MTI Report S-05-01

National Garrett Morgan Sustainable Transportation Symposium — 2005

MTI

Mineta Transportation Institute

Created by Congress in 1991

MINETA TRANSPORTATION INSTITUTE

The Norman Y. Mineta International Institute for Surface Transportation Policy Studies (MTI) was established by Congress as part of the Intermodal Surface Transportation Efficiency Act of 1991. Reauthorized in 1998, MTI was selected by the U.S. Department of Transportation through a competitive process in 2002 as a national "Center of Excellence." The Institute is funded by Congress through the United States Department of Transportation's Research and Innovative Technology Administration, the California Legislature through the Department of Transportation (Caltrans), and by private grants and donations.

The Institute receives oversight from an internationally respected Board of Trustees whose members represent all major surface transportation modes. MTI's focus on policy and management resulted from a Board assessment of the industry's unmet needs and led directly to the choice of the San José State University College of Business as the Institute's home. The Board provides policy direction, assists with needs assessment, and connects the Institute and its programs with the international transportation community.

MTI's transportation policy work is centered on three primary responsibilities:

Research

MTI works to provide policy-oriented research for all levels of government and the private sector to foster the development of optimum surface transportation systems. Research areas include: transportation security; planning and policy development; interrelationships among transportation, land use, and the environment; transportation finance; and collaborative labor-management relations. Certified Research Associates conduct the research. Certification requires an advanced degree, generally a Ph.D., a record of academic publications, and professional references. Research projects culminate in a peer-reviewed publication, available both in hardcopy and on *TransWeb*, the MTI website (http://transweb.sjsu.edu).

Education

The educational goal of the Institute is to provide graduate-level education to students seeking a career in the development and operation of surface transportation programs. MTI, through San José State University, offers an AACSB-accredited Master of Science in Transportation Management and a graduate Certificate in Transportation Management that serve to prepare the nation's transportation managers for the 21st century. The master's degree is the highest conferred by the California State University system. With the active assistance of the California Department of Transportation, MTI delivers its classes over a state-of-the-art videoconference network throughout the state of California and via webcasting beyond, allowing working transportation professionals to pursue an advanced degree regardless of their location. To meet the needs of employers seeking a diverse workforce, MTI's education program promotes enrollment to under-represented groups.

Information and Technology Transfer

MTI promotes the availability of completed research to professional organizations and journals and works to integrate the research findings into the graduate education program. In addition to publishing the studies, the Institute also sponsors symposia to disseminate research results to transportation professionals and encourages Research Associates to present their findings at conferences. *The World in Motion*, MTI's quarterly newsletter, covers innovation in the Institute's research and education programs. MTI's extensive collection of transportation-related publications is integrated into San José State University's world-class Martin Luther King, Jr. Library.

MTI REPORT S-05-01

National Garrett Morgan Sustainable Transportation Symposium

May 9, 2005

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16. Abstract

The Mineta Transportation Institute brought together experts in surface transportation and students from elementary, middle, and high schools to discuss sustainable transportation topics on May 9, 2005. The goal was to introduce the students to transportation-related careers and to inspire them to pursue the academic curriculae that would lead to success in those careers. Students from Maryland, Virginia, and California participated in a videoconference, during which they heard a keynote statement from the U.S. Secretary of Transportation Norman Y. Mineta.
The students also presented project proposals for innovative transportation alternatives during the videoconference. The presentations were followed by a moderator-led question-and answer period featuring peer review of the projects and discussions of the young people's perceptions of critical transportation issues that they will face in the future. This publication is an edited summary of the May 9, 2005 event.

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ACKNOWLEDGMENTS

We are deeply grateful to U.S. Secretary of Transportation Norman Y. Mineta for the generous gift of his time and for his continuing support of the Garrett A. Morgan Program, a program that has influenced the lives of thousands of young people over the years.

The success of the Garrett Morgan symposium is due in large part to the volunteer efforts of Mineta Transportation Institute Trustees and members of their organizations who sponsor the participating schools. In 2005, presentations were made by six schools, with the following hosts:

- Ron Barnes, Deputy Director, Miami-Dade Transit, sponsoring Dr. Alvin Brennan's students from Homestead High School, Homestead, Florida
- David Conrath, Dean, San José State University College of Business, sponsoring Mr. Randall Landrith's 6th-grade class from Meadows Elementary School in San Jose, California
- John Horsley, Executive Director, American Association of State Highway and Transportation Officials (AASHTO), sponsoring Ms. Barbara Musser's 9th-grade classfrom Leonardtown High School in Leonardtown, Maryland
- William Millar, President, American Public Transportation Association (APTA), host to Secretary Mineta and sponsoring Ms. Kimberly McLurkin-Harris' 8th-grade classfrom Argyle Middle School (the 2004 winner) in Silver Spring, Maryland
- Michael Townes, General Manager, Hampton Roads Transit, sponsoring Mr. Dennis Borgerding's 8th-grade class from Kemps Landing Magnet School in Virginia Beach, Virginia, the winner of this year's competition.

Thanks also go to the videoconference technicians at the AAR and AED sites in Washington, D.C., at Vicom in Virginia Beach, Virginia, and at the San José State University Academic Technology Network (ATN).

Thanks are also offered to MTI staff, including Research Director Trixie Johnson, Project Manager and Writer James Swofford, Research and Publications Assistant Sonya Cardenas, Webmaster Barney Murray, Graphic Artists Pamela Bishop and Shun Nelson. Editing and publication services were provided by Catherine Frazier, Irene Rush, and Beth Blevins.

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FOREWORD

The Garrett A. Morgan Symposium on Sustainable Transportation in the 21st Century is part of the Mineta Transportation Institute's ongoing mission to provide information transfer, education, and research on current issues and emerging solutions in the field of sustainable surface transportation.

This videoconference symposium was part of the Garrett A. Morgan Technology and Transportation Futures Program, which was established by the Honorable Rodney Slater, former secretary of the U.S. Department of Transportation, and continued through the support of Transportation Secretary Norman Y. Mineta.

Students from sixth grade through high school addressed the topic of sustainable transportation and proposed innovations for the surface transportation industry. This account of the videoconference proceedings provides an interesting look into the thoughts of these students, who showed great promise as the next generation of transportation leaders. This publication is intended to give teachers and transportation professionals alike a glimpse at the creativity and capabilities of this up-and-coming generation.

Thanks to the efforts of the many people previously acknowledged, this event and this publication will add to the spirit of progress and innovation exemplified by the life and works of Garrett Augustus Morgan (1877-1963), a black American inventor honored by Congress for his contributions to transportation and public safety.

Ron Diridon

Executive Director

EXECUTIVE SUMMARY

Mineta Transportation Institute (MTI) continued its support of the U.S. Department of Transportation's Garrett A. Morgan Technology and Transportation Futures Program by conducting the Fifth National Garrett Morgan Symposium on Sustainable Transportation on May 9, 2005. The purpose of the symposium was to stimulate the minds of young people and encourage them to excel in mathematics and sciences, which could lead to careers in transit engineering, transportation planning, and innovation in general.

PURPOSE

The middle-school curriculum includes a class or team project on sustainable transportation and culminates in this national videoconference symposium featuring presentations by each of the participating classes. It is designed to increase students' awareness of transportation issues, interest them in careers in transportation, and motivate them to take the appropriate classes in high school that will prepare them for engineering and public administration majors in college.

Figure 1 Middle school students nationwide compete via videoconference

BROADCAST SITES

The videoconference was conducted through four broadcast sites:

In Washington, D.C., the American Association of State Highway Transportation Officials (AASHTO) sponsored Leonardtown High School from Leonardtown, Maryland, and the American Public Transportation Association (APTA) sponsored Argyle Middle School from Silver Spring, Maryland.

In Virginia Beach, Virginia, Hampton Roads Transit sponsored Kemps Landing Magnet School from Virginia Beach.

In Miami, Florida, Miami-Dade Transit sponsored Homestead High School from Homestead, Florida.

In San Jose, California, MTI and San José State University sponsored Meadows Elementary School from San Jose, California.

EVENT HIGHLIGHTS

U.S. Secretary of Transportation Norman Y. Mineta welcomed the students from the American Public Transportation Association site. He spoke to them about the importance of transportation to American life. Secretary Mineta also encouraged the young people to work hard in school, study sciences and mathematics, and pursue careers in transportation.

Each school made a project presentation that addressed one or more elements of sustainable transportation.

Argyle Middle School students from Ms. Kimberly McLurkin-Harris' 8th-grade class made two presentations.

The Plane of the Future, an airplane powered by a combination of ethanol fuel and solar cells, also incorporates a novel airport runway design to facilitate shorter take-off and landing distances.

A hydrogen-powered car was proposed by another Argyle team.

Meadows Elementary School students from Mr. Randall Landrith's 6th-grade class presented *Biomass Banshees,* a flashy pair of methane-powered motorcycles.

Homestead High School students from Mr. Alexander Boxley's Senior class presented *Project Ocean Drive,* a ship powered by hydrogen fuel cell technology.

Kemps Landing Magnet School students from Mr. Dennis Borgerding's 8th-grade class presented *UniModal,* a regional transportation system integrating a Maglev personal people-mover and bus rapid transit.

Leonardtown High School students from Ms. Barbara Musser's 9th-grade class presented *GeoTanic,* a ship powered by steam generated from seawater using geothermal compressed heating principals.

A question-and-answer session followed the presentations, moderated by MTI Research Director Trixie Johnston. Students asked questions about each other's presentations, and also questioned the transportation professionals in attendance from each of the sponsoring organizations. MTI Executive Director Rod Diridon's closing remarks ended the symposium.

The Kemps Landing Magnet School *UniModal* presentation was selected the winner. A representative from the winning team, student Krista O'Connell, her father, and teacher Dennis Borgerding received an expense-paid trip to the June 2005 MTI Scholarship Awards Banquet in San Jose, California, plus a $500 check for the school. The teachers of all participating classes received a $50 gift certificate for classroom supplies, awarded upon completion of the post-conference evaluation.

Figure 2 Winning teacher Dennis Borgerding and student Krista O'Connell with MTI Research Director Trixie Johnson and Nannette Bouknight of Hampton Roads Transit

KEYNOTE ADDRESS

Rod Diridon
Executive Director, Mineta Transportation Institute

The Mineta Transportation Institute at San José State University is very happy to be presenting the 2005 Annual National Garrett Morgan Sustainable Transportation Symposium. Our liaison person here, and the moderator for the program, is Trixie Johnson, the past Vice Mayor of the City of San Jose, and currently the Research Director for the Mineta Transportation Institute.

The objective of this symposium is to introduce middle school students across the United States to transportation as a potential career and to encourage them to take the math and science courses in high school that lead to technical degrees in college, which will allow them to become a transportation expert in their future careers.

Figure 3 MTI Executive Director Rod Diridon (foreground) greets Transportation Secretary Norman Mineta, APTA President Bill Millar, and teacher Kimberly McLurkin-Harris on the video screen

It is my pleasure now to transfer the program to Bill Millar, President of APTA. Bill will introduce our special guest.

Bill Millar
President, American Public Transportation Association

The American Public Transportation Association is very pleased to be part of this national Garrett Morgan Sustainable Transportation Symposium. This is APTA's third year of participating in this, and I particularly want to congratulate you, Rod, and Trixie, and everyone at San José State for putting this together. As you indicated, we have a great privilege here at APTA in Washington of hosting the Honorable Norm Mineta, the Secretary of Transportation.

Secretary Mineta serves in President Bush's Cabinet. He is the fourteenth Secretary of Transportation of the United States, and he was sworn in on January 25th, 2001. Now he is working to make the transportation department the best it can possibly be. It is a large department, with some $58 billion of budget and with 100,000 employees. He is reshaping that department to meet the challenges of the future.

I have had the privilege of knowing Secretary Mineta for many years. He has, in the past, served as the Mayor of San Jose, California. I first met Secretary Mineta when he served in the Congress. For over 20 years, he represented the people of San Jose and the Santa Clara Valley in the United States Congress, serving in many important positions. One in particular that was most important to our topic today was being very active on the Public Works and Transportation Committee. In fact, he served as Chair of that Committee, and as Chair of several of its subcommittees, including aviation and surface transportation. I know we are going to hear presentations later from the students about both of those topics. He also has served in the private sector, having been a Senior Vice President at one of the major corporations of America, Lockheed-Martin.

We have worked with the Secretary on many occasions; in fact, right now, the Congress is considering a very important piece of transportation legislation and the Secretary is one of the key players in making that legislation happen. So we know him for his excellence, we know him for his leadership, we know him for his commitment to community, his commitment to getting good things done, and especially we know him for his commitment to help training tomorrow's leaders, which is what today is all about. So all over the country, please welcome the Honorable Norm Mineta, Secretary of Transportation.

The Honorable Norman Mineta
Secretary, U.S. Department of Transportation

Good afternoon, and in some instances, good morning, to all of our friends, parents, students, and faculty across the country. I want to thank all of you very much for taking part in this year's fifth annual symposium. Rod, I am really delighted to be joining you there with the Argyle Middle School, here right behind me, in Silver Spring, Maryland. These folks behind me were the winners of last year's competition, and I want to congratulate all of you, very, very much.

I also want to welcome the other four schools participating today: Meadows Middle School in San Jose, California; to Homestead High School in Homestead, Florida; to Kemps Landing Magnet School in Virginia Beach, Virginia; and Leonardtown High School in Leonardtown, Maryland.

There are lots of thrilling adventures awaiting you in the world of transportation, and I hope that by the time this symposium is over that you will be as excited about transportation as I am. I have dedicated more than half of my life to the world of airplanes, trains, ships, and automobiles, and transit systems. Each day still brings to me something new and very different.

I hope that when you enter the working world, all of you will feel the same way about your jobs as I feel about my own. That is why today I am urging you to consider taking classes that will prepare you for careers in the exciting field of transportation. There are a wide variety of challenging and rewarding positions in the transportation field. By last count, there are more than 20 million people employed as mechanics, engineers, vessel operators, and other significant jobs in the field of transportation.

Before I became the Secretary of Transportation, I was a member of Congress, representing California's Silicon Valley, America's hotbed of technology. The software and the hardware that I saw coming out of there is now playing an important role in keeping America moving.

You too can be a part of that future. For example, it might surprise you to learn that the very technology that powers your digital music players, your Playstations™, and your GameBoys™, is the same high-tech know-how that is turning cars into smart cars that are capable of warning drivers if they are getting too close to the vehicle in front of them. You could develop technology that tells drivers if their car is drifting off the road, or if it is safe to change lanes on the highway.

Safety is the bread and butter of our jobs at the Department of Transportation, and we will not hesitate to step in if we feel that someone is not playing by the rules. Maybe you want to be a safety inspector, like the ones who recently discovered that auto shops like West Coast Customs, the same one seen on MTV, was taking apart airbags and other safety equipment in order to install DVD screens. Now, let me say that there is nothing wrong with customizing cars, as long as the safety equipment is left alone, because we want everybody to get where they are going as safely as possible.

Jobs in the transportation sector do not just focus on moving people, they also move billions of dollars of cargo, and that is just in one day. Every item that you use or consume—food, clothes, book bags, or DVD players—all reached the store shelves through a massive transportation network that includes millions and millions of miles of tracks, pipelines, waterways, and roads. Most people probably don't think about this network in action, but we are placing greater demands on it every day, whether we are moving cargo or moving people, and we are going to need bright, motivated energetic young people like all of you, to pave the way for the future. It is never too early to consider a career in transportation.

Garrett Morgan, the African-American inventor for whom this symposium is named, left his Kentucky farm as a young teenager who struck out on his own in the world. He later invented the gas mask and the automatic traffic signal, items that are still being used today. Maybe one of you will be the next Garrett Morgan.

If you are wondering what job is right for you in the field of transportation, your choices are endless. You could captain a massive cruise ship in the lush waters off the Florida coast, or design the next hot-selling sports car, or you could even pilot Air Force One as it flies from Maryland to California with the President of the United States on board. So whether you have an interest in cars, ships, trains, airplanes, or buses, there are many fascinating directions in which a transportation career can take you.

My advice is this: be ambitious, dream big, and go after a rewarding job that fills you with excitement. That is exactly the way transportation makes me feel, and I hope it will do the same for you as well. So again, thanks for allowing me to share a few thoughts with you today. Find a career in transportation, travel safely, and may God bless each and every one of you, and may God bless the United States of America.

STUDENT PRESENTATIONS

Trixie Johnson, Research Director of the Mineta Transportation Institute, was moderator of the student presentations and the following question-and-answer period. Ms. Johnson described the procedures to be followed by each of the schools, established the order of the presentations, and set a 10-minute time limit per school.

Representatives from the host organizations, in turn, identified and welcomed the distinguished guests present at their location and introduced the teacher from the school that they had sponsored. Each teacher then introduced the student(s) that would make the presentation for their school or group.

The distinction of being first to present went to Argyle Middle School, whose students had won the competition the previous year. Their sponsor, APTA President Bill Millar, took great delight in introducing their teacher, Student Support Specialist Kimberly McLurkin-Harris, and the students from Argyle participating in this year's symposium.

ARGYLE MIDDLE SCHOOL
THE PLANE OF THE FUTURE [Insert link to Plane_Argyle.pdf]

Project Team: David Harris, Peter Nguyen, Jamaal Royal, and Eliab Thakurdas
Instructor: Kimberly McLurkin-Harris

This group of Argyle students took turns delivering an oral report, supported by a computer-based presentation, that described a new use of ethanol fuel to power a jet airplane. The students proclaimed, "*The Plane of the Future* will not only be changing the world of airplanes, it will also be economically smart."

Their proposal not only featured the fossil-fuel alternative, ethanol alcohol, but also recommended the use of airplanes with vertical- or short-take-off and landing (VTOL/STOL) capabilities, coupled with runways uniquely designed to "save millions of dollars in ecological habitat and wildlife."

The students said ethanol is a much cleaner fuel than conventional gasoline. They noted that it is already in use today in cars and is being tested in airplanes at South Dakota State University. They speculated that with new innovations in ethanol use, it would not be long before it supplants gasoline as the everyday fuel.

The Argyle students proposed using ethanol fuel in airplanes based on the Harrier Jump Jet technology. They said this plane is not like many others because it can take off vertically, virtually eliminating the cost of runways and saving miles of forest and habitat in the process. They want to attach this kind of engine to a passenger airplane that would not require as much runway. Additionally, they want to use an inclined ramp instead of a flat runway so the plane can leap into the air without needing to gather so much speed. They said this idea has been used before at the airport in Tegucigalpa, Honduras.

The Argyle *Plane of the Future* team concluded that combining cleaner fuel with innovative aeronautic technology could help both the economy and the ecology, saving millions of dollars and reducing the destruction of wildlife habitat for airport expansion.

ARGYLE MIDDLE SCHOOL HYDROGEN-POWERED CAR

Project Team: Vadi Pouri and Demetrius Woodson
Instructor: Kimberly McLurkin-Harris

Another team from Argyle used the remaining portion of their school's allotted time to make a short oral presentation on hydrogen-powered automobiles.

These students believe that, in the future, hydrogen-powered cars will be preferred over other cars because of their capability for higher speeds over long distances with less atmospheric pollution. To enhance their vehicle's safety, they proposed using computer-controlled systems that would automatically apply the brakes if the car were about to be in a collision.

Above all, what makes their car special is the fuel. They said that because hydrogen is the lightest gas, with an atomic weight of 1.00794, their car will be lighter weight and thus capable of more speed. They also said that we will never run out of hydrogen because most of the earth is water.

However, they pointed out the major disadvantages of hydrogen are that it is hard to store and is more expensive than the fuel it would replace. They noted that, in cars, gasoline is still easier to store than hydrogen, which needs to be compressed or kept at a very cold temperature. They observed that hydrogen would need to be highly compressed; otherwise a filling stop would be needed every few kilometers—yet one tank produces as much energy as 20 tanks of regular fuel.

They estimated that manufacturing hydrogen using electricity generated by the wind would cost from three to five times more than gasoline. They noted that in Europe, where gasoline is already three to five times more expensive than in the United States, hydrogen represents a cost-competitive fuel. They were optimistic that as fuel-cell vehicles achieve higher efficiency, hydrogen is a strong possibility as an alternative fuel.

The Argyle *Hydrogen-Powered Car* team concluded that the advantages outweigh the disadvantages, and that hydrogen cars are good for our future because they could be safer, faster, and more environmentally friendly for travel.

MEADOWS ELEMENTARY SCHOOL

THE BIOMASS BANSHEES—CRUISER AND RACER {Link to Biomass_Meadows.pdf}

Project Team: Cynthia Angellis, Ashlee Arnella, and Kelly Ropa
Instructor: Randall Landrith

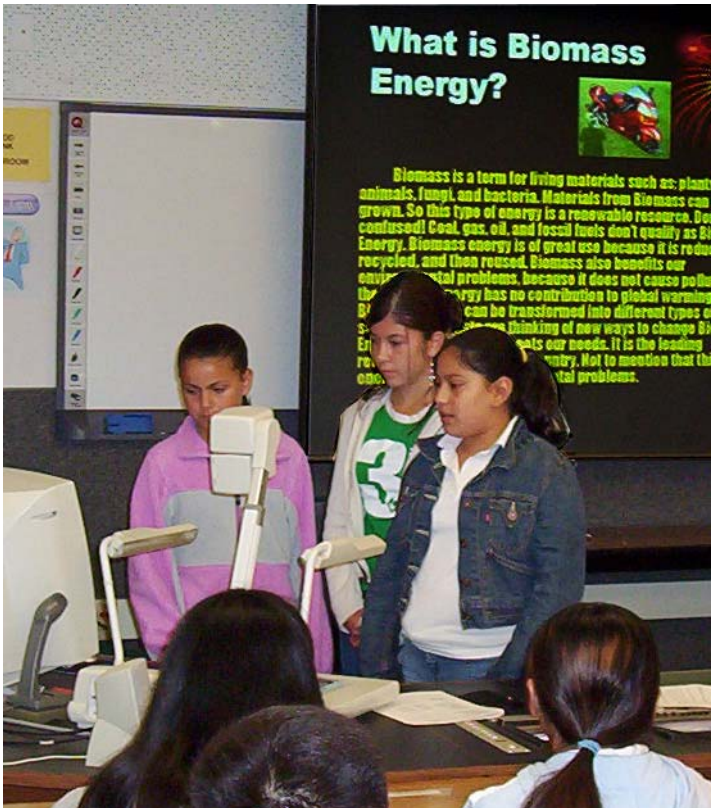


Figure 4 Meadows Elementary School's team

This team of sixth graders came up with a flashy product name for their methane-powered motorcycles—the *Biomass Banshees*—that operate on fuel recovered from biomass and landfill gas. Their presentation was an oral report, supported by computer-based graphics.

The Meadows students described the elements that comprise biomass and talked about how scientists are exploring its various uses. Noting that biomass can be regrown, and is thus a renewable resource, they distinguished it from depletable resources like fossil fuels and cited its environmental benefits.

A production process was described for recovering landfill gas and turning it into methane fuel for use in generating electrical energy and, of course, for powering the sleek *Biomass Banshee* motorcycles.

The students described the benefits of their motorcycles as causing fewer environmental problems, making their way through traffic more easily, taking up less space in parking lots, and being fun to drive.

Because biomass energy is a renewable resource, these students believed this type of energy would strengthen the economy, which would increase tax dollars. They said that by using biomass as an alternative fuel, we would spend less money on overseas oil and could invest more into local economies.

HOMESTEAD SENIOR HIGH SCHOOL
PROJECT OCEAN DRIVE

Project Team: Mike Jones, Patrick Rhodes, Aaron Smith, Andrew Tujoures, and Angelo Trussel
Instructor: Alexander Boxley

This group of high school students prepared an oral report on hydrogen fuel titled *Project Ocean Drive*, which was delivered by team member Andrew Tujoures. Their concept was to produce hydrogen fuel from seawater, with fresh water as a byproduct. Mr. Tujoures stated that because of increasing gas prices, environmental damage from fossil fuels, and the rapid depletion of nonsustainable fuels, the world must examine new and innovative ways to power transportation.

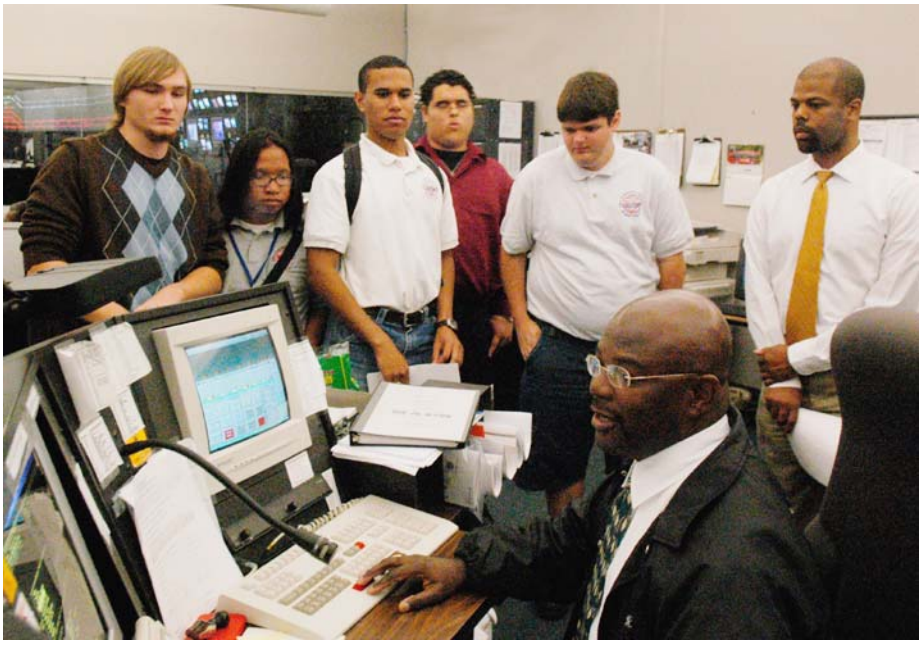


Figure 5 The Homestead High School team toured Miami-Dade Transit facilities before the symposium

As background information, he noted that hydrogen cells were first introduced in 1839 by Sir William Grove. Functional vehicles have already been crafted to use pre-existing gasoline engines to run on both hydrogen and gasoline. These, he said, could be a practical steppingstone toward a purely hydrogen electrical engine.

He stated the main benefits of using hydrogen power are that it is a sustainable fuel and that it is ecologically safe. The drawbacks he noted are the volatility of the substances being used, since hydrogen and oxygen are very flammable, but he said that by using cone-shaped fuel cells, they will dissipate the heat emanating from the engine. An explosion would be unlikely, he said, but if one occured, it would not be as strong or as deadly as that of a gasoline engine.

The students concluded that hydrogen would be cost effective and fuel efficient. As an abundant resource, since 75 percent of the earth is made up of H_20, we could use it continuously as the safest possible energy source.

KEMPS LANDING MAGNET SCHOOL
UNIMODAL TRANSIT SYSTEM [Insert link to Unimodal_Kemps-Ldg.pdf]

Project Team: Elyse Anderson, Dru Letourneau, Krista O'Connell, Michael Protacio, Jonathan Rich, Ariel Tatterson, and Jessica Truong
Instructor: Dennis Borgerding

Figure 6 The Kemps Landing Team: (front row) Ariel Tatterson, Jessica Truong, Elyse Anderson, Michael Protacio, and Krista O'Connell; (back row) Dru Letourneau, Jonathon Rich, and instructor Dennis Borgerding

Kemps Landing students proposed a UniModal™ system of electric Maglev personal pods to operate throughout the Hampton Roads Transit service area. The ADA-compliant pods and stations would connect at intermodal terminals to other transit, including a Bus Rapid Transit (BRT) shuttle operating through a tunnel under the bay. The team did comparative costs with other transit modes, and they proposed build-operate funding alternatives to reduce taxpayer subsidies. Like all good academics, they published their work and listed their research sources in a bibliography.

Their presentation for the videoconference included oral reports by each of the team members, supported by poster boards and computer graphics that illustrated their findings and proposed solutions. They also prepared a separate written document about their proposal.

The first part of their presentation looked at transportation issues in their region and identified challenges to the movement of people, commercial goods, and other activities. They evaluated local trends, including the needs of commuters, shift workers, and tourists, and possible solutions, such as High-Occupancy Vehicle (HOV) lanes. They factored in the effects of geography, including bridges, tunnels, and waterways, finally determining that an integrated transit solution was needed.

They described their needs analysis and comparison of the costs for building and operating various transportation modalities. They also described their reasoning process for recommending a new state-of-the-art UniModal system, developed by SkyTrain™ and adapted for local use to interconnect with existing or near-term public transportation systems.

Design elements and technical functionality were described in detail, including system operation, user interface, Americans with Disabilities Act (ADA) compliance, safety and security, vandalism deterrence, and environmental footprint. Ridership and revenue data were forecast and the financial impacts of the local transit system were described, along with some incentives for local businesses to help underwrite the operating and maintenance costs.

The full transcript of this winning presentation is provided in Appendix B.

LEONARDTOWN HIGH SCHOOL
GEOTANIC CRUISE SHIP [Insert link to Geotanic_Leonardtown.pdf]

Project Team: Lauren Huff, Misheálah McBride, Anthony Schmidt, and Michael Wood
Instructor: Barbara Musser

Leonardtown High School students presented an oral report, supported by computer-based graphics. The report was in two parts, beginning with a history and overview of the use of geothermal energy, followed by their concept of the GeoTanic cruise ship that runs off what they called "artificial geothermal energy."

They described historic uses of geothermal energy from the time of ancient people to an early commercial use in 1807 with the charge of one dollar for a bath in a natural hot spring. Modern uses of geothermal energy in the production of electricity also were described in detail. A cycle was demonstrated of rainwater being absorbed into the earth, heated under pressure by hot rock, releasing steam, and the process continuing. A benefit, they said, is that geothermal power plants have no smoky emissions because they emit only water vapor.

The students explained the production of electricity with steam turbines using the heated water from beneath the earth's crust to a ship's energy source based on the concept of steam-driven turbines generating electricity. Underneath their ship was a battery and coils to heat the water flowing through the ship, creating steam that turns the turbines to make

electricity. Steam emitted from the turbines was used to heat the pools and spas on the luxury vessel, which was described in detail.

Environmental concerns were addressed by placing netting in front of the water intake valve to minimize the risk of marine life being hurt when the boat is moving. A tube was provided to release any sea life that might enter the intake valve back into the sea. The steam was condensed back to water by a cooling tower and released into the ocean through the back of the boat, along with the salt that was taken out during the heating process.

SLIGO MIDDLE SCHOOL
WHEELCHAIR SAFETY LOCK FOR TRANSIT

Project by: Preacher Isaac
Instructor: Ms. Daily

Student Isaac:

Sligo Middle School joined the symposium already underway at the AASHTO site in Washington, D.C. In the innovative, yet practical, tradition of Garrett Morgan himself, one of the Sligo students, Preacher Isaac, made an oral report, supported by an illustration, of a wheelchair safety lock for use on transit systems.

Mr. Isaac said that in 1990, 36.1 million people in America needed wheelchairs, adding that since then, the number of people needing wheelchairs has grown. He noted that these people have jobs, go to school, and need transportation, but not many of them ride the Washington Area Metro trains.

His proposal was a safety lock for the Metro. The mechanism could be installed on the transit vehicle floor right next to the doors. The person in the wheelchair could roll their chair back into position and then press a button that would engage the lock, keeping them safe and secure as the train accelerated and decelerated. When they wanted to move the wheelchair, they could press the button again to release the lock. He proposed installing a sensor, coupled to the door, to make sure the Metro train could not move until the wheelchair was clear.

Mr. Isaac concluded that people in wheelchairs are people are like everyone else. They need transportation to different places, and they do not have enough chances to go because they have to use some special type of car. His invention would allow them to safely use public transit.

QUESTIONS AND ANSWERS

A question-and-answer session followed the project presentations. This transcript of that session, with only minor edits, also includes commentary and answers from the transportation professionals who acted as moderators for each site. MTI Research Director Trixie Johnson led the discussion.

Figure 7 The students presented challenging questions

Trixie Johnson: The next part of the program is where the students ask a question. With so many schools participating, we are asking that each school come up with one question for one other school about their project.

We are going to go in the same order that you presented your project, so the first school that gets to ask a question is Argyle Middle School.

Q. **Argyle student**—My name is Micki, and my question is for the people who did the ship with the turbine. If they have turbines on the ship, the steam would have to come out, and if the steam gets close to a person, would it actually harm the person?

A: **Leonardtown student—**On our ship, the excess steam is either piped up into the spas or underneath the pools, or it is sent out portholes in the side of the ship. Any excess steam that is left over is condensed back into water, cooled, and sent out into the ocean. None of the heated steam actually touches anyone.

Ms. Johnson—So, they reuse the heat or they expel it.

The next question will come from Meadows Middle School. Do you have a question of one of the other schools?

Q: **Meadows student—**My name is Cynthia, and I would like to ask a question to the UniModal presentation. What energy source are you using?

A: **Kemps Landing student**—We are using magnetic levitation. Basically, they are propelled on a track without wheels by the repulsion of north-north or south-south magnets and the attraction of south-north and north-south electromagnetic signals and pulses which are sent out via an electrical-powered computer system.

Ms. Johnson—The next school for a question is Homestead High School in Miami-Dade.

Q: **Homestead student—**This question is for the school that proposed the Maglev. Where is the power supposed to come from?

A: **Kemps Landing student—**The power comes from power plants, which we presumed would come from the city power lines, such as power plants powered by nuclear power or hydroelectric power. However, if it does use coal power or a fossil fuel power, it is more efficient and cleaner due to the fact that power plants monitor their emissions much more carefully and they are cleaner, safer, and basically healthier emissions. This is equivalent to 400 miles per gallon for a car, so if we have thousands of people riding this every day, we are saving gallons and gallons of fossil fuels.

Ms. Johnson—Next question will come from Hampton Roads, Kemps Landing Magnet School.

Q: **Krista, Kemps Landing student—**This is for the GeoTanic group. Since the geothermal ships cost a whopping $600 million, who would actually be able to afford them, much less want to buy them, since so many governments are already in debt and this is a very expensive ship?

A: **Leonardtown student—**On our cruise liner, anyone who can go on a normal cruise can afford ours, because it is basically the same price. It costs $400 dollars per ticket, which is the same price.

Large companies would want to buy the ship for themselves; Disney might want to buy it for personal use. The average cruise liner costs about that much too, so you are not spending a great amount more.

Ms. Johnson—All right, the next question will come from AASHTO, from Leonardtown High School.

Q: **Leonardtown student—**We have a question for the UniModal. If your pod is going 150 miles an hour, how would the G-forces affect the people in the pod; would it harm them in any way?

A: **Kemps Landing student—**No, because it is such a smooth ride and the turns are very light; also, because the tracks are not actually touching the pod, there is no feeling of pull or G-force. Due to the magnetic forces, there is no friction, therefore you would not feel any vibration. The riders will not be harmed in any way by vibrations or any G-forces.

Ms. Johnson—We have been through one round of questions. The second round of questions will be on your own site, and this is the time that you get to ask your host a question. Each one of these people either runs a system or has some special connection to transportation, so this is your chance to ask a question of the person who hosted your site.

We are going back to Argyle Middle School now. Your question will be for Mr. Millar of the American Public Transportation Association.

Q: **David, Argyle student—**How do you fund the Garrett Morgan project?

A: **Mr. Bill Millar—**That is a very good question, but I think that our friends at San José State probably know more about it than I. But I believe they receive money from the government for their Institute, and then the sponsoring organizations each find the location and we pay for it out of our funds, so it is a combination of funds. Maybe Mr. Diridon would like to say more about that.

A: **Mr. Rod Diridon**—President Millar, you have covered it very accurately. We do receive an annual grant from the Federal Department of Transportation and that is matched by the California Department of Transportation. That grant is used to pay for the annual Garrett Morgan program that organizes the central support facilities, creates your lesson plans, and establishes the origination site here in San Jose. Then, APTA and the other sponsoring organizations sponsor the local site, where you are located. Again, the objective is to encourage you youngsters to become involved in transportation as a career, and of course to do that, you have to take math and

science in high school, and you need to take technical courses in college like engineering and other kinds of technical courses.

Ms. Johnson—The next question is going to be here in San Jose, and the Meadows Elementary School students will be asking a question of Mr. Diridon.

Q: **Meadows Student—**If we use all of the ideas, who is going to pay for all the energy?

A: **Mr. Diridon—**I think that is a good question for Mr. Millar, back at APTA. Mr. Millar runs the organizations in the nation that provide mass transportation. He knows how to finance transportation programs, so I will refer that question to President Millar.

A: **Mr. Millar—**In the United States, transportation systems are funded by a combination of what people pay to use them. If they ride the bus, they might pay a fare. If they drive their car, they have to buy the car plus pay perhaps a fuel tax. If they fly an airplane, they may pay some taxes related to the operation of the airline system, but they also then pay a fare to cover some of the costs. Many of the ideas we saw today could be financed by a combination of both user fees. In other words, what people pay and taxes. That would be consistent with how all the modes of transportation are paid for in the United States, whether it is roads, airplanes, rail systems, or transit systems.

Ms. Johnson—Our next question is going to come from Miami-Dade, Florida, and Homestead High School.

Q: **Homestead student—**What accommodations have been taken to assist the disabled on public transit in the Dade County area, and what can be improved?

A: **Mr. Roosevelt Bradley**—For the ADA, the Americans with Disabilities Act, we have our Specialty Transportation Services, STS, that provides door-to-door service anywhere, whether you are going to the store or the movie or down the street to a relative's house.

Specialty Transportation Services has a fixed rate right now; we charge the client $2.50. No matter the distance, we charge $2.50 per trip. We also have the Medicaid services that provide accessibility and trips to and from the doctor.

All our bus routes are accessible. We have low-floor busses that have a ramp that folds out and folds in. Our Metro Mover system and our Metro Rail system are accessible, and with your STS card you actually ride free. Those are the types of services we have that relate to the Americans with Disabilities Act.

Figure 8 Tate Jackson, AASHTO TRAC Program Manager, is questioned during "Ask the Expert"

Ms. Johnson—That also is a challenge for every area.

Now we will go to Ms. Bouknight in Hampton Roads with the Kemps Landing students.

Q: **Michael, Kemps Landing student**—Does having the light rail in Norfolk and the Bus Rapid Transit on the oceanfront make integrating the system easier, or does it achieve the opposite of your goals?

A: **Ms. Nanette Bouknight**—Well, here at Hampton Roads Transit, we do not have a definitive answer. The one thing we can say, though, is that as we venture out into using the different technologies and transportation, our main goal is to have a comprehensive system that will meet all the needs of our regional cities.

Something we have always been faced with, as you have discovered yourself, are the varying needs of the military in Norfolk and the tourism in Virginia Beach. We pride ourselves on being able to meet those needs. Unfortunately, even though we are a regional transit system, cities do not always think on a regional basis. So, we work hard on every type or mode of service that we provide to make sure that those systems are able to link. One day we look forward to having a large, integrated, balanced system for the Hampton Roads area.

Ms. Johnson—I think any region would say they have the same challenge.

We are going next to the AASHTO site for Leonardtown High School and your question.

Q: **Leonardtown student—**Where is AASHTO headed in the future?

A: **Mr. Tate Jackson—**AASHTO's future goals are to continue to help the states maintain their roads and to find the funding that they need to build and maintain the roads. Also, we will continue to set the design standards for the roads and highways in the United States.

A: **Ms. Johnson—**Do the Sligo Middle School students also have a question for AASHTO?

Q: **Sligo student—**What caused you to start this business? What problem came about, or what moved you to start this business or to start this program?

A: **Mr. Jackson**—The question is, what caused us to start this symposium with the students? The answer to that is very simple. We are hoping to talk one or more of you into becoming transportation professionals or engineers when you get older, because we are going to need people like you in the business. We want to start at your age, and hopefully we will get many of you to want to become transportation professionals.

Ms. Johnson—Now we are open for any question you want to ask of any of the experts that we have at any of the sites. You are now free to ask a question at your site of the expert there, or of any of the experts at any of the other sites around the country.

Q: **Bethany, Argyle Student—**How does APTA influence legislation on better transportation?

A. **Mr. Millar—**APTA works with the Congress and with the administration to try to come up with policies that are good for public transportation. Our members are the organizations that provide public transportation all over the country: Metro here in Washington, or HRT in Hampton Roads area, or Miami-Dade Transit, or Valley Transit in the San Jose area are all examples of APTA members. We rely on our members to decide what are the important policies and issues they want us to work for. Then we work with other organizations, like AASHTO, the American Association of State Highway and Transportation Officials. Many times our members will have issues that are very close to the issues that AASHTO members have, so sometimes we will work together and try to convince the Congress that the policies that we advocate are good for America, good for your future, and ought to become law. It is a complex process and one at which we work very hard. In the end, we hope to have success and have good policies and good funding so that public transportation and other forms of transportation can be available for everyone in the country.

Ms. Johnson—You heard earlier that the money often comes from the government or from taxes. The legislation that shows where the money is going to come from and how it is going to be put to various uses is an important part of what legislation does.

Okay, we're now going to have a question here in San Jose, and again you can ask that question of anybody around the country, and we have our question over here.

Q: **Cynthia, Meadows student—**I would like to ask, how did they get here where they are now?

A: **Mr. Millar—**Well, I have always liked transportation. My great-grandfather was a conductor on the New York Central Railroad. I also used to go to the airport when I was a kid to watch the planes. My grandmother lived on a rail line, and I used to watch the trains there. I liked transportation at a very young age. I went to college and graduate school, and I have been very lucky since then to be able to have a good career in transportation. It has always been interesting for me.

A: **Mr. Diridon—**I also was involved in transportation from the time that I was a young person. My father was a brakeman on the railroad, and I worked my way through college as a brakeman and a fireman on the railroad. When I got out of college, I began to be involved in the political community. I was a County Board of Supervisors member—some areas call those County Commissioners. As a County Board of Supervisors member, I was assigned the responsibility for transportation in Santa Clara Valley, and so I continued to be involved in transportation through that resource.

When I was in high school, I studied math and sciences, and when I was in college, I studied business, accounting, and finance. Those kinds of things are very important parts of transportation management. So, those are all careers that you can think about, young folks, as you think about where may be going with your own careers.

A: **Ms. Karen Burnette—**My name is Karen Burnette and I am Vice President here at Hampton Roads Transit. I came into public transit not through a traditional route. I started off in the early 1970s with an antipoverty program, specifically with personnel, and oddly with transportation. I started off with a degree in psychology, and after working with the antipoverty programs, I then went on to get my Master's Degree in Public Administration, and at that time I came to work with Hampton Roads Transit. I started off in Grants Administration and, based on my background, that led me into starting a Human Resources program for our organization. From that, I moved into varying positions, which have taken me to being Vice President for Administration.

Ms. Johnson—So what you are hearing is that you do not have to be an engineer to be in transportation. There are lots of different things you can study that make a difference when you go to get the job.

A: **Mr. Bradley—**Roosevelt Bradley, Director, Miami Dade Transit. I started off in transportation by taking a bus up the hill to success… just kidding. When I was at the University of Miami, I needed a summer job, and the Seaboard System railroad was hiring switchmen. I thought it was fun to play with trains and throw switches. Then I became a conductor and then an engineer, driving the Seaboard System railroad freight trains and also Amtrak trains. I thought it was interesting. As a matter of fact, I thought it was more of a hobby, because it was fun to me.

I went from there progressing through the ranks of private industry, to a public industry and Miami-Dade County, which was building a new rail system. They only had a bus system previously, before 1984. I came on board here with railroad experience for the new rail system, and I progressed through the ranks here. I became Assistant Director of Bus Operations, Assistant Director of Rail Operations, then the Deputy of both, and then the Director of Miami-Dade Transit. I think getting into all modes of transportation has really been fun. Transportation gives you an opportunity to help everyone. It puts a smile on my face when someone in the public makes a comment that they enjoyed their ride that day.

I remember when I was about 14 or 15 years old, I used to catch the public bus to school. The bus operators would sometimes see you running for the bus and then leave. I made a comment to myself: I said if I am ever in charge of those buses, they are going to wait for everyone when they are running. So we do not have any buses leaving anyone who is running for the bus anymore. The bus operators have to wait for them.

A: **Mr. Jackson—**I always knew I wanted to be an engineer. I started off as a mechanical engineer in college and switched over to civil engineering when I discovered how much fun it was to build bridges. I went to work for the Maryland Department of Transportation for 10 years. There I did a lot of transportation planning, and a little bit of bridge design and remedial bridge design. It was always a lot of fun. I have always had a liking for math and science, so engineering just seemed the way to go. Transportation let me build big things, and that was just a lot of fun for me.

Ms. Johnson—That is probably what most of you were thinking when you thought of transportation, an engineer.

We now have time for a question from Homestead High School.

Q: **Homestead student—**I would like to know how long it usually takes to become head of transit.

Ms.Johnson—Let us ask someone who is at the top in a transit district how long it takes to move up through the system, like Mr. Bradley in Florida.

A: **Mr. Bradley—**It took me about 26 years, but it does not take everyone that long. Because I enjoyed the other positions I was in, I probably went through about 10 different positions on the way up the ladder, but you can get there a lot sooner. As you are going through the positions, make sure you do the best that you can do on every one. Remember that. It was very easy when positions came about, knowing that I had performed well in a previous position. I would tell anyone: work hard, do a good job, and you will be recommended and rewarded when other opportunities come up.

Ms. Johnson—Good answer. We are going to go to Kemps Landing now. You now have an opportunity to ask a question of anybody.

Q: **Kemps Landing student—**This question is for the APTA President, Mr. William Millar. We know from previous research in class that a big issue that the Secretary of Transportation is currently dealing with is that Amtrak has been declining in recent years. Why has this been happening? Is it due to speed, convenience, or just the fact that Amtrak is a rail company? If a nationwide rail company has been declining, how would a rail company or rail system on a localized level survive or even be used by the masses?

A: **Mr. Millar—**For many years, passenger rail service in America was run by private rail companies. Those rail companies found it more profitable to invest in freight service than in passenger service, and they let their passenger service go. By 1971, those companies wanted to pull out of rail passenger service altogether, but an agreement was made in the Congress of the United States to create a separate corporation, namely Amtrak, to run railroad passenger service throughout the country.

Many of you talked about how we, as a country, are running out of fossil fuels, how we need to clean up the air, how we need to provide opportunities for persons with disabilities, and a whole host of other ideas that need to be handled. Certainly a good, solid, well-funded, intercity passenger rail service could be one of the important contributions in all those areas. That is something you are going to hear a lot about in the next several years as we debate, and decide as a country, do we want to have just a little bit of intercity rail passenger service, or do we want to have an amount such as many other countries have, and really give people a choice, whether they want to take their car, whether they want to fly on an airplane, whether they want to use the intercity bus, or whether they want to use intercity rail transportation to move around.

It is a very good question. It is a question that all of you will have some input to, because in your lifetime, it is a question that our country has to decide. However

Amtrak, for the most part, does not have its own tracks. It still has to rely on those private freight companies to actually run the trains for them. This is a very unusual circumstance. In most other parts of the world, passenger rail service has the priority, not freight, and in most other parts of the world, the federal government invests large amounts of money into their passenger service. In this country, the federal government, compared to the rest of the world, has invested very little money in rail passenger service, and the freight companies, on whose tracks the Amtrak trains have to run, still do not like the idea that there is passenger service on those tracks. They feel that they make more money carrying freight than passengers. As a result, Amtrak has been underfunded for many, many years. As you said, many people do not like the service because sometimes they have to sit and wait until freight trains pass, or sometimes they are not able to run many trains, so it is not very convenient.

The debate that you refer to here in Washington is what should be the future of passenger rail in the United States. Should we continue as Amtrak currently does? Many people believe that perhaps the states should use the money to build roads. Also, many states help support regular public transportation in local communities; maybe the state should also help to support an intercity passenger rail service such as Amtrak provides. Some people believe that, in addition to Amtrak, there should be other companies that provide intercity passenger service. It is a very important issue.

Ms. Johnson—Thank you. We have time for one very short question from the AASHTO site in Washington.

Q: **Sligo student**—What are your recommendations to students interested in entering your career?

A: **Mr. Jackson—**Basically, if you want to go into transportation, you need to study math and science. But you also need to have those good communication skills, so you need to study English and reading. Work hard in school, go to college, and you can definitely have a good career in transportation.

Ms. Johnson—You need to be well-rounded.

Congratulations to all of you. You all had wonderful projects and you had very good questions for our experts, some questions that made them think hard before they answered.

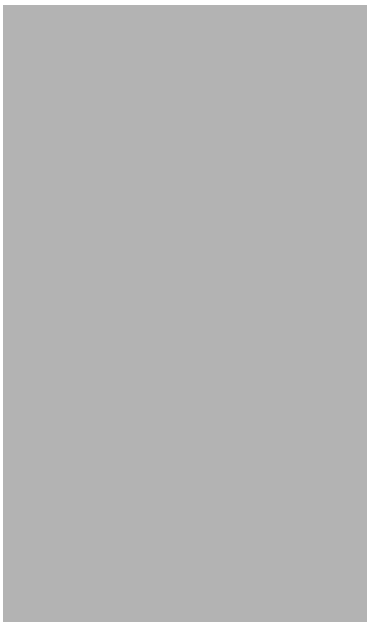
We want to thank all of you for coming to this transportation symposium and for doing all the work that you have done in the past week to get ready for today. Especially we want to thank the sponsors around the country who made it possible, and your teachers who took the extra effort to make this program available to you.

So we want to thank you once again for your participation today. Congratulations and big applause for all of the students who did such a terrific job.

APPENDIX A
GARRETT AUGUSTUS MORGAN (1877-1963)

Garrett Augustus Morgan, the man for whom the U.S. Department of Transportation Technology and Transportation Futures Program is named, was born in Paris, Kentucky, in 1877. The seventh of eleven children, his parents were former slaves. Although his formal education ended at the sixth grade, Garrett Morgan went on to become a world-famous inventor and entrepreneur.

Despite his humble beginnings and lack of formal education, Morgan made an impact on the course of human events. Shortly before his death in 1963, Morgan was awarded a citation by the U.S. government for his significant inventions.



Notably, in 1923, Morgan invented and patented a successful early traffic signal (shown at right). It was during this time that the automobile, which shared the nation's streets with bicycles, animal-powered wagons, and pedestrians, was becoming common. Accidents were frequent and often bloody. After witnessing such an accident in Cleveland, Morgan decided to invent a device to make the flow of traffic safer. The Morgan traffic signal was a T-shaped pole topped with three illuminated signs: Stop, Go, and an all-directional stop that let pedestrians cross the busy street.

The Mineta Transportation Institute presents an annual symposium by videoconference as part of its ongoing mission to provide information transfer, education, and research on current issues and emerging solutions in the field of sustainable surface transportation. The videoconference is part of the Garrett A. Morgan Technology and Transportation Futures Program, which was established by the Honorable Rodney Slater, former secretary of the U.S. Department of Transportation.

Teachers and students addressed the topic of sustainable transportation and proposed innovations for the surface transportation industry. The purpose of the symposium was to stimulate the minds of young people and encourage them to excel in mathematics and

sciences, which could lead to careers in transit engineering, transportation planning, and innovation in general.

Through the efforts of many people, this event and this publication will add to the positive spirit of innovative transportation progress so ably personified by Garrett Augustus Morgan.

APPENDIX B
WINNING STUDENT PRESENTATION
2005 GARRETT A. MORGAN SYMPOSIUM

UniModal Transit System:
Transport Solutions for People, Products, and Data

By
Kemps Landing Magnet School
Virginia Beach, Virginia
Dennis Borgerding, Instructor

Sponsored by Hampton Roads Transit District
Michael Townes, President and CEO

Authors: Elyse Anderson, Dustin Anthony, Chad Corillo, Joshua Everard, Stacy Fernandes, Dru Letourneau, Krista O'Connell, Michael Protacio, Jonathon Rich, Ariel Tatterson, and L. Jessica Troung

In the Hampton Roads area of Virginia, there is currently a huge transportation problem for commuters who must travel to and from work every day. Commuters must face heavy traffic. High Occupancy Vehicle (HOV) lanes work well in city areas where people have similar commuting hours, like in Washington D.C. However, in Hampton Roads, many people work at Naval Station Norfolk. Many of the military personnel have varying working hours, meaning they have different commuting hours. This makes it hard for the military members to carpool (if they did, they would spend hours waiting for those whom they would carpool with), and these people are therefore unable to use the HOV-2 lanes. The more individual cars using the roadways, the more gas and oil are emitted, contributing to the already growing pollution problem. An excessive amount of cars on the road also means that there is a lot of unnecessary traffic.

Several waterways in Hampton Roads cannot be crossed by a normal, above-water bridge, because shipping industries must also use the waterways. On the other hand, building underwater tunnels for the roadways is extremely expensive because it forces people to drive all the way around the waterways, which adds a lot of time to their drive. There already are bridge tunnels on these waterways, such as the Hampton Roads Bridge-Tunnel, but they are insufficient for commuting; the tunnels cause more traffic, as cars seem to slow down as they exit the tunnel.

The only solution to this problem is to have a way to transport mass amounts of people, while using the least amount of money and making the smallest footprint possible. This solution also needs to be more environmentally friendly, as the fossil fuels that are burned in nearly all kinds of transportation today are not only very harmful to the environment, but are expensive and the resources are being quickly depleted. The best solution to this transportation problem is that of the UniModal, a form of magnetic levitation on a suspended track.

However, UniModal can not feasibly be installed on the Hampton Roads Bridge-Tunnel, where much of the traffic problem is. To solve this problem, Bus Rapid Transit (BRT) systems will shuttle commuters from across the bridge-tunnel from Norfolk Naval Station to Hampton. The BRT shuttles will run nonstop to and from the Naval Station to Hampton. The BRT buses have higher capacity, are faster, and are more energy efficient—running on both gas and electricity—than normal buses. The BRT can hold over one hundred passengers at once, which should relieve the bridge-tunnel of at least one hundred commuter vehicles. This will free up the tunnel and is easier on the environment. UniModal stations will lie at both ends of the BRT route, effectively giving connections to the intercity UniModal lines.

The UniModal system is composed of tracks that run throughout the city, with pods running on them by magnetic levitation. Poles similar in size to telephone poles suspend two tracks, one above the other. The top track is the main track, and the subtrack is for each individual stop, or portal. At each portal is a docking system, with a stairway and/or simple elevator leading to the pod. From the portal, passengers enter the pod, select their destination, and the pod then merges, from the subtrack, onto the main track.

UniModal may almost sound too good to be true, but everything about it is entirely factual. The UniModal was designed by a team of very prestigious individuals, including engineer Douglas Malewicki, a renowned inventor, and Paul Williams, Dean of the University of Montana. Malewicki, main engineer and designer behind the UniModal and

graduate of Stanford University, has a very strong background. Malewicki has the expertise and experience necessary to design a successful, working system. He has designed and worked upon many projects involving airplanes, space, and mass transit. However, what is important is the main principle behind the UniModal: magnetic levitation.

The principal of magnetic levitation is simply the levitation of objects by the repulsion and attraction of electromagnetic pulses. Magnetic propulsion is one of the strongest types of propulsion, and, by far, the most energy efficient. Working magnetic trains and subways are up and operating in Japan, while Shanghai, China, features a maglev train system that can reach speeds of over 300 kilometers per hour. The UniModal's design is a suspended version of a maglev transportation system. The pods are locked onto the tracks, but instead of being propelled by wheels and axles, are propelled by magnets, and are suspended several inches above the track in midair by magnetic levitation. All of the electromagnetic forces are controlled and dispatched by several central computers. The pods are individually repelled by north-north or south-south magnets, and pulled together by north-south and south-north magnets, by the electromagnetic pulses at the same time. As the pods move forward, the pulses shift from north to south. When the destination is reached, the pulses cease to be sent, and are sent to the individual pod once the passenger slides their smart card.

The pods in the UniModal system can hold four people, and can transport commuters effectively throughout any area, but generally within and between cities. The pods are controlled by computers and are electrically powered. They are suspended from a guide rail, which would go all throughout Hampton Roads. The footprint of the guide rail is similar to that of a telephone pole, making it easy to install nearly anywhere and everywhere, including alongside sidewalks. The rail is suspended high enough so that people can walk and drive underneath it, which means that space does not have to be cleared for the track and it does not have to be built around roads. Stops will be located near neighborhoods and along main roads so they can be easily accessed, every half to whole mile, making the maximum walking distance only 1/4 to 1/2 mile.

Travel time around the city would also be greatly cut down because intercity travel with the UniModal design will reach at least 100 miles per hour. Passengers would not have to wait for a bus to come around either, because at each stop, vehicles are already lined up and waiting. Additionally, the only stop the vehicle makes is when one gets to their destination, meaning they would not have to sit through the stops of other passengers. UniModal is also very energy efficient due to the fact that it runs on magnetic levitation and its efficiency is the equivalent of 200 miles to the gallon in a gas-powered vehicle.

Pollution would also be greatly cut down, since the maglev does not use fossil fuels such as oil or gasoline.

It is important that all systems of transportation, such as the UniModal, are safe. The vehicles are locked into the guide ways, so there is no risk of derailing. Should disaster strike, an automatic, computer-controlled braking system would be immediately activated. Otherwise, it is nearly impossible (within human power) for the tracks to be knocked out. Should high winds affect the areas where the UniModal tracks are installed, they will not get knocked over; the poles will be inserted deep enough into the ground that they will remain stable in the harshest of conditions. Furthermore, if a tree or any large object falls onto the track, it will not collapse, due to this stability. Also, the pods cannot collide because they are equipped with electronic, automatic separation computers, controlling the separation between pods. This separation is defined as two seconds long.

The suspended maglev track proposed by UniModal is not only the best alternative to all transportation methods, but superior to all transportation options that are currently available. It is estimated to cost a mere $3 to 4 million to construct one mile of the UniModal track, and the price is under $10 million per mile to construct the track, cars, stations, and portals. With the proper equipment, a crew can install an entire mile of UniModal track in one day. The footprint for UniModal tracks in both the air and the land is very small. The track is able to be built on sidewalks, the sides of roads, through swamps and small lakes, and just about any other area. Compared to other kinds of transportation tracks, which do not offer the speed, independency, and small footprint that UniModal does, UniModal is extremely cheap to install, both in time and in dollars.

UniModal has a large advantage in price of construct and maintenance. To construct a standard road (such as one that would appear within a standard-sized city), it costs $5 to 10 million. An interstate highway costs an estimated #15 million per mile and up to $20 million in mountainous areas. To install a subway system within a city, prices range from $25 to 500 million, while it is extremely difficult to install in cities with a high water table. The BRT (Bus Rapid Transit) is estimated to cost $20 million per mile. More importantly, the newly proposed light rail systems end up costing *at least* a total of $100 million per mile.

UniModal tracks do not rely on gas, but instead on magnetic levitation. With oil and gas prices on the rise, and the fact that gas and oil are a nonrenewable resource that pollutes the environment, magnetic levitation shows itself to be a superb and cheap alternative. There are no known health hazards associated with magnetic levitation technology, while,

on the other hand, oil and gasoline are a huge burden to the environment. Oil spills damage and destroy marine ecosystems and life, while the pollution caused by burning fossil fuels is linked to air pollution, lung cancer, and global warming. These three effects all can result in human and animal deaths.

As mentioned earlier, it would take only about a day for an adequately trained and equipped crew to install one mile of UniModal track. It would take merely three to five years for a city to completely install an entire UniModal maglev system. In comparison, a simple road takes decades to install within the city, a humongous troupe of workers, and a large sum of taxpayers' dollars. A road also leaves a very large footprint on the ground. Also, it would take over a decade to install just 100 miles of a light rail system, which, in reality is a feasible distance, due to the fact that such a length of a path would be needed for travel around a large area, such as Hampton Roads.

Part of the UniModal project for Hampton Roads will be paid for by the local, state, and federal governments. Since the UniModal system has never been implemented in the world before, and the maglev system has not yet been used in the United States, subsidies by the federal government should help pay for the UniModal project. The state and local governments will also support UniModal, as they are currently supporting Hampton Road Transit (HRT). One of the duties of the government is to provide for its citizens, and there is no better way to do this than the UniModal. Fares, paid by the passengers, will also help pay for this project. Initially, the one-time installation of the UniModal will be paid for by the government; while all further operating costs will be paid for by the commuters and families that use the system, and some businesses.

The fares that will be charged on the UniModal will pay for the operating costs, to send out the electromagnetic signals, clean the cars, and maintain the staff that will ensure the safety and operation of UniModal. UniModal riders will be able to pay for their ride with a prepaid renewable smartcard, which can be acquired at any of the main stations. This card will store mileage, which the consumer can use by simply swiping the card in a slot on the outside of the UniModal car. Passengers will pay for their trips by miles. Miles (but not cards) can also be bought individually through a vending machine found at most of the portals. If the passenger does not have enough miles to get to their desired location, the pod will not move. One of the benefits of charging passengers in miles as opposed to trips, is it that it will more accurately pay for the operating costs, and will be more fair to the users. Individual businesses and organizations will, through the UniModal company, also be able to request and fund UniModal portals outside their company's building. The

profits earned from the businesses that decide to purchase these portals will help further reduce the travel costs for the passengers.

The UniModal system complies with the standards set forth by the Americans with Disabilities Act (ADA), making it easily accessible to those with disabilities. All major UniModal stations will be equipped with a simple elevator, in addition to a stairway. Certain pods will be specifically designed for the handicapped—they will be slightly larger, and will not have chairs, but, instead, space to accommodate a wheelchair or any other equipment that the disabled need. If the disabled need assistance to get to any of the UniModal stations, all they need to do is to notify any of the UniModal staff ahead of time, who will arrange for a van or other method to pick them up and transport them to their desired station.

* * *

In every aspect, UniModal goes beyond solving the transportation and pollution problems in the Hampton Roads area. UniModal is extremely affordable, more so than any transportation system that has been proposed. UniModal is practical, fast to install, and leaves a very small, efficient footprint. Although UniModal is public transportation, each pod is very private, and all the passenger has to do is slide their smartcard in, request their stop, and then enjoy their ride. UniModal is safe to both humans and the environment. It is nearly impossible for natural or human forces to endanger any of the pods. UniModal is environmentally friendly, does not involve the burning or wasting of fossil fuels, and runs silently. The Bus Rapid Transit (BRT) system will speed up the rides through the tunnel and Norfolk Navy Base. UniModal gives freedom to those who use it, while it still complies with the ADA. UniModal not only solves all of the problems in the Hampton Roads area, but all that could arise in the future. For our area—not to mention the rest of the world—it is the best solution available.

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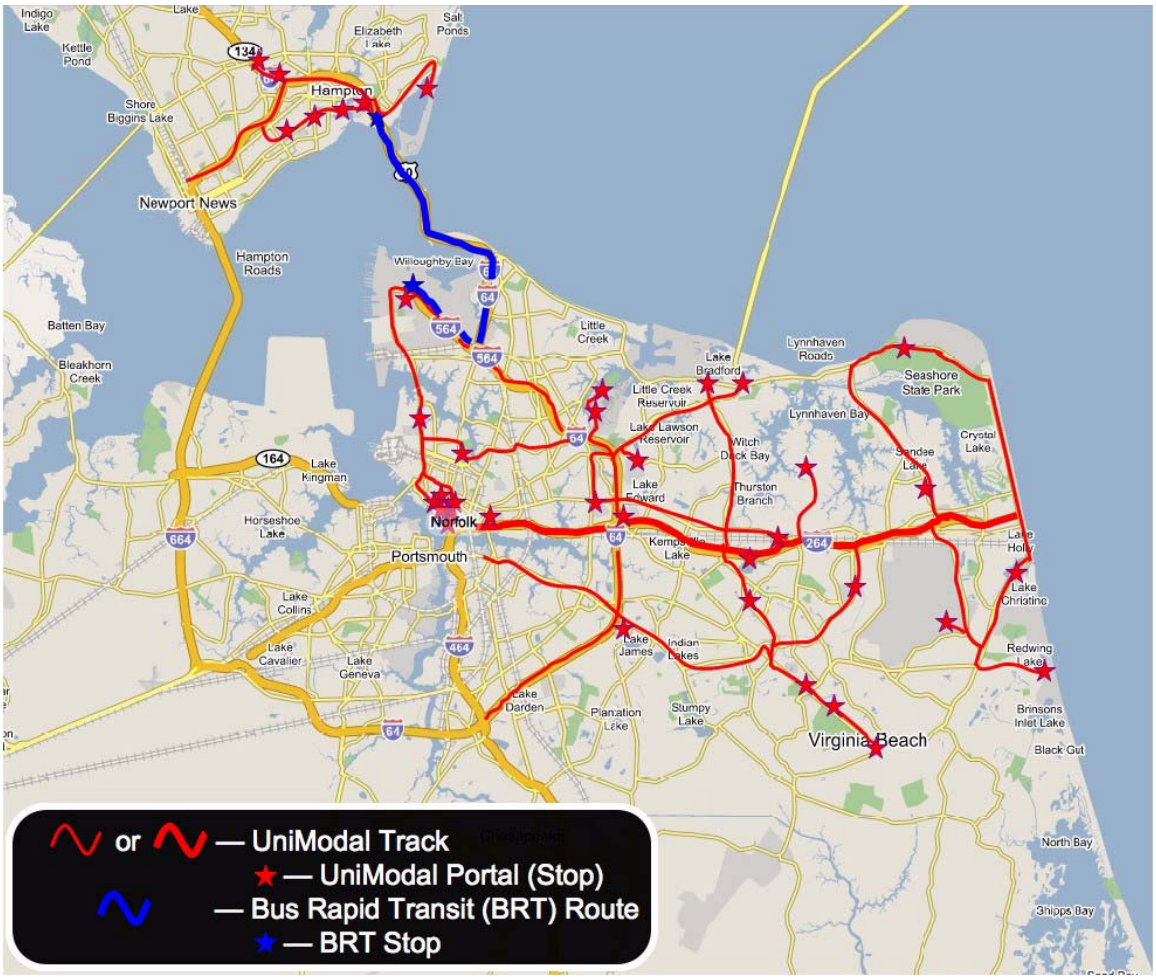

Figure B-1. Proposed HRT System Route Map

Figure B-2. Sample Web Site Home Page

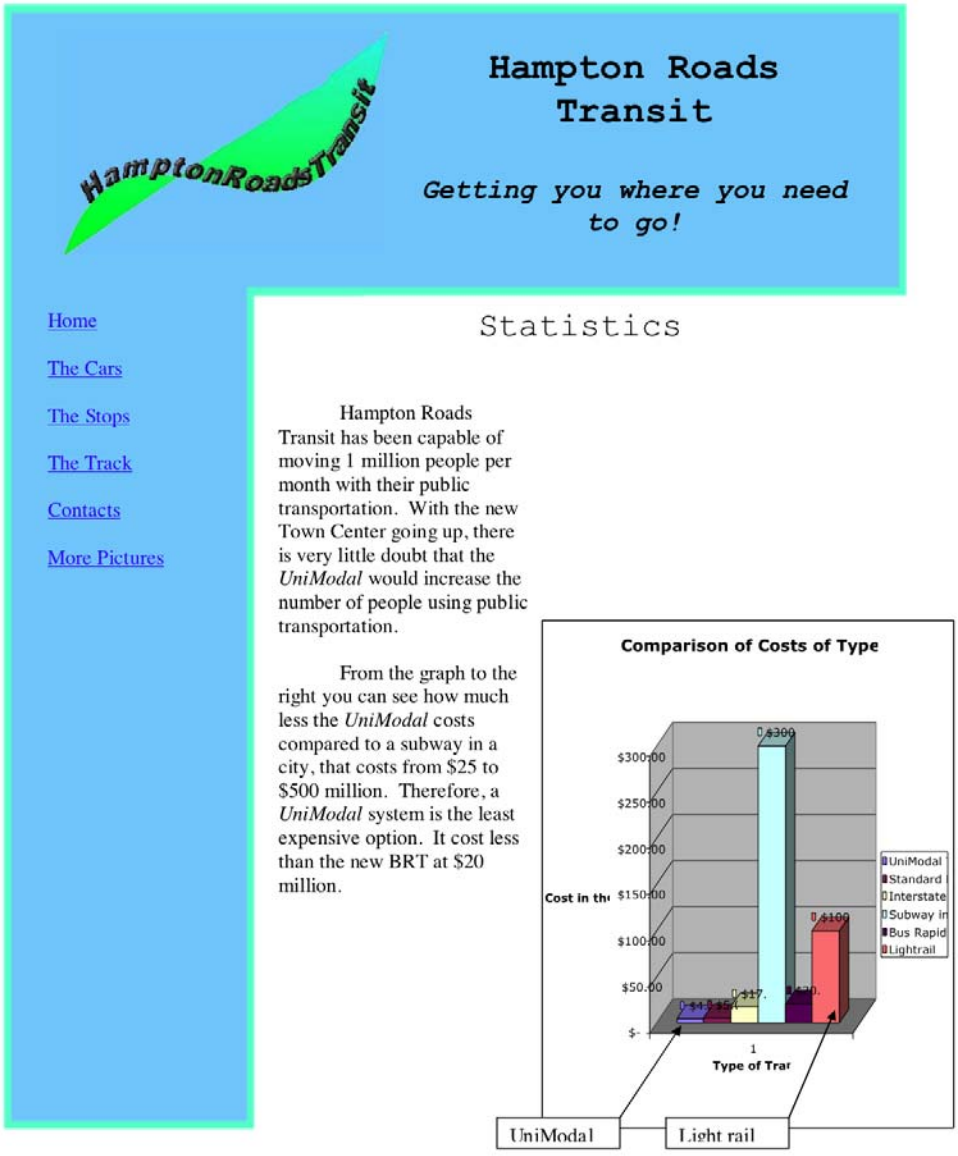

Figure B-3. Sample Web Site Statistics Page

Figure B-4. Sample Web Site Cars Page

LIST OF UNIMODAL STOPS

UniModal Hub:
Town Center / Pembroke Mall / Columbus Shopping Center
Minor Portals (Stops):
Norfolk Naval Base
Norfolk Navy Exchange
Old Dominion University / Christopher Newport Convocation Center
Sentara Norfolk General Hospital
Lafayette Park / Virginia Zoo
Chrysler Museum
Town Point Park
Chrysler Hall / Scope / MacArthur Center
Harrison Opera House
Tidewater Community College—Norfolk
Norfolk State University
Norfolk International Airport—ORF
Norfolk Botanical Gardens
Virginia Wesleyan College / Norfolk Academy
Little Creek Naval Amphibious Base—Gate I
Chesapeake Bay-Bridge
Seashore State Park / Fort Story
Little Neck Road*
Virginia Marine Science Museum
Military Circle Mall
Virginia Beach Central Library
HRT Park-and-Ride Virginia Beach (South Independence)
Municipal Center of Virginia Beach
Mount Trashmore
SportsPlex
TCC—Virginia Beach
Lynnhaven Mall / Business Area
Great Neck Road*
Dam Neck Naval Amphibious Base
Oceana / Ocean Navy Exchange
Atlantic Avenue*
Virginia Beach General Hospital
Regent University
Indian River Road*
Hampton Roads Beltway (I64)*
Hampton Coliseum
Coliseum Mall
Hampton University
Virginia Air & Space Museum
Fort Monroe
Sentara Hampton General Hospital
Darling Memorial Stadium
Harbor Park

LIST OF BUS RAPID TRANSIT (BRT) STOPS

Shuttle Across Hampton Roads Bridge-Tunnel:
Norfolk Navy Exchange

*Road is an expressway; stops can be requested by businesses for a certain price.

Figure B-5. Sample Web Site Stops Page

Figure B-6. Sample Web Site Track Page

Figure B-7. Sample Web Site Contacts Page

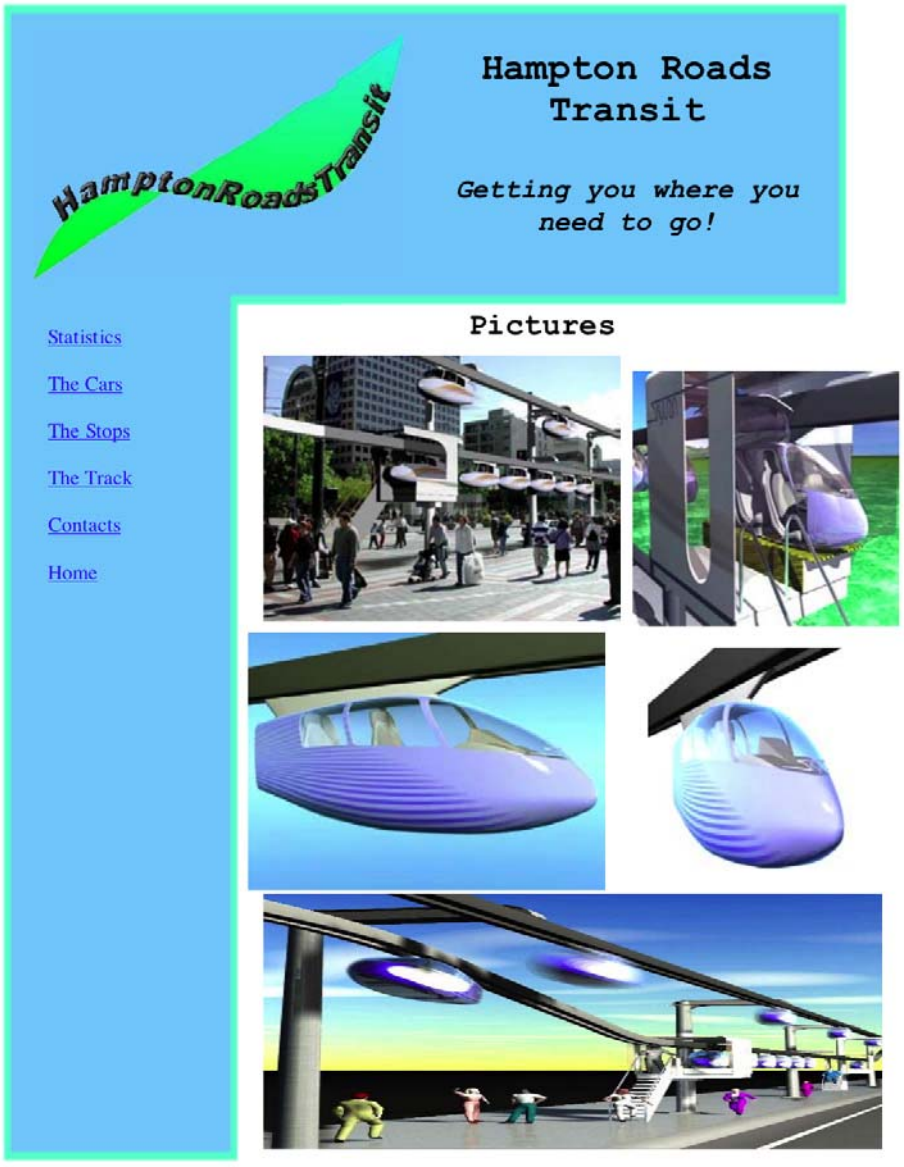

Figure B-8. Sample Web Site More Pictures Page

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