Maglev. For example, a state may find that it needs the high speed, high frequency type of service that can only be provided by New HSR or Maglev. It may also find that freight railroads are not interested in mixing freight trains with high-speed rail passenger trains, and thus eliminate the possibility of using Accelerail technologies. States are also better able to judge how and where HSGT fits into their intermodal planning process. Because the development of a HSGT national network is not cost effective, states can better determine how to incorporate it into their existing air, road, and mass transportation infrastructure. The absolute size of the required initial investment will also greatly vary the partnership ability of a proposal. These examples demonstrate the importance of the states, not the federal governments, need to invest in regional partnership studies.

Complete Privatization

This alternative would mandate that HSGT research, development, and deployment be financed through private entities. While this is certainly the most economically safe and affordable position for both the federal and state governments, it is highly unlikely. Each existing mode of transportation in the United States, although now many are privatized, was established through federal and state investment in research, development, and deployment. Private entities simply cannot afford, nor wish to risk, the capitol expenditures required for implementing HSGT.

Affordability and investment risks are not the only obstacles to total privatization. Private driven implementation of HSGT would face tremendous government obstacles and restrictions that would vary between each, town, city, county, or state that the HSGT corridor would pass through. The general public would not have the opportunities to present their needs on an organized level as they would through a federally or state sponsored project.

Privatization of a HSGT system would likely establish a monopolized public transportation system. Due to the high deployment costs of all HSGT technologies, it is unlikely that a competitive commercial system will be established, as in the automotive and airline industries. A monopolized transportation system could potentially be harmful if customers become dependant on its services or are only able to use HSGT as a mode of transportation.

Who is accountable if a public transportation system is completely privatized? With privatization comes the exclusion of federal or state influence of operations and other matters of the HSGT system. This could produce some unwanted shortcomings such as lack of

safety, planning, and fare regulation. HSGT could not be regulated as the automotive and aviation industries are through government agencies such as the FAA. With no federal or state ownership of a public mass transportation system, a private company could easily compromise safety and comfort of its customers.

RECOMMENDATIONS

The current public policy for research and development of HSGT is no longer effective at providing an environment that promotes the further development of new technologies and their application for deployment. The federal government HSGT research and development programs do not receive enough funding to meet, in a reasonable amount of time, the technological needs of implementing systems at the state level. States do not have a clear understanding of their role in research, development, and deployment of HSGT. HSGT research and development will not progress and lead to implementation of HSGT systems unless the United States develops a public policy that defines the state and federal research, development, and deployment roles.

The most effective use of federal research and development dollars would focus on applied research that adapts and enhances the worldwide technologies that exist, for use in the United States. It should also focus on the development of technologies that reduce the overall capital costs of deploying the new mode of transportation. These technologies for high-speed rail include and should not be restricted to, positive train control (which provides the option of upgrading existing track to accommodate high-speed trains and slower moving freight trains), non-electric high-speed locomotives, grade-crossing mitigation, and track, bridge, and tunnel infrastructure upgrades.

There are three areas of HSGT technology currently being actively researched. Of these three areas, one is currently being used in the U.S. (Accelerail technology Northeast corridor). It is recommended that due to the costliness of developing an industry that can produce the necessary materials for constructing guideways and vehicles for deployment of magnetically levitated trains, that it be only considered in instances where it would be competitive with the existing modes of transportation. Emphasis should be placed by the federal government on developing Accelerail and New HSR for potential application in various corridors across the U.S. These alternatives represent the most cost-effective alternative modes of HSGT.

As international and national technology is adapted at the federal level, the states should focus on applied research and development for their respective regions. States need to focus more on the economic, political, and social aspects of introducing HSGT into their area. It is recommended that states conduct comprehensive public/private partnership studies of HSGT corridors. Federal policy should direct states to produce a commercial public/private partnership feasibility study for their respective corridor of interest before receiving any federal support for deployment. States should perform cost benefit analysis studies to determine if HSGT is a preferred approach to enhancing intercity travel ability in their region. A successful analysis of the public/private partnership opportunities is essential to determining if states can attract a private HSGT entity that is self-sustaining. States need to

also determine the public/private role in developing the necessary infrastructure for HSGT deployment.

Finally, while research and development often constitutes a vicious cycle of continuous innovation and failure, the states and federal government need to establish a policy for deployment of HSGT. Deployment funding should become the primary burden of the state(s) involved in a HSGT enterprise. Federal loans and assistance should be used for introduction of the new HSGT system. The HSGT system should produce sufficient revenue to not only be self-supporting, but to repay the federal loans.

Taken together, these recommendations should provide a more structured approach for the research, development, and deployment of HSGT in America. With the state and federal role defined, a structured approach to introducing HSGT to the U.S. will be realized.