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National Garrett Morgan Sustainable Transportation Symposium — 2004

MTI
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National Garrett Morgan Sustainable Transportation Symposium

March 23, 2004

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16. Abstract

On March 23, 2004, the Mineta Transportation Institute brought together experts in surface transportation and students from elementary, middle, and high schools to discuss sustainable transportation topics. 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 and California participated in a videoconference, during which they heard a keynote statement from the U.S. Secretary of Transportation Norman Y. Mineta.

Five teams of students also presented project proposals for innovative transportation alternatives during the videoconference. These included two variations of magnetic levitation (Maglev) trains, an alternative power-source airplane, and a solar-powered car. 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 March 23 event.

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The Mineta Transportation Institute would like to thank the following individuals for their assistance in organizing and delivering the 2004 National Garrett Morgan Sustainable Transportation Symposium on March 23, 2004.

- The Honorable Norman Y. Mineta, U.S. Secretary of Transportation
- Rod Diridon, Executive Director, Mineta Transportation Institute
- Trixie Johnson, Research Director, Mineta Transportation Institute
- Pam Boswell, Vice President of Program Management and Education Services, the American Public Transportation Association
- John Horsley, Executive Director, American Association of State Highway and Transportation Officials
- Matt Chew, substituting for Barbara Musser, and the ninth grade class of Leonardtown High School in Leonardtown, Maryland
- Randall Landrith and his fifth and sixth grade students at Meadows Elementary School in San Jose, California
- Ms. Kimberly McLurkin-Harris and her students at Argyle Middle School in Silver Spring, Maryland

The event was sponsored by San José State University (SJSU), the Mineta Transportation Institute (MTI), the American Public Transportation Association (APTA), and the American Association of State Highway and Transportation Officials (AASHTO), and was presented by MTI as part of the Garrett A. Morgan Technology and Transportation Futures Program.

Thanks also go to the videoconference technicians at the two sites in Washington, D.C., and at the SJSU Academic Technology Network (Media Production and Delivery).

For their work in publishing this report, MTI would also like to thank the following people: Communications Director Leslee Hamilton, Research and Publications Assistant Sonya Cardenas, Writer Karl Sonkin, Editors James Swofford and Catherine Frazier, Graphic Designer Shun Nelson, and Webmaster Barney Murray.

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FOREWORD

GARRETT AUGUSTUS MORGAN (1877-1963)

The man for whom this Technology and Transportation Futures Program is named was born in Paris, Kentucky. 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, engineer, and entrepreneur. [1]

Figure 1 Garrett Augustus Morgan (Courtesy of U.S. DOT).

Most notably, in 1923, Morgan invented and patented the first successful traffic signal. 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.

[1] "Inventors: Garrett Morgan, Gas Mask and Traffic Signal." About.com, available http://inventors.about.com/library/inventors/blgas_mask.htm (accessed April, 2004).

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. [2]

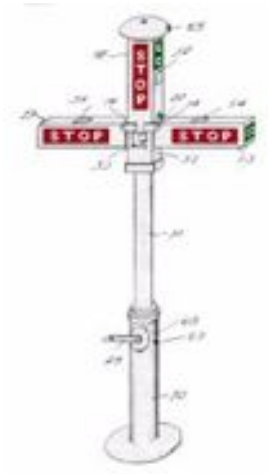


Figure 2 Morgan's traffic signal (Courtesy U.S. DOT).

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 invention.

I can only wonder what innovations the young students of this year's symposium might produce that could change the future of transportation. That certainly was among the challenges they received in the keynote address so kindly offered by United States Secretary of Transportation, the Honorable Norman Y. Mineta.

Judging from the energy and enthusiasm of this year's participants, the fourth National Garrett Morgan Videoconference Symposium was a vibrant platform from which the transportation designers and policy-makers of tomorrow could express their ideas.

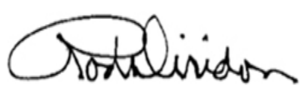
2 "Garrett Morgan." BlackInventor.com, available http://www.blackinventor.com/pages/garrettmorgan.html (accessed April, 2004)

This annual symposium 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. I believe that this edited summary will provide an interesting look into the perceptions and promise of the next generation of transportation leaders.

This publication, which is available on our website at http://transweb.sjsu.edu, will give teachers and transportation professionals alike a glimpse into the thoughts of these students, as revealed through the processes of this videoconference. The student workbook and teacher's guide for this year's event are also available through the *TransWeb* site.

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

I invite comments regarding this transcript and the MTI Garrett Morgan project.



Rod Diridon
Executive Director

EXECUTIVE SUMMARY

PURPOSE

The fourth National Garrett Morgan Videoconference Symposium, presented by the Mineta Transportation Institute (MTI), was held on March 23, 2004, with video hook-ups between the San José State University (SJSU) campus in San Jose, California, and two locations in Washington, D.C. The videoconference 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. 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.

OPERATIONS AND BROADCAST SITES

Students participated from three broadcast sites linked by satellite and phone lines. In San Jose, students from Meadows Elementary School were sponsored by MTI and made their presentation from SJSU's Academic Technology Network; in Washington, D.C., the American Public Transportation Association (APTA) sponsored Argyle Middle School from Silver Spring, Maryland; and at the American Association of State Highway and Transportation Officials' (AASHTO) site, the ninth grade class from Leonardtown High School of Leonardtown, Maryland, introduced their ideas.

ACTIVITIES AND EVENT HIGHLIGHTS

MTI's Executive Director, Rod Diridon, introduced Pam Boswell of APTA, John Horsley of AASHTO, and Trixie Johnson of MTI in a round-robin opening statement.

Mr. Diridon, speaking in San Jose, emphasized the importance of the symposium.

> The idea is to let you young people, who will be the leaders of our nation in the future, know how important it is for you to be involved in transportation as a career

area, to be running our transportation programs, building our roads, building our transit systems, running our railroads and our airplanes and doing all the things that are necessary to keep America on the move in the future.

Figure 3 Mineta Transportation Institute Executive Director Rod Diridon addresses the participants in San Jose.

Mr. Diridon then warmly introduced the Honorable Norman Y. Mineta, United States Secretary of Transportation, recounting their many years of friendship as politicians and transportation proponents in San Jose. Mr. Diridon detailed Secretary Mineta's long and distinguished career as the nation's first Japanese-American mayor, serving the city of San Jose, followed by several terms in Congress and appointments to the Cabinets of two presidents.

Secretary Mineta challenged the students to consider careers in transportation, because "America needs visionary, bright young leaders in the transportation field."

Figure 4 United States Department of Transportaion Secretary Norman Y. Mineta.

After the Secretary's brief remarks, there was a presentation of each school's teams' original ideas for sustainable transportation innovations for the future.

Leonardtown High School made two presentations:

1. A CO_2 –propelled Maglev train, capable of carrying 600 passengers; and
2. A commercial airliner powered by wind, solar panels and fuel cells.

Argyle Middle School made one presentation: a Maglev train, super-powered by vacuum tunnels that accelerate the train's speed.

Meadows Elementary School made two presentations:

1. SkyWeb Express, a solar-powered, computer-controlled monorail taxi system; and

2. SPB&C, a car that runs on solar energy, a battery, and helium.

Figure 5 Argyle Middle School students during the videoconference.

After all the schools made their presentations, there was a spirited question-and-answer session between the videoconference sites. An edited transcript of that is provided later in this publication. Please note that students are identified by either their first names only, or by the name of their school, to protect the privacy of the participants.

In closing, MTI's Trixie Johnson congratulated the students for the thought they put into their presentations and reminded them of Secretary Mineta's words; transportation is "…work that makes you feel good about what you're doing, because you're doing something to help people do what they need to do."

WELCOME AND INTRODUCTIONS

Participating schools and speakers of the fourth National Garrett Morgan Videoconference Symposium were welcomed by Rod Diridon, Executive Director of the Mineta Transportation Institute (MTI). Speaking directly to the students in San Jose, and via television to the other sites, Diridon talked about the symposium.

"The idea is to let you young people, who will be the leaders of our nation in the future, know how important it is for you to be involved in transportation as a career area," he said.

For thirty years, Rod Diridon has been a transportation advocate in Silicon Valley and California. He reminded the students that this is an important time in their education. "You need to take math and science programs in high school in order to take the college courses that will allow you to become transportation managers."

Diridon then introduced the three participating classes and their sponsors:

- Trixie Johnson, Research Director of the Mineta Transportation Institute (MTI), was at the SJSU Videoconference Center in San Jose with teacher Randall Landrith and his fifth and sixth grade class from Franklin-McKinley School District's Meadows Elementary School.
- Pam Boswell, Vice-President of Program Management and Education Services of the American Public Transportation Association (APTA), was at the Farragut Square videoconference center in Washington, D.C. with teacher Kimberly McLurkin-Harris and her seventh and eighth grade students from Argyle Middle School of Silver Spring, MD.
- John Horsley, Executive Director of the American Association of State Highway and Transportation Officials (AASHTO) and newly-elected chairman of the MTI Board of Trustees, was in Washington, D.C. with Tate Jackson, III, director of the AASHTO Transportation and Civil Engineering (TRAC) program involving 800 schools in 24 states nationally. They were with Matt Chew, substitute teacher for Barbara Musser's ninth graders from Leonardtown High School of Leonardtown, MD.

KEYNOTE ADDRESS—THE HON. NORMAN Y. MINETA

"America needs visionary, bright, young leaders in the transportation field."

With that statement, U.S. Secretary of Transportation Norman Y. Mineta challenged the youngsters to consider transportation as a career goal in their futures. He fondly recalled his years as a city council member, then mayor of San Jose, and as a member of Congress representing the Silicon Valley. "I wanted to pursue a career that would make a difference in people's lives; one that would be fun; one that would be interesting and challenging."

To this day, the secretary says, he still can't wait to get to his office at the U.S. Department of Transportation to help manage the issues facing America's vast transportation system.

Some interesting facts about the United States' transportation system:

- Americans travel 11 billion miles every day;
- 15 billion tons of goods and products move across our country every year; and
- 20 million people were working in the transportation sector in 2002, including automobile and aircraft manufacturing.

With those figures in mind, the secretary told the youngsters at the two sites in Washington, and the one in California, that they can fill an important need. "If we don't have educated and skilled people with fresh ideas and new solutions, we will all pay the price."

With that, Secretary Mineta cited the accomplishments of transportation pioneers like Henry Ford, Orville and Wilbur Wright, and Garrett Morgan, for whom the symposium is named.

Secretary Mineta urged students to "…think big, think big dreams, and always persevere, be ambitious… and go after a rewarding career and a rewarding job where you feel you're making a difference in society, and that's exactly the way my job makes me feel."

PROJECT PRESENTATIONS

Rod Diridon introduced MTI's Research Director Trixie Johnson, to facilitate the presentations of the three schools and the question-and-answer period afterwards. Johnson is a former San Jose planning commissioner, city council member, and vice-mayor, said Mr. Diridon, adding, "She's also a Phi Beta Kappa, which means very, very smart person through a master's degree, and she at one time was a teacher."

Figure 6 Executive Director Rod Diridon introduces MTI's Research Director Trixie Johnson.

Ms. Johnson talked briefly about the videoconference system, which is used when the MTI puts on graduate-level courses for college students all over California and outside the state.

"They'll go through an entire master's degree and never meet each other until they graduate, which is kind of cool, actually," she said.

When Ms. Johnson asked the students at all three locations how many of them planned to go to college, there was a nearly unanimous show of hands. She then set the format for presentations, moving from site to site in the videoconference, starting with students from Leonardtown High School participating from Washington, D.C.

LEONARDTOWN HIGH SCHOOL
CO_2-POWERED MAGLEV TRAIN

In the first presentation, four students used a poster-board diagram to propose a high-speed, non-polluting train, powered by carbon dioxide and using magnetic levitation (Maglev) instead of wheels.

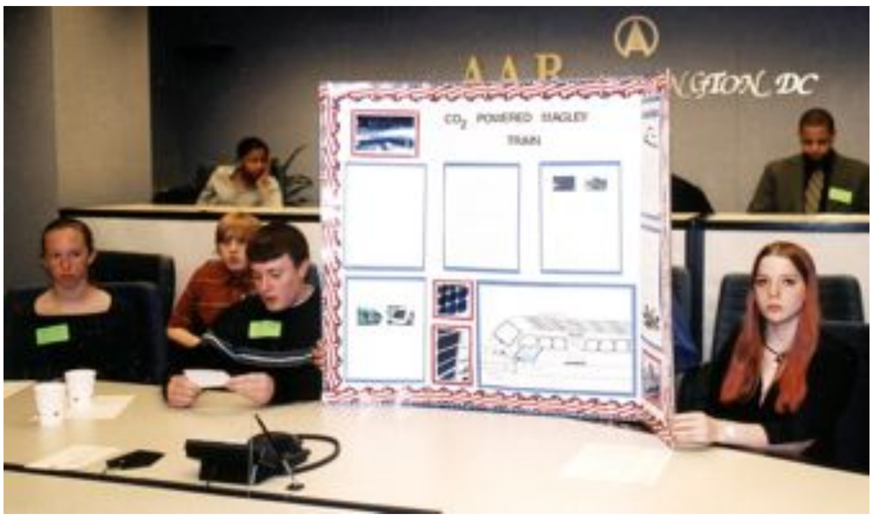


Figure 7 Leonardtown High School's presentation of a CO_2-powered Maglev train.

As the camera panned over to the poster board, it revealed a sketch of their proposed train: a rounded-nosed box with skirts where the wheels would be.

"It runs on a magnetic track and there's {sic} magnets on the bottom of the train... the magnets repel each other, which makes the train float in the air," a student explained.

Carbon dioxide pumped out of the front or rear of the train would drive it backward or forward. The diagram showed solar panels on the roof of the proposed train to provide electricity for passengers, as well as a back-up propulsion system.

The Leonardtown High School students propose that their train be made of lightweight steels, fiberglass, and plastics to promote its mobility.

Their presentation concluded with the specifications and cost of their CO_2-powered Maglev:

- Each train will carry 600 passengers;
- Each train will be made up of six cars, carrying 100 passengers each; and
- The first part of their magnetic railroad will cost $25 million-per-mile.

Seventy-five percent of the cost will go toward building the track, said the students, and the rest for the rolling stock. They justify the cost by saying their Maglev train doesn't pollute, is fast, and runs without needing electricity: in effect, relying on itself for propulsion.

During the question-and-answer period, John Horsley of AASHTO asked the Leonardtown team how soon their Maglev would come on the market.

A Leonardtown student replied, "We probably have the ability to make it, if we really wanted to make it... it would only take the building process."

Figure 8 Secretary Mineta (front row, left) looks on as Leonardtown students ask questions from the AASHTO site.

MEADOWS ELEMENTARY SCHOOL
"SKYWEB EXPRESS" SOLAR-POWERED MONORAIL TAXI

Five young students from Meadows Elementary School bounded to the front of the videoconference room and made a Power Point™ presentation about their SkyWeb Express.

Figure 9 Meadows School Team One shares their SkyWeb Express project with the symposium audience.

The computer screen, which was broadcast to the other videoconference sites, showed a bulbous red vehicle with large windows, running on a monorail, and carrying four passengers. A student explained, "The taxi is computer automated. Each station is off-line, allowing vehicles to travel directly to their location without stopping."

Students estimate the installation would cost $1.5 million. A second screen showed several pictures of SkyWeb, including the interior of each car, the tracks, and a station. The fifth and sixth graders presented very professional and polished PowerPoint™ graphics.

The SkyWeb Express is powered by solar energy and some electricity, said the students. Solar panels are mounted on the roof of each station, and there is a backup battery to run the taxis for 12 hours in an emergency.

A final screen outlined the benefits of SkyWeb:

- It helps the environment by using low amounts of generated electricity;
- It should replace a lot of cars on the streets, which will reduce the use of gasoline; and
- SkyWeb could reduce the number of automobile accidents.

During the question-and-answer period, David, from Argyle Middle School, asked the Meadow's fifth and sixth grade team, "What about the cost of the vehicle? Couldn't you just use a regular taxi, rather than the expensive–but still environmentally-friendly (car)?"

Answering for the Meadows youngsters, Trixie Johnson said the team was going for environmental friendliness. "They were saying the regular taxi would pollute, they wanted a car that would not pollute."

Leonardtown High students wondered about the practicality. One Leonardtown student asked, "It says it could only hold four people. How would this benefit rush-hour traffic?"

A Meadows student replied, "It's a good question. The taxis are quick; they come quickly after each other."

Trixie Johnson sought clarification: "They are so close together that the number of them can serve the capacity needed. They're running frequently. Therefore, they can handle the number. Is that your answer; did I interpret that correctly?"

"Yes, you did!" responded the Meadows student.

An Argyle student asked, "If the taxis are so close together, what would happen if one of the taxis broke, wouldn't that cause a whole line of crashed taxis?"

The Meadows student replied, “Well, they have sensors; they’re powered by one of these computers, so they would know, and they would probably use a different way to get to their destinations.”

Figure 10 Meadows School Team One relaxes after their presentation.

ARGYLE MIDDLE SCHOOL VACUUM-TUNNEL-ENHANCED MAGLEV TRAIN

The Argyle Middle School presentation started with an inspirational televised public service announcement that was played after the president’s recent “State of the Union” address. It showed images of people riding public transit to the song “It’s Your Thing” and ended with this statement: “Every day, public transit helps people do their thing, and when people thrive, communities thrive. *Public transportation: for wherever life takes you*.”

The Argyle presentation looked into the not-so-distant future, using experimental Maglev technology with a twist: vacuum tunnels along the route that would further enhance the speed of their trains.

Seventh grader David stated:

- Germany and Japan are experimenting with Maglev technology;
- Powerful on-board magnets let trains "float" over the trackway by 1-to-10 cm.;
- Strong electromagnets to the side of the guideway either repel or attract the vehicle, causing forward or reverse movement; and
- With little friction, trains travel at 500 km/hr.

Figure 11 Argyle Middle School team.

Seventh grade student, Alexis, used graphics to show the proposed design of their Maglev vehicle, with a sharply-pointed nose at the front and more square body to the rear. But it was their innovation that enhanced the Maglev's speed.

"What we plan to do is make a vacuum tunnel, making the train even faster than the record," a student explained.

According to Argyle School's proposal, the Maglev train would travel through tunnels where pumps have reduced the air pressure to an altitude of 15,000 meters. In this thinner air, there would be less resistance to forward motion. At the higher speeds, their Maglev would utilize small wings to aid stability.

Their presentation discussed safety issues:

- Maglev is 20 times safer than an airplane, 250 times safer than other railroads, and 700 times safer than traveling by highway;
- Their Maglev trains will travel in synchronization, at the same speed, limiting the chance of collisions;
- Guidance systems prevent derailments; and
- Trains are built of fireproof and low oxidant materials.

Trevis, a seventh grader at Argyle, said the Maglev train would have seating similar to contemporary metro transit, with ceiling handles and poles for use by standing passengers when the train is full. Passengers in wheelchairs would be locked in place for safety. He added, "The main concept of the Maglev train station is to relieve as much surface traffic as possible."

To this end, Trevis proposed 14-level garages for automobiles, half above and half below ground, and multiple boarding platforms to minimize congestion.

"In many urban areas, parking is an issue, so you just have limited parking spaces, and some people end up parking their vehicles millions of miles away from (the station)."

Pretha, an eighth grader at Argyle, spoke about the economics of Maglev. She said hydro-electric power would be used to run the trains; it's one-third the cost of nuclear or fossil-fuel power.

- The electromagnetic energy for levitating and propelling the train will cost $3.5 million dollars per mile of track;
- The partial cost of vacuum tunnels is $7 million, $500,000 per mile;
- Airlocks, to slow the train at stations, are $1 to $2 million each; and
- The Maglev guideway is $950 million.

During the question-and-answer period, Argyle fielded questions about tunnel safety and more:

A Leonardtown student asked, “How can an open-ended tunnel stay vacuumed?”

An Argyle student answered, “We maintain the vacuum tunnels and the vacuum and low pressurized air levels by the airlocks. The airlocks open and close behind the trains… also there are pumps located in the tunnels.”

The Meadows students and others wondered how the Argyle Maglev trains would use solar panels underground.

An Argyle student responded, “Our stations are made with the roof made out of glass so they can get light into the bottom of the station. The solar panels could use that light emitted from the sun, so they could use that power for backup.”

LEONARDTOWN HIGH SCHOOL
WIND-, SOLAR-, AND FUEL-CELL-POWERED JETLINER

Two Leonardtown High School students proposed a Boeing 737 with multiple sustainable power sources, rather than just fossil fuels. Using a large poster board, they showed how the jetliner would be propelled by electrical motors powered by:

- Solar panels on the wings and ailerons;
- Massive turbines also mounted on the wings and the rear of the jet; and
- Fuel cells for night flying.

The Leonardtown presentation team conceded that their jetliner might be too heavy to take off or stay in the air with the power-generating devices. Or, in the same vein, that their power sources might not produce enough energy. However, their concept is fuel-efficient and non-polluting.

They estimate the cost to be $141,000 for the power sources plus $60 million for the airplane itself. General Electric and NASA experimented with fuel-cell-powered airplanes in the mid-1960s. And while windmills have been around for 14 centuries, only recently have they become efficient enough to generate electricity as wind turbines.

Later, in the question-and-answer period, an Argyle student asked, “Would it cost more to maintain than the regular commercial planes already in the airports today?”

“Probably not,” responded a Leonardtown student, “because you have to think about the cost of gas–I think it’s around 6,000 gallons of gas–and so that just costs so much more than what solar panels and wind generators [would cost], because you only have to pay for them once and then you can use them for a while.”

Trixie Johnson concluded, “Okay, so they’re counting on the savings from petroleum-type fuels, which we know are getting more expensive.”

LEONARDTOWN HIGH SCHOOL
WIND-, SOLAR-, AND FUEL-CELL-POWERED JETLINER

An all-girl team from Meadows Elementary in San Jose used a PowerPoint™ presentation to propose a car that runs on solar energy, a battery, and helium. The fifth and sixth graders are concerned about the environment, stating “...we should have more solar-powered cars so that the air is less polluted.”

Their vehicle, called “The SPC&B-powered-car,” would get energy from solar panels in the morning, using the battery at night when there is no sun, and using the helium tanks as backup. The car would use little fossil fuel.

The girls explained, “…we are using too much gas, which we only have a certain amount of. [Our car] doesn’t let out any exhaust which causes a lot of pollution, so people will be happy since they won’t get sick.”

In their final slide, they spoke in unison, thanking their mothers, fathers, teachers, and most of all, “…our wonderful teacher, Mr. Landrith, for supporting us through all of this hard work. Thank you.”

Figure 12 Meadows School Team Two presents the SPC&B-Powered Car.

Afterwards, their SPC&B-powered car got the most comments and questions from the other schools on the video hook-up.

An Argyle student asked, “If the helium tanks are in the back of the car, is there still room for trunk space?”

A Meadows student explained, “You have some room for trunk space. The tanks are on the side, face down.”

A Leonardtown student said, “I was wondering, do you have to press a button to make the helium work?”

“If the battery runs out,” a Meadows student answered, “there would be some gas in the car, so it burns the helium to make the car go.”

Figure 13 Meadows Elementary School Team Two enjoys the event after their presentation.

QUESTIONS AND ANSWERS

The following is an edited transcript of the lively question-and-answer session that followed the presentation of the projects in the 2004 National Garrett Morgan Sustainable Transportation Symposium, which includes commentary, questions and answers from transportation professionals who were acting as moderators for each site. Some questions and answers appear immediately after each group's presentation; those answers are repeated in this section to ensure clarity from question to question.

Unfortunately, videoconferencing technology is not foolproof: often there were inaudible words and, more than once, a video site was disconnected. Also, students did not identify themselves when asking and answering questions, except for the Argyle Middle School team.

Trixie Johnson served as the moderator of the question-and-answer session from her San Jose location with the Meadows Elementary School students. Pam Boswell, Vice-President of Program Management and Education Services of the American Public Transportation Association (APTA), was with the Argyle Middle School students. John Horsley, Executive Director of the American Association of State Highway and Transportation Officials (AASHTO), moderated the Leonardtown High School students.

INTRODUCTION

Trixie Johnson: We're now going to have some discussion and that can be between, and among, the classes. You can ask each other questions, or you can ask questions of the transportation people who are here in the rooms with you—that would be me or Ms. Boswell, or Mr. Horsley. If you have some specifically transportation-oriented questions, we can probably help you out.

Q: **Meadows student**—I would like to ask the last group, the project that they're planning to have in the future, would it be efficient or no?

Ms. Johnson—This is a question to the last group in San Jose.

A: **Meadows student**—The cost of the vehicle would be $20- to $30,000.

Q: **Ms. Johnson**—They're saying the car would cost between $20- and $30,000. So you're talking cost efficiency and then?

A: **Meadows student**—It would be kind of heavy to do, but it would be light enough that it can run on the road with solar power.

Ms. Johnson—Okay, it would be a light enough car so that it wouldn't have to be carrying around all that weight, and that's part of its efficiency.

Figure 14 Meadows Elementary School fifth and sixth grade students at the end of a busy session.

Q: **Ms. Johnson**—Is there a question from APTA?

David, Argyle student—Yes, I do, about the SPB&C-powered car. If the helium tanks are in the back of the car, is there still room for trunk space?

A: **Meadows student**—You have some kind of trunk space. The tanks are on the side face down.

Q: **Leonardtown student**—I was wondering, do you have to press a button for the helium to work?

A: **Meadows student**—If the battery runs out, there would be gas in the car, so it burns the helium to make the car go.

Q: **Ms. Johnson**—It's actually a burning process? How do you start that? Is it with a key?

A: **Meadows student**—The helium is liquid.

Q: **Ms. Johnson**—It's liquid helium, so it would work like gas does in a car?

A: **Meadows student**—Yes, yes.

Ms. Johnson—Okay, that's their answer. Let's see, I still haven't had a question out of the AASHTO folks; I don't see a hand there. I've got a whole bunch of hands here in San Jose.

Q: **Meadows student**—On the solar-powered car, how many passengers can it take, or will there be a different amount in each car?

A: **Meadows student**—Three in the back, and two in the front.

Ms. Johnson—Okay, sort of like a standard car today. I do have a question back there at AASHTO, the lady in the pink.

Q: **Leonardtown student**—How fast can the helium-powered car go?

Ms. Johnson—You gals are getting all the questions, how fast can your car go?

A: **Meadows student**—It's normal speed just like a regular car. It goes up to 160 miles per hour.

Ms. Johnson—I think we just got an off-the-cuff answer of 160. I think the more honest answer came from the person to her right, who said that it would be just like a normal car. It's just a different way of propelling it.

Let's see, do we have questions from anywhere but San Jose? I've got lots of San Jose hands, these kids are eager here. Are there any questions out of Washington? They don't necessarily have to be questions about the projects, remember.

Q: **Mr. John Horsley, AASHTO**—Trixie, could I ask a question? We had two presentations about Maglev, magnetic levitation trains; one was hydrogen powered and the other one was solar powered. I'd like to ask each team whether they think the solar would be sooner to come to the market or the hydrogen power would be sooner to come to the market.

Ms. Johnson—Good question. He's asking how fast we can see these. Okay, this is the Maglev project, who wants to speak first?

A: **Leonardtown student**—Well, actually our train is magnetic powered and CO_2 powered, so we have solar panels and we have it powered by CO_2.

Q: **Mr. Horsley**—So, how soon will it come on the market?

A: **Leonardtown student**—I think it actually will take a while to actually build the train, but we actually probably have the ability to make it, if we really wanted to, so as soon as we started building it, it would only take the building process.

Q: **Ms. Johnson**—Okay, so you're using current solar panel technology or current CO_2 technology, compressed air technology?

A: **Leonardtown student**—Yes.

Q: **Ms. Johnson**—No new technology in yours–other than the Maglev, which is relatively new?

A: **Leonardtown student**—Yes.

Q: **Ms. Johnson**—And the other Maglev project from Argyle?

A: **Trevis, Argyle student**—Well, our Maglev will have the same current solar panel technology. It also has the hydrogen batteries, so they can produce electricity. We also have vacuum tunnels for our train to go faster. There is a project in Europe that's being formulated and it's called the Swiss Metro. They predicted that one of their trains in this tunnel could go up to 310 miles per hour.

Q: **Ms. Johnson**—Do you happen to know what energy they used to create the vacuum?

A: **Argyle student**—They used vacuum pumps to get it to be vacuumed and almost airless, and they have tunnels that are made out of fireproof materials as well. The magnets, instead of being located on the bottom of the Maglev, are located on the sides of the train, so it can make better turns.

Q: **Ms. Johnson**—So it's sort of like the current Maglev, but you're altering the deployment of the magnets?

A: **Argyle student**—Yes.

Ms. Johnson—Sounds like they're trying to stay with what we've got now. Okay, we have another question? Yes, the gentleman at Argyle.

Q: **David, Argyle student**—I have a question for the taxi monorail, what about the cost of the vehicle? Couldn't you just use a regular taxi, rather than the expensive– but still environmentally friendly (car)?

A: **Ms. Johnson**—Okay, who wants to answer that question from that team? Why did you design a special vehicle for your system? Why not use just a taxi? They were going for something that didn't pollute, so they were saying the regular taxi would pollute, they wanted a car that would not pollute.

Do we have somebody in Washington at the AASHTO site with a question?

Q: **Mr. Horsley**—I have another question for the group that made the presentation on the wind-powered and solar-powered airplane. I thought that was a fascinating idea, does this in part use glider technology, so that once it gets up in the air, it can stay in the air, like a glider? Have you looked at how you're going to sustain the plane in flight, when the clouds come over?

A: **Leonardtown student**—The wind turbines, when we're up in the air, would power the engines to keep the plane in the air.

Q: **Ms. Johnson**—Okay, so you're using the actual motion of the plane to kind of self-propel.

A: **Leonardtown student**—Yes.

Q: **Ms. Johnson**—All right, we have a question here in San Jose.

Meadows student—How would the solar panels work if it were in a tunnel?

Ms. Johnson—That's a question for the Argyle folks.

A: **David, Argyle student**—Well, as you can see, our Maglev also is powered by hydrogen batteries. In case it does go into a tunnel, it can keep moving.

Q: **Ms. Johnson**—Okay, so it's not always in the tunnel?

A: **Trevis, Argyle student**—No, and our stations are made with a glass roof, so they can get light into the bottom of the station. The solar panels could use that light emitted from the sun, so they can use that power for backup.

Ms. Johnson—Thank you. I had the same question when I was listening to you. Okay, how about another question from say, Argyle?

Q: **Argyle student**—This is for the taxi monorail. If it can only hold four people, how would this benefit rush hour traffic?

Ms. Johnson—What about a vehicle for four people in rush hour traffic? Who's going to answer that for me? I'm seeing a lot of grins, but no answers.

A: **Meadows student**—It's a good question. The taxis are quick. They come quickly after each other.

Q: **Ms. Johnson**—They are so close together that the number of them can serve the capacity needed. They're running frequently, therefore, they can handle the number. Is that your answer, did I interpret that correctly?

A: **Meadows student**—Yes, you did.

Q: **Ms. Johnson**—All right, here's a question from San Jose.

Meadows student—I would like to ask the San Jose group once again if you would you have any backup power, just in case of any emergencies?

A: **Ms. Johnson**—You're asking about the solar-powered, helium-battery car. The helium is the backup. If you're down on your helium, you have to go re-supply your helium, but basically they're saying the backup power is the helium power, that's what they would use.

Are there any further questions about the projects, or shall we move to more general questions about transportation?

Q: **Leonardtown student**—This is for the Maglev panels. How can an open-ended tunnel stay under vacuum?

Ms. Johnson—Okay, that's a question for you, Argyle. If your tunnels are open-ended for the trains going in and out, how do you maintain your vacuum?

A: **Trevis, Argyle student**—We maintain the vacuum tunnels and the vacuum and low pressurized air level by the airlocks. The airlocks open and close behind the trains, allowing the tunnels to still be as they are. Also, there are pumps located in the tunnels, so that it can maintain being a vacuum tunnel.

Ms. Johnson—The pumps are strong enough to accommodate the air movements that might occur was the answer.

Figure 15 A Meadows Elementary student listens to the proceedings from SJSU's Academic Technology Network Classroom

Q: **Meadows student**—This is for the judges. If we have solar panels, why aren't people using them?

Ms. Johnson—This is a more general question. If there are already solar panels, how come they're not being used in transportation as an energy source?

A: **Ms. Pam Boswell, APTA**—A lot of it has to do with the cost of development. Any time there's a new product put into service, there's a time when it needs research and development.

Ms. Johnson—I would have given roughly the same answer. There's research and development time, even if the panel exists, it would have to be altered to work for transportation. There's the question of how much power it draws, versus say, a very efficient diesel engine, or a very powerful fuel cell. Actually for the most part, the electric energy that's being studied for vehicles is looking toward using fuel cells. The most common fuel mentioned for those would be hydrogen, rather than solar power. Part of the answer also is the size the solar panel needs to be in order to collect enough energy to move something as heavy as a vehicle.

Q: **Leonardtown student**—I have a question about the Maglev. They were saying they're going to build the station and stuff underground, like twelve stories. Isn't their safety at risk?

Ms. Johnson—That's for Argyle, who had the underground stations. What about safety in an underground tunnel? I find that interesting coming from a student in the Washington, D.C. area where a lot of the Metro transit system is underground.

Argyle, we now have a question for your Maglev group, which is what about the safety for these activities that happen underground? How do you make the underground facility safe?

A: **David, Argyle student**—Yes, we will have steel arches to hold the ground above the trains, where it doesn't fall onto the Maglev. Steel arches and steel girders to keep it up.

Ms. Johnson—Okay, a well-supported underground facility.

Q: **Mr. Horsley**—Trixie, we have two other questions here.

Ms. Johnson—Let's go with one of your questions there at AASHTO. What's your next question?

Leonardtown student—For the Maglev group, how would the solar panels be underground and still be able to work?

A: **Trevis, Argyle student**—As we mentioned before, the station will have a glass roof, to allow light to come in from the sun, so at the station where the trains are, light can reach the solar panels. Also there probably will be solar panels on the station itself, so it can collect the energy and transmit it to the energy on the trains.

Ms. Johnson—Maglev is actually magnetism and that requires electricity to make the magnets work. That electricity doesn't have to be along every inch of the rail.

Q: **Leonardtown student**—When they say the solar panel is attached to the train, if you had the glass, would you have sunlight? Well, what if under the tunnel, a rock or buzzard fell on the glass, what if it breaks? What would happen then?

Ms. Johnson—This is a question for those who were using solar panels, but more particularly for Argyle. Solar panels made of glass can break. What happens if your solar panel is broken in some fashion? What's your backup?

A: **Trevis, Argyle student**—Our solar panels are not made of glass–the solar panels are regular–and the solar panels are on the glass roof, on the station. If something were to happen to those panels, we have a backup battery in the train itself. It's a hydro-battery, and that battery can create electricity for the train itself.

Ms. Johnson—There's an answer, backup power. We have a question from Argyle?

Q: **Argyle student**—The taxi monorail, if the taxis are so close together, what would happen if one of those taxis broke, wouldn't that cause a whole line of crashed taxis?

A: **Meadows student**—Well, they have sensors. They're powered by one of these computers. So they would know if there were a problem, and they will probably use a different way to get to their destinations.

Ms. Johnson—The answer is the whole system is controlled by a computer, so as soon as one car malfunctions, the computer handles the movements for the others and diverts them around the stalled vehicle. Okay, now a question in San Jose.

Q: **Meadows student**—I would like to ask about the taxi-monorail. Is it for something that you would drive, or does it just stop, more like a bus?

Ms. Johnson—Is it one you drive yourself, does someone else drive it, or is it self-propelled?

A: **Meadows student**—You just program it in and it will just take you there, and then you can get off.

Ms. Johnson—Essentially it's programmed, you program where you're going and it goes there, so it's computer run. I see a hand up there in Argyle, your question please?

Q: **Trevis, Argyle student**—I have a question for the airplane design group. Would it cost more to maintain than regular commercial planes already in the airports of today?

A: **Leonardtown student**—Probably not, because you have to think about the cost of the gas, how much gas, I think it's around 6,000 gallons of gas, and so that just costs so much more than solar panels or wind generators, because you only have to pay for them once, and then you can use them for awhile.

Ms. Johnson—So they're counting on the savings from petroleum-type fuels, which we know are getting more expensive. Okay, any other questions from Washington?

Mr. Horsley—There are three.

Ms. Johnson—Sooner or later I'd like to get to some general transportation questions here, as opposed to project questions.

Q: **Ms. Bosley**—I just want to throw this question out for all the teams. You hear a lot today about safety and security, and that's a priority for our industry in transportation. I heard a little bit in some of the presentations about safety, could each group just kind of address what the safety features are, in terms of protecting our customers and the public?

Ms. Johnson—I'm going to ask for one speaker from each project, be thinking about it, we'll go in the same order that you presented. So we'll start with the Leonardtown Maglev, so that's at AASHTO. What are the safety materials?

A: **Leonardtown student—**Well, I guess it will be close to that of the Metro. We haven't had any problems yet with the Metro, that I know of, so yes, it's pretty much the same as the Metro is doing right now, with, yes.

Q: **Ms. Johnson**—So, it's like a standard train system in terms of safety and security?

A: **Leonardtown student—**Yes.

Q: **Ms. Johnson**—The second project then, was the San Jose "SkyWeb Express." What about safety and security in your system?

A: **Meadows student**—Well, there aren't many accidents. It's not for pedestrians to walk on it anyway, and just by the small size of it, there shouldn't be any emergencies like sudden stops or anything.

Ms. Johnson—They're saying it's safer for pedestrians.

Meadows student—Because no one can walk on the rail or anything, no one should get hit by the taxi.

Q: **Ms. Johnson**—You're already covered the collision, because of the computer control. Okay, so how about safety and security at Argyle?

A: **Trevis, Argyle student**—We will have security available throughout the stations. For our station, the main part, there's three stories: the ground level–where people from the surface can get to the trains–they will have security there to monitor all activities; then below that is where other people will filter in–and that's where people can buy their cards and their tickets to board the train; and under that is where the actual train activity goes on and there will be security and police officers to monitor the boarding of the trains. The trains themselves are safe, because only sections of the track–for Maglevs in general–are turned on at the time. So collisions are virtually impossible.

Q: **Ms. Johnson**—And now, Leonardtown Number 2, the plane, safety and security?

A: **Leonardtown student**—It would be just like a normal plane, you'd go through metal detectors and have security guards, so it would just be the same. They're doing a pretty good job, but there's a slight risk of a plane actually crashing. As the Maglev people said, there are much more car accidents than plane.

Q: **Ms. Johnson**—Again, using pretty much the systems we have in place. Now, the final San Jose project, safety and security?

A: **Meadows student**—There's a {inaudible} and it will not go up, it will not blow up the tanks, and they will be reinforced.

Ms. Johnson—Their primary security concern was the helium tanks and those are reinforced containers to prevent them from exploding. Does that answer the question?

Q: **Ms. Johnson**—Let's see if we've got some general transportation questions. I have one. How many of you rode transit in the last week? That is, you went on a bus, or a train? Anybody? Nothing like that? Well, our class rode here by bus, so they can all answer that today. No fair!

Okay, how about you in Washington? At the AASHTO site, how many of you have been on transit in the last week? Either a bus or a train? Pretty fair proportion. Yes, they all came by bus, too, so that may be the wrong question. Then how about the Argyle kids, especially those who are at the APTA site?

Mr. Horsley—I didn't see anybody who didn't raise his or her hand. One of the features of American life, which kind of distinguishes us from most other countries, is that we tend to have more cars per household than anywhere else. In fact, in California we have more cars than we have drivers licensed to drive them. So I'm going to ask the question, when you grow up, when you are old enough to have your own car, and for the folks at Leonardtown, that's not too far away, how many of you expect to have a car by the time you're age 18, and to have that be the prominent way you get around? Let's see, all those hands are going up.

Ms. Johnson—Exactly. Then I'm going to ask a second question. Who's paying for it, you or your parents?

Q: **Ms. Johnson**—One of the things maybe we need to add to this curriculum is what it costs to drive a car in America today; it's getting more and more expensive to drive cars. I don't know about you in Washington, but the projections for us here in California are over the next few decades we're going to add as many as 30 more million people here, almost double in size. We have already, of course, many more people than any other state in the country, and we're starting to think about if everybody wants to drive their own automobile, how in the world are we going to accommodate 30 million more people, or even 20 million more people. It's a big question. You are, on the East Coast, living in very large cities with a lot of congestion and a lot of cars. You're not projected to grow quite like that, but everybody's expecting your traffic will only get worse. How do you think your projects will deal with congestion, and getting people around, when there are so many more people wanting to go somewhere? Anybody want to take that on? Why is your project better for congestion?

A: **Meadows student**—It's moving people.

Ms. Johnson—That was from here in San Jose.

Meadows student—I think we use too much gas if you go on the highway. Our car does not use gas at all.

Q: **Ms. Johnson**—They're saying it doesn't use gas, but how does that move them? Yes, it's good for the environment. But what if they're still all on the road, jammed up together in a traffic jam, and they're not moving?

A: **Meadows student**—They're stuck.

Ms. Johnson—So there it is, in fact. You're coming up on one of the toughest problems we're facing in urban areas now, and the question is whether there's a technological fix here.

Q: **Ms. Johnson**—Okay, second project in San Jose, have you got an answer as to how your idea deals with congestion?

Meadows student—The taxi-monorail is elevated above ground, so then the traffic can go underneath it like a bridge.

A: **Ms. Johnson**—They're actually adding capacity, because their sky cab runs on a monorail above ground so it doesn't take up existing space. It adds new space, so they're saying that's how they help with congestion.

Q: **Ms. Johnson**—How about the other projects? How do you think your project will help deal with congestion?

A: **Meadows student**—Okay, ours is mass transit so it can hold a bunch of people.

Ms. Johnson—Okay, get him out of his little car and put him in a big vehicle.

Meadows student—It gets many people off of the roads, and it goes fast, which would replace people driving across the country. Also, it will be very easily accessible and convenient, so more people will want to ride it.

Ms. Johnson—If you make it, they will come; and they'll get out of their cars to do so. All right, how about the other projects?

Leonardtown student—Well, our (airplane) project, since these ideas were cheaper than gas, we might be able to lower the cost of the tickets, so more people would ride the planes, rather than driving for a far distance.

Q: **Leonardtown student**—Actually, are there any by-products or waste associated with their vehicle or their transportation system. Is there anything that you guys can think of that would be a by-product of your transportation?

Ms. Johnson—This was a question directed to the projects and the question is, what about waste by-products from your vehicles or your transportation system? What are you doing that is the equivalent of what a car puts out of the exhaust pipe? And are you pollution free or what kind of pollution do you create? Okay, we'll start with the AASHTO site up there—how about pollution from your projects?

A: **Leonardtown student**—Our project, the Maglev power train is non-polluting, so we wouldn't have any by-products.

Q: **Ms. Johnson**—What about the carbon dioxide, which is a greenhouse gas?

A: **Leonardtown student**—Yes, I guess there would be a little bit. The only thing we know is that with compressed air, it comes in the tanks and you have to worry about the tanks and everything, but our train makes it own compressed air.

Q: **Ms. Johnson**—How about the other projects, the plane project, while we've got you on screen? What about your pollution by-product?

A: **Leonardtown student**—Well, the gas always gave out pollution, but with the solar panels, it doesn't and also the wind turbines don't. The fuel cells, I don't believe give out any pollution.

Ms. Johnson—There is an issue always with fuel cells about, at the end of their life, how they're disposed of, which potentially has some problems. I just mentioned and throw in there, that airplanes are hugely polluting right now. If you've ever watched a plane take off, you see the exhaust coming out of the back of the plane, it's very thick, very heavy, and if you take air pollution measurements around an airport, they're very heavily impacted. They have an issue, however, with how the engines work. Obviously the primary thing an airplane worries about is getting off the ground and staying flying. The pollution becomes secondary. So there is a lot of work going on now, a lot of research, about how to deal with airplane pollution.

Q: **Ms. Johnson**—Okay, let's talk about the two San Jose projects and their pollution prevention.

A: **Meadows student—**Ours is pollution free, because we're not using any gas, we're using solar power.

Ms. Johnson—Since it's solar powered, there's no pollution. That's the "SkyWeb Express." Okay, and the other?

Meadows student—With our project, it doesn't use any pollutants because of the helium tank. Our car will use that helium, so then there's no gas at all and you don't have to wait until you're out of gas.

Ms. Johnson—The one with the helium and the battery also uses no gas, so there is no pollution of the kind that we're used to. Okay, we've got just a few more minutes for questions here, let's go one more round, and then we can wrap it up here. Yes, in the back?

Q: **Leonardtown student**—What would be the total cost for the station, for the train, and how would you plan to get this cash?

Ms. Johnson—They're asking a question, I think this must have been for Argyle, because she mentioned particularly the stations and you made a lot about the stations in your presentation, the high level, multiple level stations, and the question was about cost and how you think it would be financed, who would pay for it? Leonardtown (also) had a Maglev, do you want to talk a little bit about the cost of a Maglev station or system?

A: **Leonardtown student**—Yes, it wouldn't be the cheapest thing to start building, but after a while it relies on itself, it doesn't really cost (for) gas or anything. So it would cost in the beginning, but then later on, it would actually be cost effective.

Ms. Johnson—So higher capital costs, lower operating costs, if you're using the standard terms?

Leonardtown student—Yes.

Ms. Johnson—Higher to build, lower to operate. A lot of the costs for transit aren't related to building the buses or the light rail vehicles, or the track; they're for the operators who run them every day. It's the people costs of the system that generally are the largest part of the cost over time.

Q: **Leonardtown student**—Our question is like, well for like the car that runs off the helium, how and where would you go to get your tank refilled? Do they have like gas stations that you can go to? Or would you have a guy run house to house and to your car, how would they do that?

Ms. Johnson—That was a question for filling the helium. We didn't get the last part of your question.

A: **Meadows student**—There are stations right there, and you fill it.

Ms. Johnson—It would be a station system, much like for gasoline, where you'd fill it. The same I think is being discussed for hydrogen, if we were to go to fuel cells. There would be some kind of a network of fueling stations that would be required. Okay, let's see, I have a question here in front?

Q: **Meadows student**—I don't know which it is, but one of the Maglevs said that (it would cost) $25 million dollars per mile. Why did they want to pay so much?

A: **Leonardtown student**—Because it's environmentally friendly, and in the long run, it will be non-polluting and it would be a lot more efficient than any other train. It's just efficient.

Q: **Ms. Johnson**—The efficiency would sell it over time. Is Argyle with us? How about your Maglev system? If Maglev is going to cost so much to build, why would people want to build it?

A: **Trevis, Argyle student**—Well, it gets them there faster to where they want to go, and it costs more to build airplanes, to maintain cars in the airports and other trains station. So, I don't think Maglev would be such a big problem and an issue about price. Because if you get a person to where they want to go faster and seat more people, and you have revenues in the station, you're able to receive more of a profit than what you spent.

David, Argyle student—And also, as time goes by, the price of making the Maglev will decrease, because it will become more common. So it won't be so rare and valuable.

Ms. Johnson—It's always more expensive to start something new. That's a good observation. And that's true of any system that we would be using. Okay, a couple more questions.

Q: **Leonardtown student**—For the Argyle group, is their project basically more about money, or more about helping the environment?

Ms. Johnson—For the Argyle group, she has a question about what benefits more from your project. Is it because it's economical, or the economics of the project, or because of any environmental advantages that it offers? Because if it's better environmentally, what do you think sells it the most?

A: **Argyle student**—Better environmentally, because it doesn't pollute; it doesn't produce pollution. And as we said before, it does cost a lot of money, but it is efficient to the environment.

Argyle student—And also, Maglev runs quieter. The vibrations caused by the Maglev? You can barely feel them. They cut down on noise pollution, as well.

Ms. Johnson—That's a good point. If you live near a train system where it's steel wheels on steel rails, you understand the noise pollution idea. Okay, let's go to a question here in San Jose.

Q: **Meadows student**—The one that's from Argyle, the Maglev, at $25 million dollars a mile, who would be able to pay that for the Maglev?

A: **Trevis, Argyle student**—Taxes will probably pay most of it, fundraisers will pay a little bit, and also corporations might put in investments for the idea, and that's where the money will come from to build the tracks.

Ms. Johnson—Let's see, have we got any other questions there in Washington, D.C. before I come back to San Jose? Let's go to AASHTO. You have a question there, John?

Q: **Leonardtown student**—About the helium car, I know that helium is flammable, if it got into an accident, couldn't it be dangerous to other people?

A: **Meadows student**—The helium is only for backup. If for some reason the battery runs out, like if you're driving the car all day long, then the helium tanks come in.

Q: **Ms. Johnson**—I think his question was more, say you had an accident and the helium tank ruptured, can it explode or have fires? Are you concerned about that?

A: **Meadows student**—It's in its tank and it's liquid.

Ms. Johnson—So, for one thing is liquid, as opposed to gas, and it's sealed, which makes it less flammable, and it's sealed in a very strong tank. So they're hoping they've engineered their way around the problem. Engineers will usually tell you they can engineer anything, if you'll pay them enough.

Q: **Leonardtown student**—In the Maglev, where would you get all the magnets?

Ms. Johnson—There's a question about the magnets used for the Maglev. The question is, where do you get them? How are they supplied? Where do magnets come from, or the type of magnets that are used for this kind of system? We can take it from either Maglev project. Let's go to, since we have the picture there from AASHTO, your Maglev project, if you have an answer.

A: **Leonardtown student**—You can actually make a magnet. If you take a nail or something and wrap wire around it and run electricity through it, it actually makes a magnet. So you don't actually go and get a certain kind of rock or something.

Ms. Johnson—It's electrically-created magnetism is what she's saying.

Leonardtown student—Yes.

Q: **Ms. Johnson**—Thank you. Argyle, did you have a different response? The question was where do you get your magnets, or I might expand that, your magnetism to run your Maglev train?

A: **Trevis, Argyle student**—Magnets, they're supplied by our engineers. They can make the magnets for you to place on the tracks, as powerful as you want them, and they can charge them. Magnetism, if you put two of the same types of magnets, for example, if they're both negative, they will repel each other and cause the train to go forward.

Ms. Johnson—So it's done by electric charges as opposed to what you're thinking of, the physical magnet again. So the same answer basically as we had from the other site. We have any other general transportation questions here?

Q: **Pretha, Argyle student**—Could each group say how many jobs approximately would be created or sustained if your project were to be implemented?

Ms. Johnson—The question has to do with job creation, that's a very good question. One of the arguments for putting a lot of transportation money in budgets at the federal and the state level, especially when you're in tough economic times, is that it does create a lot of jobs. Have you thought about the kinds of jobs that would happen if your system were to be built? And I don't know that they necessarily thought about that, but it's off the top of your head, what kinds of jobs do you think we're talking about and how many? Okay, San Jose?

A: **Meadows student**—I think tens of thousands, because there would have to be maintenance and someone would have to do planning to make sure everything is secure and then do {inaudible}. And some people would have to maintain the master computer.

Ms. Johnson—Okay, the "SkyWeb Express" team has identified jobs building, maintaining, and running the system. So, they'd have basically three different kinds of jobs, she said tens of thousands.

Q: **Ms. Johnson**—How about the other San Jose project–jobs?

A: **Meadows student**—Engineers and lawyers.

Ms. Johnson—Engineering and lawyers. Would there be manufacturing involved in the solar panels and for the helium tanks, and getting the helium into liquid form and marketed? So there would be a lot of jobs, both building their car and then after it's going. You have to keep the helium system operating.

Q: **Ms. Johnson**—Let's go to Washington. What about jobs with your activities? What kinds of jobs, how many?

A: **Leonardtown student**—For the Maglev train, it's going to be computer.

Ms. Johnson—Computer operated?

Leonardtown student—Yes. The maintenance, the people that work on the train and so on, might need help, 500 at the most, just working on the train.

Ms. Johnson—Okay, and then of course, people to build it?

Leonardtown student—That's it.

Ms. Johnson—So fairly low operating costs and personnel is what he's saying for the Maglev.

Q: **Ms. Johnson**—Okay, what about the plane system? Jobs?

A: **Leonardtown student**—Yes, you need to get more pilots to pilot the plane and then the people to build the planes and then to fix the planes. Then if you wanted to add more security, you'd have to get more security people, and so it could create quite a bit of jobs.

Ms. Johnson—It's new manufacturing jobs, I think is what I heard. Okay, I think I'm going to take maybe one more question from each place and then we'll thank everybody for joining us. So fight amongst yourselves and I'm going to go to the AASHTO site, for one more question, who's going to get it? Okay, the fellow in the back.

Q: **Leonardtown student**—My question is regarding the batteries, is that going to be rechargeable or after over a period of time, like a normal car battery, where you have to replace it, and how would you dispose of it? Because you don't want the battery acid to leak out and go into our soil and mess us up like that.

A: **Ms. Johnson**—This is a question for the battery helium car, what about your batteries? They are rechargeable batteries and the helium stations would handle changing them in and out, so you'd have a secure disposal site. One more question from San Jose, who's going to be up, we haven't had a question from you yet?

Q: **Meadows student**—(question about computer problem danger on Maglev).

Ms. Johnson—The question would be for the computer-controlled Maglev trains. What about malfunctions? What kind of safety do you have built in, if your computer malfunctions? What is your backup? What do you do for safety if the computer goes down?

A: **David, Argyle student**—If the computer goes down, we would also have a manual driver, just in case, to speed the Maglev along to the nearest station so that it can be repaired.

Trevis, Argyle student—Also to prevent collision, the magnets will be turned off. The train can be on standby so rescue crews can reach the train in time to try and repair the problem.

Ms. Johnson—So in essence, the system has a shutdown feature?

Argyle student—Yes, yes.

Q: **Ms. Johnson—**How about the other Maglev, at the AASHTO site?

A: **Leonardtown student—**Well, if there's electric failure, there would be solar panels to keep it going. And if the computer goes down, it will automatically shut it down and get people to work on it and fix it as fast as possible.

Ms. Johnson—We always know that computers are going to go down some time, so you better be thinking about what happens if they do, especially a computer that controls something that important.

CONCLUSION

Ms. Johnson—I think we have reached the end of our questions.

You have been very engaging and you certainly have given a lot of thought to the kinds of systems that might power vehicles and what they might look like in the future. You have, I hope, learned what it means to be sustainable. That is, something that, when you start having children, you're still turning over to them the kind of world that's at least as clean as you inherited, if not better, and a place that people can still enjoy. That's a big charge for your generation and I must say my generation hasn't made your job very easy, so I'm wishing you all good luck.

I hope you're all thinking about taking math and science all through high school, and thinking about when you get to college, the kinds of careers that would help you think about transportation, so you could join the 20 million people that Secretary Mineta mentioned, who now have their jobs somewhere in the transportation field. It's a good place to work, I really love the work that I do, and I know that John (Horsley) does, and Pam (Boswell) does as well. Part of that is because of what Secretary Mineta said. It's work that makes you feel good about what you're doing, because you're doing something to help people do what they need to do. That's always something that makes you feel better.

So we hope you'll think about that and we want to thank you, and especially the teachers in each of the classrooms, for helping us make this project possible. Thank you very much for joining us.

Figure 16 Winners of the 2004 Garret Morgan Sustainable Transportation Symposium, Argyle Middle School, and their teacher, Ms. Kimberly McLurkin-Harris, are congratulated by MTI's Research Director Trixie Johnson and Congressman James L. Oberstar.

ABBREVIATIONS AND ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
APTA	American Public Transportation Association
Maglev	**Mag**netically **Lev**itated Vehicle (A high-speed transport system that is independent of wheel-and-rail friction. Trains run on superconducting magnets and linear motor technology.)
MTI	Mineta Transportation Institute
NASA	National Aeronautics and Space Administration
SJSU	San José State University
SPC&B-powered car	Solar Power and Battery-Powered Car (Meadows Middle School project)
TRAC	AASHTO's Transportation and Civil Engineering program

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