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MTI

Twelfth Annual Garrett Morgan Sustainable Transportation Symposium

Report S-12-02

March 2012

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The Norman Y. Mineta International Institute for Surface Transportation Policy Studies was established by Congress in the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). The Institute's Board of Trustees revised the name to Mineta Transportation Institute (MTI) in 1996. 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.

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TWELFTH ANNUAL GARRETT MORGAN SUSTAINABLE TRANSPORTATION SYMPOSIUM

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ACKNOWLEDGMENTS

The Mineta Transportation Institute thanks the following individuals and their agencies for their unwavering ongoing support and sponsorship for the Eleventh Annual Garrett Morgan Sustainable Transportation Symposium, which was held on March 30, 2011. Without their contribution of time and resources, this innovative videoconference educational symposium simply would not be the success it is today.

Thank you to Caltrans Director Cindy McKim; Caltrans Chief Deputy Director Malcolm Dougherty; Caltrans Deputy Director Bijan Sartipi, District 4; John Horsley, CEO, American Association of State Highway and Transportation Officials (AASHTO); United States Secretary of Transportation Norman Y. Mineta (ret.) and current Secretary of Transportation Ray LaHood.

Thank you to this year's classroom sponsors and their organizations: Emma Cleveland, Caltrans District 1; Alfonso Miles, Caltrans District 4; Marcela Anderson, Caltrans District 10; Sarah Serdienis and Stella Lin, Orange County Transportation Authority; Linda Clifton and Tequamech Tadesse, AASHTO, and Cheryl Pyatt, APTA

Thank you to this year's participating schools, their teachers and transportation agency sponsors for contributing to the education of tomorrow's transportation industry professionals: Edna Brewer Middle School, Oakland CA, teacher Amy Martinez; Monument Middle School, Rio Dell CA, teacher Sheryl Steiner; Morada Middle School, Stockton CA, teacher Aaron Saas; Redland Middle School, Rockville MD, teacher Kimberly McLurkin; St. Callistus School, Garden Grove CA, teacher Joy Martin; and Tupelo Middle School, Tupelo MS, teacher Julia Smith.

Sincere thanks to the technicians at each videoconference site, whose technical know-how and troubleshooting allowed this coast-to-coast video-conference.

As always, MTI thanks the Honorable Norman Y. Mineta for his unwavering support for this event and for promoting the transportation industry as a viable future for young people.

For their work in producing this event and its report, thanks to the MTI staff, including Director of Communications and Technology Transfer Donna Maurillo, Student Publications Assistant Sahil Rahimi, and Webmaster Frances Cherman, who also provided editorial and design support. Transcription services were provided by Meg Dastrup of Word Power Plus.

Please note that all research for this symposium was performed by middle school students, and the Mineta Transportation Institute cannot verify the content accuracy of each group's presentation.

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FOREWORD

It is our pleasure to present this edited transcript from the Eleventh Annual Garrett Morgan Sustainable Transportation Symposium, which was held March 27, 2012. This event is central to the Mineta Transportation Institute's ongoing goal to provide information and technology transfer. Middle school students are this event's target audience, because they are transportation's future leaders and innovators.

There is no doubt that transportation is a growth industry in both the public and private sector. Our nation has a renewed interest in improving and expanding public transportation, on repairing and improving our existing highway and rail systems, and creating modes of sustainable transportation. This will offer opportunities in all areas of transportation planning, from engineers and urban planners to policy managers and communications professionals.

Where will those talented professionals come from? No doubt, past and future participants in the Garrett Morgan Sustainable Transportation Symposium will provided a good start! Every year the projects are more original and visionary, and each year it is more difficult to select a winner! Students faced many challenges as they conceived and created their sustainable transportation entries for this competition. It compelled them to use many of the skills that are required of transportation professionals—math, physics, chemistry and other sciences, and of course, excellent communications skills.

I'm happy to congratulate all students. They met the challenge. I also to extend my personal thanks to those individuals included in the acknowledgements section. Without each of them, this educational opportunity simply would not have happened.

Sincerely,

Rod Diridon, Sr.
Executive Director
Mineta Transportation Institute

EXECUTIVE SUMMARY

On March 27, 2012, the Mineta Transportation Institute (MTI) continued its support of the United States Department of Transportation's Garrett A. Morgan Technology and Transportation Futures Program by conducting the Twelfth Annual National Garrett Morgan Symposium and Videoconference on Sustainable Transportation. The purpose of this national videoconference is to stimulate young people's minds and encourage them to pursue the academic programs that will prepare them for professional careers in transportation engineering, planning, administration, and technology.

Purpose

The Garrett A. Morgan Technology and Transportation Futures Program was established in 1997 by former U.S. Secretary of Transportation Rodney E. Slater. The program has three cornerstone components:

- To establish a partnership among the U.S. Department of Transportation, state departments of transportation, public and private transportation providers and local communities to ensure that today's students are prepared to become the next generation of transportation leaders
- To develop a curriculum that can interest younger students in transportation and provide learning tools that can guide them to advanced academic and professional levels
- To provide the technologies that will enable students to develop skills that they can apply to future careers in transportation

Participating Schools

This year's videoconference schools included:

- Edna Brewer Middle School, Oakland, CA
- Monument Middle School, Rio Dell, CA
- Morada Middle School, Stockton, CA
- • Redland Middle School, Rockville, MD
- St. Callistus School, Garden Grove, CA
- Tupelo Middle School (two teams), Tupelo, MS

Event Highlights

The students were welcomed by MTI's Communications Director Donna Maurillo, American Association of State Highway and Transportation Officials CEO John Horsley, and Caltrans Chief Deputy Director Malcolm Dougherty. Ms. Maurillo moderated.

She reminded the students that today's activities today are to encourage middle-school students to take technical classes in math and science in high school and direct their interests toward transportation. Then they can qualify for the technical courses in college that will then allow them to become transportation professionals, building US transportation systems in the future.

Pamela Boswell of the American Public Transportation Association (APTA) welcomed the students, teachers, and others on behalf of APTA president Michael Melaniphy who could not attend.

Students were also addressed by retired United States Secretary of Transportation Norman Y. Mineta and current Secretary of Transportation Ray LaHood, who appeared via videoconference link from the US Department of Transportation site in Washington DC. Each school was allowed to ask one question of Secretary LaHood, who engaged with the students and provided encouragement to complete their educations.

This year's research student presentations included the "Mazu SI" – a methane-and-solar-ink-powered car; a Green Plan for the city of Rio Dell, CA, to convert city vehicles from gas to electric and install an electric charge station for city and public use; a biofuel/hybrid school bus; a multifuel-injection system for buses; a sustainable-energy vanpool, a solar/wind/water-powered train; and a "flying airport."

A lively question-and-answer period followed each presentation, with each school asking questions of the presenting team. Extra points were awarded to schools for each of their questions and answers. The winning team was announced a week later. Teacher Aaron Saas and representatives from his Caltrans District 10 winning team traveled to San Jose, CA, in June to attend MTI's annual scholarship banquet and to accept the grand prize cash award and a plaque.

A biography of Garrett Augustus Morgan is included as Appendix A.

A video of this symposium in its entirety can be downloaded from http://dot.ca.gov/research/planning/garrett_morgan_symposium/garrett_morgan_progam.htm

INTRODUCTIONS

ROD DIRIDON

This is the twelfth annual Garrett Morgan videoconference competition between junior high school-grade students across the nation.

This event commemorates Garrett Morgan, who was one of the finest and most remarkable inventors of the last century, an African American gentleman we should all emulate. We especially honor Secretaries LaHood and Mineta with him, who will be introduced a little later. And we're really excited and happy to be hosting the next generation of transportation leaders from across the nation, who will present their concepts for the future. We wish them good luck, not only today, but in their careers. It's now my honor to introduce Donna Maurillo. Donna is the director of communications and special projects and technology-transfer for the Mineta Transportation Institute, and she organized this event. Donna?

Figure 1. MTI's Donna Maurillo and Rod Diridon anchor the competition broadcast from the Caltrans site in Oakland CA.

DONNA MAURILLO

Thank you, Rod. As Rod mentioned, this is our twelfth annual competition specifically for junior high school students, and today we have students from California, Mississippi and Maryland, and you'll all be – we'll all be – broadcasting today from a couple of our sites.

Now I would like to remind everybody, first of all, please turn off your cell phones, so that we don't have any interruptions. Second, avoid talking during the broadcast unless you are on camera, because once in while a mic might be on accidentally, and we've had some

talkover previously. So try to avoid talking unless you're absolutely sure that your mic is off, okay?

For our competition today, you'll be presenting your sustainable-transportation projects, and the winning team will be given a trip to San Jose, California, June 23, which is a Saturday. You can have a teacher and a parent and one of the students, or a teacher and two students, and you'll spend the night at a hotel in San Jose. You'll attend the awards banquet where you'll receive your plaque and a thousand-dollar cash award for your classroom. The second- and third-place teams will receive a plaque. And if there are any questions about the competition, I think we've made it all clear previously with your teachers. So we will go on to Washington, DC, where Pamela Boswell is representing the American Public Transportation Association. We'll proceed from here. So thank you, Pam.

PAMELA BOSWELL

Thank you, Donna. Good afternoon. On behalf of the American Public Transportation Association, APTA, I welcome our students, teachers and transportation colleagues to today's event. APTA has been pleased to partner with the Mineta Transportation Institute for the last several years on this event.

Our president, Michael Melaniphy, wanted to be here today, but he is recovering from surgery, and sends his best regards.

[To the students] Congratulations on working on your sustainable-transportation projects, and being able to participate in this national competition. We look to you as the future of our transportation industry. We look to you as innovators in taking our industry to the next level as you work in the transportation industry. We stand ready to work with you, to support you in those endeavors.

Now I have the honor and privilege of introducing our next speaker. The Honorable Norman Y. Mineta is the 14th United States Transportation Secretary, with the distinction of serving the longest as secretary in our nation's history.

Secretary Mineta has had a long and distinguished career in public service. He served as the mayor of San Jose, California; as a member of the United States House of Representatives, where he championed federal investment in transportation and infrastructure. He also had the opportunity in his busy schedule to serve as the United States Secretary of Commerce. We are very pleased to be with you today, Mr. Secretary, and all, please join me in welcoming him. Thank you!

SECRETARY NORMAN Y. MINETA

Pamela, thank you very much for your kind introduction. And maybe there's something about those of us in the transportation business, Rod, where we're having problems with our throats. Today, I think I'm just about ready to come down with a cold, so I'll try to make sure that I get through this introduction.

I want to welcome all of the students, two teams from Tupelo, Mississippi, as well as the team from Rockville, Maryland. It's great to have you all here.

It's my privilege today to introduce the present secretary of transportation, who has had a wonderful background in public service. He was a teacher, and then he became head of a youth-services bureau in his hometown, in his home county; and then became the district director for a very good friend of mine, Congressman Tom Railsback. And he served in that capacity for a number of years, and then had the opportunity to come here to Washington, DC, to become the – at the time – administrative assistant; but eventually became the chief of staff for the Republican [minority] leader, a wonderful, wonderful person by the name of Bob Michel. And Secretary LaHood was in that position until 1994, when he was elected to Congress to take the place of his boss, Republican leader Bob Michel.

When he came to Congress, I had the privilege of chairing the public works and transportation committee; and so when he joined the committee, the committee had changed its name to transportation and infrastructure, and Congressman LaHood really did a great job on that committee.

Then, in 2009, President Obama picked Ray LaHood to become the next secretary of transportation. So Secretary LaHood is now the 16th transportation secretary, and has done a great job in that position.

He has also been one of those who's been encouraging young people to look to transportation as a future career; and the fact that all of you have taken this interest in the work that you do through your schools, I think, is something that excites him, as well. I know it does me to see the tremendous work that all of you have put into it, in terms of your time and effort, in thinking up these wonderful, great projects that you have put together. So it is now my privilege to introduce to you a wonderful person, the sixteenth secretary of transportation, and my very good, friend, Secretary Ray LaHood. Ray?

SECRETARY RAY LAHOOD

Well, good noontime, everybody! Good afternoon. Welcome to those that are gathered at the department, and welcome to those that are watching by video conference.

I know that most of you know that you wouldn't be here if it weren't for the great leadership of Secretary Mineta, and the idea for a program to get young people involved in transportation. Get young people involved in thinking about transportation. Get young people involved in thinking of good ways to solve transportation issues. And that's really what this program is about. Whenever I have been asked to participate, I have done that. This is my third year in a row, and I'm delighted to be here, and participate, and to say to all of you, you're all very lucky to be participating in such a wonderful program, and really thinking about transportation.

So, Norm, thank you for your vision and leadership in really engaging young people in the kind of opportunities where they can think about transportation, think about careers, think

about how there might be some opportunities for them. And to our friends in the transit organization, thank you for your leadership in hosting this, and making this happen.

I just want to talk for a minute or two about a few things in transportation, and then see if there are some questions that we might answer that you've all been thinking about. What I really want to have all of you think about is that you're in Washington, DC, those of you that are gathered at DOT; and for those of you that are watching by videoconference, at a time when – if it's not the number-one topic, it certainly is at the top of everybody's agenda – and that's transportation.

And what I mean by that is that Congress is trying to figure out how to pass a transportation bill, a bill that would allocate money for programs for roads, for bridges, for transit, for airport activities, whether they be tarmac or runways, and trying to find the resources, the money, so that we can continue to make progress in transportation.

Transportation has always been about how to deliver people around the country and around the world, and some of that will take place on our roads. Some of it will take place on bridges. Some of it will take place by air, by train, by light rail; and all of these activities require the kind of planning so that people have different kinds of transportation.

People that need to drive will have good roads. People that need to fly will have a safe passage by way of airplanes. People that need to use trains, as we do here in Washington, DC, with one of the great metro systems anywhere in the country, where you can board a train in Washington, and get anywhere in this region, because people have had good planning, and good activities.

So the Congress is thinking about the future of transportation, and what, really, are the next activities. All of this centers around the idea of safety. Think about the thousands of people who woke up today, on their way to work or school, on their way to a doctor's appointment, on their way to a grocery store or a drug store, on their way to run errands. Some of them went by car. Some of them went by plane. Some of them went by train. Some of them went by motorcoach.

Almost none of those people thought about the idea, "Is this gonna be safe?" And that's one thing that we do at the Department of Transportation. We think about safety – in trains, and planes, in automobiles, and motorcoaches, big trucks. We want to make sure that pilots are well-trained when they're flying planes, and that the planes are mechanically okay. So we have people thinking about that. We have people thinking about making sure that our trains and light rail and street cars are being operated by people who are well-trained, and that they're mechanically okay. We want to make sure that safety is number one in every form of transportation in America, so that, when we talk about transportation, we also are talking about safety, and making sure that all transportation is safe.

One of the issues that we've taken on is the issue of distracted driving – the issue of whether people can really drive safely, either drive a train or a bus or their car, while they're also trying to text or while they're on a cell phone. And we know that people can't drive safely, whether it's a train or a motorcoach or their own car, if they're distracted by texting

or using a cell phone. So we've taken that on as one of our real signature issues here as far as safety goes.

And we know that the work that we do on safety can make a difference. Twenty years ago, nobody was buckling up when they got in a car. Because of the work of Secretary Mineta and Secretary Dole and others that came before us, they initiated a program called "Click It or Ticket." In over 20 years, people were persuaded to buckle their seat belt when they got in a car. It took 20 years. Now 86 percent of the people, the first thing they do when they get in a car is buckle up. So we've made progress.

We've also made progress in taking drunk drivers off the road by developing a standard called .08, that, if you're above that level in your blood-alcohol level, it means that you can't drive safely. And police have really stepped up their enforcement. Good laws have been passed. So, today, we've taken a lot of drunk drivers off the road.

So we've made progress in safety. We've worked very hard on making sure that motor-coaches, buses that people ride on, are safe, and that the bus companies have well-trained people. So I want you to leave here with the idea that we work on a lot of different transportation issues, always with safety as the number-one part of our agenda.

So, as Congress is deliberating a transportation bill, and, as you read about that here in Washington, I want you to know that Congress is thinking about that, too. So why don't we stop and see what questions there are. I know we'll have some questions from some of our folks who are tuned in by videoconference, and from [audio distortion]. So however you want to proceed here.

Q&A for Secretary LaHood

Ms. Maurillo: We'll go in alphabetical order. I'll call on the Secretary, and that way, it won't be a free-for-all, if that's okay with you.

Sec. LaHood: Okay.

Ms. Maurillo: Edna Brewer Middle School in Caltrans District 4, do you have any questions you would like to ask the Secretary, please?

Edna Brewer Middle School Student: Is the government doing anything to help produce transportation that's better for the environment?

Secretary LaHood: The government is doing a lot, and we've done a lot here at the Department of Transportation. And let me give you an example. When President Obama was sworn in, he made a decision that automobiles were going to get higher fuel efficiency. And what I mean by that is that he was going to work with the car manufacturers to have them build cars that get better gas mileage.

And so he asked me here at the Department, and the Department of EPA, Environmental Protection, to work together, and with the car manufacturers, GM, Ford, Chrysler, and all

the foreign manufacturers – Toyota, Nissan, Hyundai, all of them were involved. And so we developed, over a two-and-a-half-year period of time, with the car manufacturers, and with the EPA, standards so that automobiles that are built in 2016 will get 35 miles per gallon, and automobiles that are built in 2025 will get 54.4 miles per gallon.

So one of the things that the President was able to do is to work with the car manufacturers and DOT and EPA in order to have the car manufacturers produce and manufacture cars that will get very good gas mileage, that will save gasoline, that will take CO2 out of the air, that will improve the environment, and give people much better gas mileage. So, as gasoline prices go up, we know that people use more trains and buses and light rail, but they also are going to want to be using cars that get better gas mileage. So that's one of the major things that we did. We didn't have to ask Congress to do anything. We did it with our colleagues at the EPA and in President Obama's administration.

Ms. Maurillo: Thank you, Mr. Secretary. Monument Middle School in Rio Dell, California, broadcasting from the Caltrans District 1 site, do you have a question for Secretary LaHood?

Woman's voice: Good morning, Donna! This is –

Ms. Maurillo: Emma!

Woman's voice: We have an echo in District 1.

Woman's voice: Just from District 4 broadcasts, so I mean we're fine with the Department of Transportation in Washington, but your dialogue is coming out echoing. But I will turn it over to our students to ask a question.

Monument Middle School Student: In the past 10 years, what's changed in transportation?

Secretary LaHood: I think, in the past 10 years, the biggest change in transportation, really, is we've completed, or almost entirely completed, the interstate system in America. We have made travel by air the safest that it can possibly be. We have really given people opportunities in their communities to get out of their cars, and to get on more trains, more buses, more light rail, more street cars. Given them a lot more options than just their automobile, so that people who can't afford the high price of gasoline could take a bus, and we've provided money to communities so they could develop bus service, or light rail, or street cars.

We've also made sure that, when somebody boards an airplane, that it's the safest it can possibly be, by having well-trained pilots, making sure that airplanes are mechanically okay, making sure that people [who] get on the planes, that are getting on the planes, are there for the right reasons. That's the reason we've set up a whole elaborate system of screening at airports, and making sure our airports are safe. I would say that over the last 10 years we've improved transportation, and safety in transportation, so that people have

many different choices, either by roadway, railway, the airways, and motorcoach could be included in that.

Woman's voice: Thank you.

Sec. LaHood: Okay. Next question?

Ms. Maurillo: I'm sorry. Our mic was not on. Next, in alphabetical order, is Morada Middle School from Stockton, California, broadcasting from the Caltrans District 10 site. Do you have a question for Secretary LaHood?

Morada Middle School Student: Yes. You said distracted driving is a major safety – [audio dropout]

Sec. LaHood: Maybe you should repeat your question. I think you got about halfway through, and we lost the audio.

Man's voice: Yes, go ahead.

Student: Okay. You said distracted driving is a major safety issue. Even though we aren't old enough to drive, what can we do to help solve this problem?

Sec. LaHood: I think by the idea that you, first of all, recognize that many young people have texting devices even before they learn how to drive. And one of the things they need to know is that you need to learn to drive by making sure you put the texting device, or the cellphone, in the glove compartment when you get in the car – that you can't drive safely while you're texting. You can't text and drive and be safe. And so even though many of you don't have your driving privileges yet, you still have the texting device, or the cellphone, and you know how to use that, and you use it very well, and you need to be training yourself to take personal responsibility that there are certain times when you can't do it. One of them is when you're driving a car. And if you learn that early on, and then persuade your friends that, if you see them, and they're driving, and they're using a texting device or a cellphone, that you tell them to put it away. So a little bit of peer pressure, recognition on your part that it's dangerous, and then helping your peers, your friends, do the same. Maybe even your parents, if you see them driving with a cellphone in their ear, remind them that's it not safe. Next question?

Ms. Maurillo: Thank you, Mr. Secretary. I believe that the echo may be coming from a site that has their microphone still on when they are not speaking. So please check your mic to make sure that it is turned off if you are not the school that is speaking.

Next in order, we have Redland Middle School from Rockville, Maryland. They are broadcasting from the US Department of Transportation site. Do you have a question for the Secretary, please?

Sec. LaHood: Who's going to ask the question? Yes?

Man's voice: We'll come up to the mic.

Redland Middle School Student: In the area of transportation, what jobs are needed the most?

Sec. LaHood: In the area of transportation, I think what we really need are people in all different modes of transportation. Some people are going to be interested in air transportation, so some people may be interested in being a flight mechanic, somebody who fixes up airplanes. Some people may be interested in being a pilot. Some people may be interested in being a flight attendant. There are lots of jobs in the airline industry.

But the truth is, there are a lot of jobs in transportation. The people that design the roads, the engineers that design the roads and bridges. There are lots of opportunities there.

There are certainly opportunities for people in transit. And what I mean by that is every community has a bus company. A lot of communities have light rail. In Washington, DC, we have a great metro system. Think of all the people that work in these programs, whether it's the drivers, or the mechanics, or the people that work behind the scenes in the administration. So there are lots of opportunities in transportation.

But the best way to get the job is to get a good education. And what I mean by that is not only just high school but college, or community college, or a technical school, where you learn how to become a mechanic, or you learn how to become a driver of a big truck, or a driver of a motorcoach. There are opportunities in many areas. But having a good education, or good technical training, is certainly a part of that. Now did somebody else here – go ahead, who's ever in charge of this.

Ms. Maurillo: Okay, thank you, Mr. Secretary!

Ms. Maurillo: Up next, in order, is St. Callistus School in Garden Grove, California, broadcasting from the OCTA site. Do you have a question for the Secretary, please?

Sec. LaHood: Could you repeat that? We missed part of the audio.

Ms. Maurillo: Sure. Next is St. Callistus School in Garden Grove, California. They are broadcasting from the OCTA site, and do you have a question for the Secretary, please?

St. Callistus School Student: Secretary LaHood, can you share with us any plans for sustainable energy growth in the public transportation?

Sec. LaHood: Well, we have an entire program on sustainable and livable communities. And I think the sustainability aspect of what I talked about, when I talked about higher gasoline standards, is certainly a program that we have implemented over the last two-and-a-half years to get cars to get higher gasoline standards. But we also are working with communities that want to provide the kind of transportation, such as street cars, such as bus rapid transit, such as the Metro system that exists here in Washington, DC, where

we're trying to expand it all the way to Dulles Airport. So there are different aspects of sustainability.

Our partners are really the communities. Our partners are people in communities who are looking for opportunities for sustainable transportation. And we really look to our partners, whether they be mayors, or city councils, or metropolitan planning organizations – all of these different organizations. Some elected, some appointed. We really look to them as the organizations to become our partners. Some are governors. And certainly, as we implement high-speed intercity rail around the country, we are working with governors in California, in Illinois, along the Northeast Corridor. So that, certainly, is a sustainable type of transportation, as is transit. And so all of these things really require us to work with people in the communities. Next question?

Ms. Maurillo: Thank you, Mr. Secretary. Next, we have team number one from Tupelo Middle School, and they're from Tupelo, Mississippi, and they are there at the DOT broadcast site. Team number one, do you have a question for the Secretary?

Sec. LaHood: Come on up here, who's ever going to ask the question.

Tupelo Middle School Team #1 Student: Why do we not use such things as solar panels and wind mills in order to power lights?

Sec. LaHood: Now you'll have to repeat that for me so I understand this.

Student: Why don't we use more things like solar panels in cars and trains?

Sec. LaHood: I don't know. Maybe you should answer that question. We are so busy doing so many other different things with automobiles, trying to get better gas mileage, I don't know if we've ever really discussed the idea of using solar panels. There is a car that's been developed that's a driverless car, which we've had here at the Department, and so we've taken a spin in that. That's about the most revolutionary thing. But cars running on solar panels? Maybe we need to send that over to the Department of Energy. Sorry I couldn't do a better job on that.

Ms. Maurillo: Thank you, Mr. Secretary. Team number two from Tupelo Middle School. Do you have a question for the Secretary? And you're the final question.

Tupelo Middle School Team #2 Student: Mr. Secretary, if I remember correctly, you said that in the future cars will have better gas mileage. My question is, why not just end using fossil fuels, which are running low, and start using more sustainable power? Is that being discussed in Congress and other places in the US government?

Sec. LaHood: Well, certainly, the idea of more hybrids, more battery-power, is an idea that really, I think, has now taken off with the car manufacturers. When you look at what the car manufacturers are really doing in terms of all-battery vehicles, some hybrid vehicles, they've become very popular. And, again, as gasoline prices go up, I think that you're going to see people buying not only more fuel-efficient cars, but cars that are powered by batteries, and I think they will become very popular.

You know, the Volt is being sold by GM, and there's actually a tax credit, an incentive, that's been given now for the purchase of a Volt. Nissan has developed the Leaf, which is an all-battery-powered car. So every car manufacturer now is getting into the kind of equipment that I think people are really going to be looking for as gasoline prices go up.

Well, I think that's the last question, and, again, I want to thank Secretary Mineta, but also the Mineta Institute, and all those who have really made this possible for these young people to really think about transportation, think about careers in transportation, think about the opportunities there are in transportation, and, obviously, lots of good questions here today. So thank you, everyone!

Mr. Diridon: Thank you very much, Mr. Secretary, and thank you also to Secretary Mineta, for being with us today and offering the motivation that will help make these youngsters the next generation of transportation leaders. We'd also like to thank APTA for hosting your site again this year. And thank you, Pam. We miss Mr. Melaniphy and wish him well with his surgery.

Now it's my honor to introduce, clear across the country, the corresponding person in California, the director of the California Department of Transportation, Malcolm Dougherty. Thank you, Malcolm, for allowing us to use your videoconference network, and please offer a comment to the young people.

MALCOLM DOUGHERTY

Thank you very much, Rod, and thank you to your team for everything you do with this symposium, as well as everything you do at the Mineta Transportation Institute. Good morning from Sacramento, California. Good afternoon to you in Washington, DC. It is my pleasure to be here representing the California Department of Transportation, which we affectionately refer to as "Caltrans."

We're very happy to have four teams competing in this competition from California, and three are sponsored by Caltrans, and one is sponsored by the Orange County Transportation Authority. I look forward to this every year for several reasons. One, we get to hear from distinguished guests, like Secretary LaHood and Secretary Mineta, and even us adults get very excited to hear from them.

But secondly, and most importantly, we get to see what great ideas our participating schools come up with as a result of all their hard work in this effort. I have three kids myself, and one of them is in eighth grade, so I have a great appreciation for all the hard work that you put into this effort, and I'm always impressed by the creative and intelligent ideas that you come up with.

Let me begin by congratulating each school and each student for getting to this point, and let me also thank each of the teachers, the mentors and the sponsors, for their hard work and commitment to help contribute to the education of all these students.

Students, if we inspired you just to pursue careers in transportation, all of us adults and future generations are going to be much better off for your efforts. Transportation can be a very exciting field to work with, as mentioned earlier. If you're interested in building bridges, if you're interested in building a high-speed rail, or if you're interested in working towards a cleaner environment, transportation has many, many opportunities in its professions, and we would encourage you to think about that, as you get older, and advance your education.

Now I'd like to take a quick moment to reintroduce all the schools, and the teams that are involved today, as well as the teachers and the mentors and sponsors who have done so much work; and, again, thank you very much.

I'm going to begin with the schools and the teams that are located in Washington, DC. I will acknowledge each school and the sponsors and if you could please stand up and raise your hand, I would greatly appreciate it.

I'll begin with the Redland Middle School 7th and 8th graders from Rockville, Maryland, Washington, DC. Their teacher is Kimberly McLurkin, and they are sponsored by the American Public Transit Association. Thank you for being here, and good luck in the competition.

The second team that I would like to introduce is the Tupelo Middle School 7th and 8th graders, the first team, which is also in Washington, DC, Tupelo, Mississippi. Their teacher is Julia Smith, and they are sponsored by the American Association of State Highway and Transportation Officials, AASHTO. So welcome, and good luck to you, as well.

And then the second team from Tupelo Middle School 7th and 8th graders, again, teacher Julia Smith, and sponsored by the American Association of State Highway and Transportation Officials.

And the first Caltrans-sponsored team is Monument Middle School from Rio Dell, California – 7th graders. The teacher is Sheryl Steiner. The Caltrans engineering mentor is Sherry Rodrigues, and they are sponsored by Emma Cleveland in the Caltrans District I.

Woman's voice: We still have the echo, and we're thinking that maybe it's Washington, DC, who has their mic open, because we can hear the applause from there as well. Just letting you know.

Mr. Diridon: Can we ask – Malcolm, can we ask our monitors at the Washington, DC, site to mute their microphone?

Mr. Dougherty: Okay. Thank you. Is that better, District 1?

Woman's voice: We still have an echo. It's not as bad –

Mr. Dougherty: Okay.

Woman's voice: But we do still have it.

Mr. Dougherty: Okay, all right. Well, we'll work on that technical difficulty, and I'll try to work through it as quickly as possible. But thank you.

Woman's voice: Now it's better.

Woman's voice: We're good.

Woman's voice: We're good now!

Mr. Dougherty: Okay.

Woman's voice: Thank you.

Mr. Dougherty: Okay. So the next school I'd like to introduce, and team, is Edna Brewer Middle School 8th graders from Oakland, California, and teacher is Amy Martinez, and the Caltrans engineering mentor was Brian Raleigh, and the sponsor is Alfonso Miles from Caltrans District 4. Welcome and good luck!

And then the next team is Morada Middle School 7th and 8th graders from Stockton, California, and the teacher is Aaron Saas. Caltrans sponsors, mentors, are Homer Zarzuela and Pat Robledo, and they're sponsored by Marcela Anderson from Caltrans District 10. So welcome to you and good luck, as well.

And lastly, I'd like to introduce the team that is sponsored by the Orange County Transportation Authority, St. Callistus School 6th graders from Garden Grove, California. The teacher is Joy Martin, and their sponsor is Orange County Transportation Authority. CEO is Mr. Will Kempton, and their coordinators are Stella Lin and Sarah Serdienis. So welcome and good luck to you, as well.

So, again, thank you to all the participants. Good luck, and I wish you well, and now I would like to introduce a former director of Caltrans, and the current executive director of the Orange County Transportation Authority. From Orange County, California, Mr. Will Kempton.

WILL KEMPTON

[I'd like to thank] Sarah and Stella and Ms. Joy Martin, the teacher at St. Callistus, for her work, and, of course, all of our students who are participating; but more importantly, I want to thank all of the students across the country who are participating in the Garrett Morgan program today. It's a tremendous opportunity not only to learn about transportation but to learn about career opportunities in transportation, and we're very thankful that you're agreeing to participate.

Transportation offers a tremendous amount of opportunity. You can be an engineer. You can be a planner. And if you like real estate, you can get involved in real estate activity related to transportation. You can be a maintenance worker, and you can be an administrator. There are so many opportunities in transportation, and we hope that you'll take advantage of one of those opportunities in the future.

We're focusing on middle schools today because we actually want to catch students before they make the choice of what they're going to be taking in high school. And so we want to encourage students to take those math and science courses, because those are so important for transportation. I guarantee you, if you graduate from high school and college with a degree in engineering, you will find a job in this country. We need to rebuild America, and you've heard from Secretary LaHood and you've heard from Secretary Mineta about the importance of transportation in accomplishing that work. So we know that you'll look at math and science classes as you advance your education, and we really encourage you in that direction.

And I'll tell you another thing. After today, I know we'll all feel very good about the fact that our transportation future is in good hands. Thanks, Malcolm!

Ms. Maurillo: Thank you very much, Will Kempton and Malcolm Dougherty. And now we will start our competition. Here is how we will proceed. We will start with each school in alphabetical order. The school will make its presentation. In previous years, we had all the presentations, and then we opened the floor for questions. This year, we will handle it a little differently. This year, we will have each school give its presentation, and then, after that presentation, I will call on the schools in alphabetical order to see if they have any questions of that team. When we are complete, we'll have up to four or five questions.

When we are finished with that team, we will move on to the next team in alphabetical order, and repeat the process, okay? And the judges who are – We have three judges, none of whom have any interest in the outcome at all, so there are no judges from OCTA or Caltrans. We have no interest in the outcome, so it will be totally fair. You will be judged on your presentation skills, your teamwork, the concept of your project, and then you will receive extra points for each question that you answer well, okay? So if you have an answer that's, "Well, I don't know," or "We haven't thought about that," you do not receive the extra point. If you have an answer that is well-thought-out, and shows that you actually have understood your subject, then you will receive an extra point, okay? Is everybody ready? Okay.

So we will start first with Edna Brewer Middle School, Oakland, California. They are broadcasting here from the District 4 site. Go ahead. You're on! The students currently are handing out their business cards to people in the audience. Okay. You may begin your presentation.

COMPETITION

EDNA BREWER MIDDLE SCHOOL

Female student: Hello. I am Zuliana Mendoza-Figueroa. We are from Edna Brewer Middle School, and we are with [unintelligible]. And we are here today to talk about our car, the Mazu SI. Our car, the Mazu SI, runs on methane and solar ink, and we chose to make a car because it's the most common kind of transportation that is used, and this is Ravyn Hunter, Tom Chao, Sam Starratt-McCune, Kirby Marion, and they will continue the presentation on our car, the Mazu SI. Caption for Edna Brewer MS

Figure 2. Students from Edna Brewer Middle School prepare for their project presentation.

Male student: Why we chose to make the Mazu SI, a solar ink and methane hybrid: The first reason is solar ink costs way less to produce the same amount of energy you get from solar panels. We estimate the solar ink to be at least ten times cheaper to make than solar panels. As for the methane, [unintelligible] components that cow waste was a major issue to the environment and the agriculture industry, releasing toxic waste to our groundwater and soil. And that's bad. So what we want to do is use that toxic waste – well, not "toxic waste" – the cow waste – as a fuel source for our car.

Female student: We didn't want the solar ink and the methane gas to compete and try to power the same component of the car, so the solar ink will power the electrical system, such as the CD player, seat warmers, BluRay, TV screen, USB port; and the methane gas will power the engine.

Female student: How the cow waste is turned into methane gas: It's fermented first, and that will produce methane. Then it's fed into a fuel cell with oxygen, and that produces electricity. There are some greenhouse gases released, but a lot less than a car that runs on gasoline – 29 percent less carbon dioxide, and 70 percent less nitrogen oxide.

Male student: Animal waste may not always be available for mass production, so, to meet our car's demand, we will use methane from landfills and municipal solid waste. We are also going to get all of our methane from local sources so that we can cut down on polluting the environment.

Male student: Some good things about our car is that it reduces the waste products of the agricultural industry and also reduces greenhouse gases to the environment. Some of the stuff that's not-so-on-the-bright-side is that solar ink is currently in development, and is not market-ready for cars. And our car still produces some greenhouse gases.

Female voice: Our car is sustainable because it reduces pollution and it uses renewable resources. And, first, our car uses renewable resources because they never run out. The sun will never run out, and cows will always be around. And, second, our car is sustainable because it limits pollution. It doesn't release as many greenhouse gases as gas cars. And it also helps eliminate groundwater and soil pollution. And, lastly, our car helps eliminate methane being released as a greenhouse gas naturally.

Male student: The cost of our car would be a lot less because solar ink [is] less expensive to make. The cost of our fuel would be less than the current cost of our gas, producing 3 cents per kilowatt-hour versus current cost is 9 cents per kilowatt-hour.

Male student: The 2017 Mazu SI is the best car that you can buy because it saves you money on fuel, and it's good for the environment. And these are some sources that we used. Thank you very much.

Q&A for Edna Brewer Middle School

Ms. Maurillo: I will go in order to ask each school if they have any questions for this team. Monument Middle School, from Rio Dell, California, do you have a question for this team?

Monument Middle School Student: Why do you think this would help our earth?

Edna Brewer Middle School Student: The cow waste we're using to make the methane gas is polluting the environment because the food industry is trying to fatten the cows up faster, and the food they're feeding them is not working with their digestive system, and so the waste is toxic. And taking the waste out of the – off – eliminating it – will eliminate groundwater pollution and soil pollution.

Ms. Maurillo: Thank you very much. Morada Middle School, Stockton, California, do you have a question for this team?

Morada Middle School student: Yes. If the solar ink isn't ready for development, when are you planning to market the vehicle?

Edna Brewer Middle School student: Solar ink should be available for – should be market-ready for cars in five years.

Ms. Maurillo: Thank you. Redland Middle School, Rockville, Maryland, do you have a question for this team?

Redland Middle School student: You run out of sustainable energy from the sun?

Edna Brewer Middle School student: Can you repeat the question, please?

Redland Middle School student: I'm sorry. What happens when you run out of sustainable solar energy when the sun dies out?

Edna Brewer Middle School student: We'll all be dead by then!

Ms. Maurillo: Okay. St. Callistus School in Garden Grove, California, do you have a question for this team?

St. Callistus School student: If solar ink is not ready, when do you predict your cars will be ready for production?

Edna Brewer Middle School student: Five years.

Ms. Maurillo: Thank you, St. Callistus. The first team from Tupelo Middle School, do you have a question for this team?

Tupelo Middle School Team #1 student: This solar ink you plan to use for the car: Is it dangerous to humans?

Edna Brewer Middle School student: No.

Ms. Maurillo: Second team from Tupelo Middle School. Last question. Do you have a question for this team?

Tupelo Middle School Team #2 student: We have already stated our question.

Ms. Maurillo: Okay. Thank you very much. Thank you very much, Edna Brewer Middle School, for your presentation.

Okay. We will move now to Monument Middle School, Rio Dell, California, broadcasting from the Caltrans District 1 site. Go ahead, please.

MONUMENT MIDDLE SCHOOL

Manurgit: Hi. I'm Manurgit.

Lilly: Hi. I'm Lilly.

Figure 3. Monument Middle School team with teacher Sheryl Steiner, standing center.

Ira: I'm Ira Beckett, and our project is the Green Plan for Rio Dell. Our project is to change the city vehicles from gas to electric cars, and to put an electric charge station in our city hall for public and city use.

Male student: First, I'd like to tell you about our city. A small, rural area in Northern California. Population 3,717. Run by a city council with city manager. Mayor heads the city council. Located just off Highway 101, 127 miles south of the Oregon border, 230 miles north of San Francisco.

Female student: We thought of a plan, but had many questions. Here's what we needed to think about: easy on/off access from highway 101; low impact to blend into its surroundings; public and city use; taking into account neighboring town of Scotia; little-to-no money in budget for extra projects; and what city-owned land is available.

Female student: We've interviewed the public works departments with our questions, and this is our plan – our green plan:

- Solicit our car-charging station for electric cars, a charging station within public and city use,
- Convert city public works vehicles to electric,
- Grants to the charging station and conversion kits,
- Possible incentives for buying electric cars and for people who already own them,
- And educate the public.

Male student: Part of our plan is to install a solar-powered charge station and use city hall for solar panels.

- Charge station behind building [will] accommodate up to four vehicles.

- City vehicle plug-in at night.
- Public use during the day.
- Cover station with benches.

Female student: This is the front of Rio Dell City Hall, and this is near where we would like to put a charging station [conversation among students].

Ms. Maurillo: Are you finished? Is that the end of your presentation?

Male student: This is behind City Hall, where we would like to have our solar-powered charge station. In the distance, you can see the mini-golf.

Female student: This is a model of Rio Dell City Hall, and this is Rio Dell City Hall, and there is a wire connecting from Rio Dell City Hall down to the charging station, where you can charge your car. There is also a bench where people can sit when your car is charging.

Female student: Cost of charging station: $1,770 for charging station. You can insert a team agreement with our solar-power partner to help with the cost of solar panels. Possibility of leasing charging unit, and grants and incentives available.

Male student: Electric conversion:

- Conversion kit much cheaper than buying a new vehicle.
- Easy to convert.
- Takes basic mechanical skills.
- Has been done before in the North Coast.
- Good for both in-town and highway driving.

Female student: These are the city public works farm vehicles that we want to change from gas to electric.

Female student: Our city made it clear that there wasn't much money in the budget for extra projects. Financial assistance:

- California Energy Commission alternative-fuel funding incentives.
- Federal stimulus-funding tax credits and incentives.
- Federal tax credits for purchase of plug-in electric vehicles.
- Federal tax credits for solar-power installation.
- California Solar Initiative.
- Car-company programs like Ford "Drive green for life" for individual charge stations.

Female student: Benefits for Rio Dell:

- Solar panels reduce city's reliance on power-plant electricity.
- Reduce energy bill.
- Plug-in time: 37-47 minutes.
- Charge station within walking distance to restaurants and shops.
- May charge public fee for plug-in use.

Male student: Environmental benefits:

- Solar fuel stations reduce emissions.
- Solar panels reduce city's electricity.
- Reduce petroleum use; average American uses 700 gallons per year.

Female student: Making a connection: This is an option where there are electric-charge stations in Northern California. Supporting the Highway 101 charge lane from San Francisco to Oregon, a large percent of electric cars are found on the West Coast. Between Santa Rosa and Rio Dell, there is one charge station, and there's an electric-charge station in Eureka. Between Santa Rosa and Rio Dell, there's an electric-charge – or San Francisco and Rio Dell – there's an electric charge station in Santa Rosa and Eureka, and there's also one in Ukiah.

Male student: This concludes our presentation. Thank you for your time.

Q&A for Monument Middle School

Ms. Maurillo: Thank you, Monument Middle School. We will commence again with questions, going in alphabetical order, starting with Edna Brewer Middle School. Do you have a question for this team

Edna Brewer Middle School student: Yes. Will other cities or countries be able to benefit from your green plan, or just Rio Dell?

Monument Middle School Student: Yes, other cities and countries will be able to benefit from it.

Ms. Maurillo: Okay. Morada Middle School, Stockton, California, do you have a question fro this team?

Morada Middle School student: Yes. How many solar panels will be needed per charging station?

Monument Middle School student: Probably two.

Ms. Maurillo: Redland Middle School, Rockville, Maryland, do you have a question for this team?

Redland Middle School student: Is it free to use the charging system? If not, how much would it cost to use?

Monument Middle School student: It just depends upon if the city wants to charge, or if they don't want to charge for use of the electric charging station.

Ms. Maurillo: OCTA, St. Callistus School in Garden Grove, California. Do you have a question?

St. Callistus School student: Yes. What kind of tax credit will you provide to those who use the solar-powered charge station? And how much would they save?

Monument Middle School student: Please repeat that question.

St. Callistus School student: What kind of tax credit would you provide to those who use the solar-powered charge station? How much would they save?

Monument Middle School student: You don't issue a tax credit.

Ms. Maurillo: First team from Tupelo Middle School, do you have a question?

Tupelo Middle School Team #1 student: Yes. If you do charge money, have you taken into consideration people who might want to try and charge their vehicles at home?

Monument Middle School student: We provide the service for people that are driving.

Ms. Maurillo: Team #2 from Tupelo, do you have a question? And this will be the final question.

Tupelo Middle School Team #2 student: Yes, do you have a plan if you need to expand this system, if there's more need for this use?

Monument Middle School student: Yes, up to four can use the charging station.

Ms. Maurillo: Okay. Thank you very much! That was Monument Middle School in Rio Dell, California. Next up, we have Morada Middle School from Stockton, California. They are broadcasting from the Caltrans District 10 site. Go ahead, please, with your presentation.

MORADA MIDDLE SCHOOL

Suki Vongchanh: Hello, everyone. We are the project team representing Morada Middle School, located in Stockton, California. Thank you for giving us the opportunity to participate in this year's Garrett Morgan program. We are all really excited to show you the ideas we have come up with that will help promote sustainable transportation. Our project is called the Morada Middle School Megatron Hybrid School Bus.

Our team consists of several individuals, each working on different aspects of the project, who will now introduce themselves.

Figure 4. Students from Morada Middle School created a hybrid school bus for their entry.

Sophera Chao: I am Sophera Chao, and I am the financial analyst.

Victor Muñoz: I am Victor Muñoz, and I am the biofuel engineer.

Ottavia Long: I am Ottavia Long, and I am the electrical engineer.

Harsimran Kaur: I am Harsimran Kaur, and I am the environmentalist for this project.

Jasmin Acosta: I am Jasmin Acosta, and I am the mechanical engineer.

Vanessa Trevino: I am Vanessa Trevino, and I'm the marketing director for this project.

Suki: And I am Suki Vongchanh, the leader/director of operations. Okay, to start things off, our environmentalist, Harsimran, will first talk about the issues and problems that will lead into the [unintelligible] for this project.

Harsimran: Thank you, Suki. As all of you know, our globe is facing many issues caused by the current forms of transportation which can be grouped in three general problems that we deal with.

The first has to do with nonrenewable fuel sources. Our fossil fuels are depleting. [As] cities and population continue to grow, we will run out of these fuels more rapidly.

Another problem we face is the presence of pollution, which means that our environment is not getting any better. In many densely polluted areas in our country and around the world, smog is filling our skies. Emissions from cars, trucks and other forms of transportation are also creating problems for our ozone layer.

Yet another problem that needs to be addressed is the continuously rising number of cars and trucks that travel on roads. This means that congestion continues to fill our streets and freeways. And to go with all this, the continuously rising gas prices are emptying out everyone's wallets.

The list of things we have to deal with goes on and on. Something needs to be done. So we have come up with a solution for this growing list of issues and problems created by our current forms of transportation. Next, our mechanical engineer, Jasmin, will introduce the project.

Jasmin: Thank you, Harsimran. Before we came up with the solution, our team had to consider many things about what our project was going to do. To help us define our project, we had to establish a set of goals that would revolve around basic ideas of sustainable transportation. The goals that we have established for our project are as follows:

- Our project must run on only renewable fuel sources.
- Our project must have very little or no negative impacts to the environment,
- Our project must also be economically affordable so that it could be usable for as many schools as possible.

Our team studied numerous ideas for our project. After much work, the idea that our team came up with is called the Morada Middle School Magnetron Hybrid School Bus. Through our research, we have combined the uses of biofuel in the form of grass pellets, an energy-producing system, and electromagnetism, to power our vehicle. It's a practical and efficient use of some of the natural energy sources that surround us. Next, we will explain this in detail as to how this all works in our project.

Our biofuel engineer, Victor, will be the first to mention how biofuel is used in our vehicle.

Victor: Thank you, Jasmin. Biofuel was chosen as one of our energy sources for the project since plants are abundant around the world and can always be produced. We figured that since nearly every school has a grass-covered field, grass clippings would be the perfect form of biofuel for our school buses. As a lawnmower cuts, it will collect the clippings and take them offsite when the job is finished. From there, the clippings will be dried and mixed with a binding agent, such as wax, to create the pellets. Since our school buses are already powered by diesel engines, we figured that modifying the engine into a biodiesel engine would be more economical, instead of designing and building new engines that run on this form of biofuel.

Next, our electrical engineer, Ottavia, will discuss how electromagnetism is incorporated into our vehicle.

Ottavia: Thank you, Victor. In addition to our grass pellets, we want to power our bus off of electromagnetism. Electromagnetism is the creation of electricity by passing a magnet through a series of coiled wires repeatedly. We have three main ways of creating this

power source: The first is by attaching magnets to the cooling fan and surround the front shot with [copper] wires. As the fan spins, electricity will be produced.

Secondly, we will have magnets attached to our bus's axle. Copper wire will be attached to the axle and the body storing the magnet. As the bus hits bumps on the road, the vertical movement will pass the magnet through the wire.

Finally, we will have wires built into the cylinder walls of the engine. A magnet will be inside of each piston. As each piston moves up and down, even more electricity will be produced. These three forms of electromagnetism will combine to produce a current that charges a group of batteries. When all the batteries are full, the bus would shut off the engine, and run off the power of electromagnetism.

Now we would like to show the Morada Middle School Megatron Hybrid School Bus. Kathy, from our design team, will now show you a little more detail on how the bus works.

Kathy: This is our Morada Middle School Megatron Hybrid School Bus, and here we have our grass-pellet biofuels. First, you need grass clippings on the school fields and you need to mow them to have the grass clippings. As you gain the grass clippings, you'll need a binding of wax. So, after you have that, you want to pour the wax on the grass to harden a little. After hardening it, you want to put it in a dye ring so it will roll up the grass pellets into big pieces, and then use the knife right here to cut it in small pieces. And then you'll have your grass pellets. And now we have here the electromagnetism.

Here is the piston right here. As you can see the cylinder, we're going to have coiled wire inside the cylinder walls, and there's a magnet here. As the car goes, the pistons go up and down, creating electricity. And here is the cooling fan. The coiled wire is going to be around it, and there's going to be a magnet in the cooling fan. As it goes, it will also cause electricity, produce electricity.

And here's the axle. The magnets will be inside the axle, and then the coiled wire is going to be wrapped around it. And, as the car goes bump, up and down, you'll see it produce electricity. And that's it.

Ottavia: Thank you, Kathy, for all that information. Next, the marketing aspects relating to this project.

Vanessa: Thank you, Ottavia. As you know, gas prices are reaching an all-time high, and will likely continue to climb to higher levels. Additionally, at the opposite end, funding for schools is at an all-time low. Our invention is geared not only to help improve our resources and environment, but to bring money back to what is really important, our education.

The money saved from using our school buses can be funneled directly into the classrooms to improve our technology and resources in our school. Who doesn't want that? It's a win for everyone. As this invention is geared to initially benefit schools, it can eventually be passed on to benefit other organizations and businesses. And, as this technology

continues to grow and spread outside our country, it can assist to promoting sustainable transportation in other places around the world.

Next, our financial analyst, Sophera, will briefly mention some financial issues related to our project.

Sophera: Thank you, Vanessa. Let me first say that money usually doesn't grow on trees. You can't just design and build something without the money to pay for it. With that said, you may be asking a valid question: "Where and how do we get the money to get this project started?" To answer that question, this is where there will be requests for donations from public organizations or public entities, or from both, to help cover the costs of the initial design and construction of this project. There may be private companies who would be willing to pitch in some money if those companies believed that there may be some sort of benefit coming out of the project.

The same can be said of public agencies that may be asked to provide some funding to help get the project started. Money coming from public agencies may come in different forms, such as bonds and grants. Where the money comes from is not really the issue. Overall, the amount of money being donated, large or small, will help get this project started. I will now turn this back over to Suki, our lead director of operations, for some final comments.

Suki: Thank you, Sophera. Overall, as you can see from our presentation, the Morada Middle School Megatron Hybrid School Bus does help to promote sustainable transportation. Our vehicle relies only on renewable fuel sources, and it also produces very little pollution, and thus produces very little negative [impact] to our environment.

Our vehicle would also be affordable and beneficial to many schools that would use these buses, and, in time, may prove to be beneficial to many establishments other than schools that will use this invention.

We would really like to thank everyone for listening to our presentation. I think that it is never too early to start collaborating on how to improve our world, especially when it comes to planning for transportation in the future. Everyone is affected by transportation, since it directly affects our resources. It is truly up to us. Are there any questions for our team to answer?

Q&A for Morada Middle School

Ms. Maurillo: Thank you very much. That was Morada Middle School in Stockton, California. We'll start from the top of the list again asking questions. Edna Brewer Middle School, do you have any questions for this team?

Edna Brewer Middle School student: What if a school doesn't have a grass field or access to grass pellets and they need to get their students to school on time?

Morada Middle School student: Every school should have a grass field.

Ms. Maurillo: Okay. Monument Middle School, Rio Dell, California, do you have a question for this team?

Monument Middle School student: How gas-efficient is your hybrid school bus?

Morada Middle School student: We are not using gas for this project.

Monument Middle School student: How efficient is your –

Ms. Maurillo: Okay. Redland – Did you have more to add for that answer?

Monument Middle School student: How efficient is your hybrid school bus?

Morada Middle School student: Very efficient.

Ms. Maurillo: Redland Middle School, Rockville, Maryland, do you have a question for this team?

Redland Middle School student: What if you're in an urban school [that] doesn't have grass?

Morada Middle School student: The grass would have to be located somewhere, such as a city, or any location, really. As long as the city is willing to donate then there shouldn't be a problem with grass pellets.

Ms. Maurillo: St. Callistus School, Garden Grove, California. Do you have a question?

St. Callistus School student: Yes, what if there is a water drought, and grass clippings are not available because there is a water shortage?

Morada Middle School student: Any alternative biofuel would be helpful for the Megatron Hybrid, since it does run on biofuels; and if it's not running on biofuels, it could still run on the electricity by using either the axles, the cylinders, or any electromagnetism running the vehicle.

Ms. Maurillo: Thank you. Tupelo Middle School first team. Do you have a question for this team?

Tupelo Middle School Team #1 student: Yes, what happens when the grass dies in the winter?

Morada Middle School student: Well, it is a hybrid, so you can use electromagnetism.

Ms. Maurillo: Okay. Tupelo Middle School second team. Do you have a question?

Tupelo Middle School Team #2 student: When will this idea be put to use?

Morada Middle School student: Can you repeat the question, please?

Tupelo Middle School Team #2 student: When will this idea be put to use?

Morada Middle School student: As soon as possible!

Ms. Maurillo: Okay, thank you very much. That was Morada Middle School, Stockton, California.

Next, we move to Redland Middle School, Rockville, Maryland, broadcasting from the US Department of Transportation. Go ahead, please, with your presentation.

REDLAND MIDDLE SCHOOL

Figure 5. The team from Redlands Middle School, Rockville MD, was sponsored by APTA.

Male student: Good afternoon. We would like to thank our sponsor, the American Public Transportation Association, Miss Cheryl Pyatt, and Miss Pamela Boswell, vice president. We would also like to thank our principal, Mr. Robert Sinclair, and assistant principal, Miss Kimberly McLurkin.

We decided on creating a multi-fuel-injection system for buses.

Our bus design would be a mid-size hybrid bus designed to be more aerodynamic than most buses. It would have four-wheel drive. It would be approximately 28 feet long, 9 feet high, with curved edges to reduce wind resistance. This bus will travel faster than other buses because of its power supply and design.

Power will come from a combination of solar panels, electric batteries, and a hybrid engine that can run, if modified, on hydrogen and natural gas.

Energy: The engine will be interchangeable so that it can be modified to use all these fuel sources. There will be a frontal air intake valve to cool the electric batteries so that they do not overheat. The battery is located closest to the front. The storage, or natural gas/hydrogen tank, is located in the rear of the bus, and the engine is located at the center of the vehicle so that [audio dropout].

Ms. Maurillo: It appears that we have lost the site at USDOT. What we can do until that problem is fixed? We can move on to the next school if that's okay with everybody. Are we back on again with Redland?

Woman's voice: District 4, I will give Washington a call. Just one moment.

Ms. Maurillo: Okay. We will pause for a second until we can figure that out.

Male student: Is the same thing that is used to make water bottles.

Appliances: Features a GPS navigation system for locating destinations and fueling stations. Also includes a control setting to change what type of fuel the bus will be using, and it will also control climate controls.

Safety: There will be seat belts and cushioned seat backs.

Ms. Maurillo: Redland Middle School, can you start again? We missed a large portion of your broadcast because the site went down, and we would like to be fair in evaluating your presentation. So would you mind starting again? Is that okay with you?

Male voice: From the very beginning?

Ms. Maurillo: After the thank-you's.…

Male student: So our team decided to –

Ms. Maurillo: Thank you, I'm sorry for the technical problem, but we want to be fair in evaluating your presentation.

Male student: Oh, that's fine. Our team decided on designing a multi-port fuel-injection system for buses.

The design: It would be a midsize hybrid bus designed to be more aerodynamic than most buses. It would have four-wheel drive, and the bus length would be approximately 28 feet, and 20 feet long, 9 feet high, with curved edges to reduce wind resistance.

This bus will travel faster than other buses because of its power supply and design. The power will come from a combination of solar panels, electric batteries, and a hybrid engine that can run on hydrogen or natural gas. The engine will be interchangeable so that it can be modified to use all of these fuel sources. There will be a frontal air intake valve at the front of the vehicle to cool the electric batteries so they do not overheat.

The batteries, or battery, is located closest to the front of the vehicle. The storage for natural gas or hydrogen tank is located in the rear of the bus, and, last, the engine is located at the center of the vehicle so that it can better power the wheels. The cost would be approximately from $300,000 to $600,000, depending on if the buyer wants the multi-port system, how many fuel sources they want the engine to be able to use, appliances, and how many wheels they want on the bus.

Male student: Bus interiors: Seating holds 24 people, 2x12 rows. The rows will be able to hold people comfortably with its 28-foot length and 9-foot height.

Frame: Built of high-tech carbon fiber with a combination of either steel [or] titanium, depending on what the buyer wants to pay.

Windows: Native lightweight glass with PET reinforcing it. PET is the same thing that is used to make water bottles.

Appliances: It features a GPS navigation system for locating destinations and fueling stations. Also includes a control setting to change what type of fuel the bus will be using, and it will also control climate control.

Safety: It includes seat belts and cushioned seat backs.

Male student: Technology: Air intake valve stationed in the front to allow air to flow back to batteries to cool them to avoid overheating.

Hybrid engine: Will use combustion-fuel choices of compressed natural gas, hydrogen, or electric power.

Four-wheel drive improves bus's stability, traction, and ability to transport over many different terrains.

Buyer has the choice of either eight- or twelve-wheeled version, depending on what buyers want. Lightweight is four wheels; medium is eight; heavy-duty is twelve.

Aerodynamic build will allow it to transport faster because, first, it will be lighter than normal buses, and, second, it will have less wind resistance slowing it down.

This is environmentally friendly to help preserve the environment and uses a combustion of clean energy. Hydrogen is 100 percent clean fuel extracted from water or super-frozen air. Natural gas is mostly clean. Releases the least amount of carbon dioxide than any other fossil fuel. Last, rooftop solar panels are 100 clean energy using sun rays as energy.

Male student: Hydrogen: The hydrogen for the vehicle must be manufactured, because it's not naturally found. It can be used in a modified conventional combustion engine. Hydrogen is burned, and the energy is eventually delivered as heat. The heat in the hydrogen flame is a radiant emission. From the newly formed water molecules, water – the water molecules are under excited state on initial formation, and then transition to a ground state. Transition unleashes thermal radiation or heat. When burning in this temperature, the air – or when burning in air – this temperature is approximately 2,000 degrees Celsius.

Male student: Compressed natural gas: Naturally-occurring hydrocarbon gas mixture consisting of methane, ethane and carbon dioxide. Natural gas is found in deep underground natural rock formations, in hydrocarbon reservoirs, in coal beds, and as methane clathrates. Compressed natural gas can be used in [conventional] combustion engines and could burn up to 1093 degrees Celsius.

Electric battery: Used to increase range, and decreases the amount of conventional fossil fuel used to [reduce] the amount of greenhouses – greenhouse gas – gasses – released into the atmosphere.

Electric motor and internal combustion engine vehicles are hybrids.

Male student: Solar cells: Called photovoltaic cells or photoelectric cells. [Capture] the sun, sun's electromagnetic waves, and converts them into usable energy for car batteries. Resupply power to battery which would allow the bus to transport people further while using less fossil fuels.

Cost: Air intake valve made just for this bus will cost probably $8,000 to $12,000. Ensures engines and power sources will not overheat.

Hydrogen: Most buses can hold around 60 to 130 gallons of liquid fuel. Hydrogen is approximately $8 to $10 per gallon.

- CNG: The cost of natural gas is $1.50 [per] British Thermal Unit (BTU).
- Electric car battery: A car battery costs about $5,000, and holds around 30 to 40 kilowatts.
- A bus battery will cost around $15,000, and hold around 75 to 130 kilowatts.
- Solar cells cost about $5,000 to $6,000 to cover a bus. Our model will cost around $10,000 to $20,000.

Aerodynamic frame: The frame will cost in the range of $100,000 to $200,000, due to its unique design.

Male student: Production: The production rate of the bus could possibly be 10 to 20 buses a month based on the current manufacturing rate of the factories. [That's] slower than average, which was around 30 to 45, because this bus is specially made to be environmentally friendly, [more] comfortable, and faster than "normal" buses. The bus also features specially-made materials to make the bus more lightweight and efficient.

- Hybrid engine: Modern hybrid engine introduced with Toyota Prius, 1997.
- Green technology in buses: First hybrid bus was Mercedes 0E30.
- Hydrogen fuel: Discovered in 1938 by German scientist Christian Friedrich Schönbein.
- Compressed natural gas: Compressed natural gas was brought to the US in 1816.

Male student: Solar cells: Charles Fritz invented the first genuine solar cell, which was built around 1883. He used junctions formed by coating silenium, a semiconductor, with an extremely thin layer of gold.

Electric car batteries: Late nineteenth/early twentieth century, Hartford Electric Light used an electric battery in a truck.

Combustion engines: Internal combustion engine is any engine that operates by burning its fuel inside the engine. The first combustion engine was used in 1860 in France, and invented by Jean Joseph Etienne Lenoir.

Male student: This is a rugged diagram of our bus. The green squares on the top of the bus represent where the solar panels will be positioned. The blue rectangles mark where the front and back windows are located on the bus. The pink or purple squares are where the air intake valves will start to intake air and release air, depending on the front and back.

The black box is where the intake air valve is released, and the air is released out the end of the vehicle. The brown square on the roof is where the roof will be sunken in a little to fit the requirements of our aerodynamic design. The yellow circles are where the exhaust from the natural gas and hydrogen will come out. The gray part on the roof is where the roof is going to be raised to fit appliances and make the vehicle more aerodynamic.

The yellow rectangles on the [bus] are the battery, engine and storage tank. The line starting at the left side of the vehicle, slowly going down, stopping on the right-side end of the vehicle, is the path of the air intake valve through the vehicle. It will go around the batteries, so that the air can cool it so it doesn't overheat. The red circles on the top is where the refueling ports are located on the bus.

The black circles are the wheels of the vehicle. The buyer can purchase this production model with eight wheels, or they can buy a variant with twelve.

Male student: Thank you. We hope you enjoyed our presentation, and that you found our bus design interesting. Questions?

Q&A for Redland Middle School

Ms. Maurillo: Thank you very much. That was Redland Middle School from Rockville, Maryland. We'll start at the top of the list. Edna Brewer Middle School, do you have a question for this team?

Edna Brewer Middle School student: Would this bus replace other buses that are already on the road, or just add to them?

Redland Middle School student: It can replace them or add to them, depending on what the buyer needs or requires.

Ms. Maurillo: Monument Middle School, Rio Dell, California, do you have a question for this team?

Monument Middle School student: Yes. What is your reasoning for having four different fuels?

Redland Middle School student: It allows the driver or owner of the bus to be more flexible, and it allows the bus to be more – to use greener energy instead of just Diesel. You can use solar panels or hydrogen or natural gas. Your choice!

Ms. Maurillo: Thank you very much. Morada Middle School, Stockton, California, do you have a question?

Morada Middle School student: Yes. Are taxpayers expected to pay for this, for these buses? And the economy is bad right now. How are we going to get the money to support this idea?

Redland Middle School student: At first, no, taxpayers will not pay for this. This bus will only [be] for the ones who are willing to pay that amount of money, and the price will go down as production methods are expected to get better, or faster.

Ms. Maurillo: Thank you. St. Callistus School, Garden Grove, California, do you have a question?

St. Callistus School student: Yes, do you think the cost of the bus is too much to produce? Will you make a profit?

Redland Middle School student: I think the bus price is somewhat…is reasonable. There are buses today that cost that amount of money, in excess of $599,000. And I think we will make a profit, because you will see the quality of this bus is going to be better than most buses, and it will be able save money on fuel.

Ms. Maurillo: Thank you. Tupelo Middle School in Washington, DC, please? First team, do you have a question for this group?

Tupelo Middle School Team #1 student: Could the bus be used for school buses, also?

Redland Middle School student: Yeah. If the school wants to repaint it, yes, it could!

Ms. Maurillo: Tupelo Middle School, second team, do you have a question?

Tupelo Middle School Team #2 student: Will other people in the world be able to use this idea?

Redland Middle School student: Yes, other people in the world will be able to use the same concept as more than one fuel for a modified engine, and the bus design will be sold, hopefully, globally.

Ms. Maurillo: Thank you very much. That was our last question. Thank you for your presentation. Okay. Next we will move to St. Callistus School in Garden Grove, California. Please start your presentation.

ST. CALLISTUS SCHOOL

Female student: Good morning. We are going to be talking about a sustainable energy vanpool, by the St. Callistus School sixth-grade class.

Figure 6. A sustainable vanpool was the entry for the St. Callistus School competition team.

Female student: This presentation will be presented by Andrea Nicholas, Adriana Torres, Kevin Pham, and Verna Nguyen.

Male student: The way we transport ourselves has a large impact on the environment, accounting for nearly 25 percent of the world's energy consumption. Most Americans are solo commuters, which means they transport themselves in their vehicle alone. The United States is dependent on foreign oil.

Female student: Greenhouse gas emissions are increasing at faster rates than any other NEGs in sector.

Female student: The social cost includes road crashes, air pollution, physical inactivity, time away from family while commuting, and vulnerability to higher fuel prices.

Male student: Traffic conditions create economic costs by wasting people's time and by slowing the delivery of goods and services.

Male student: Solution: Environmental impact can be reduced by enhancing the role of public transportation in our lives. Green vehicles can reduce energy consumption and smog-causing emissions. Other transportation options such as cycling, walking, carpooling, and vanpools are environmentally conscious.

Female student: Get more solo commutes off the road and into a bus, train, carpool, on a bike, or walking, to get where they need to go.

Female student: Our question is, "Can a vanpool be created that runs on sustainable energy resources?"

Male student: Solar energy: A solar vehicle is an electric vehicle powered by direct solar energy. Photovoltaic cells contained in solar panels convert the sun's energy directly into

electric energy. This energy can be used for a vehicle's propulsion, for communication, controls, and other auxiliary functions. Solar-powered vehicles rely less on gasoline to power the engine and other functions in the vehicle itself.

Female student: A hydrogen vehicle uses hydrogen as an onboard fuel for power. Hydrogen energy is converted into mechanical energy by burning hydrogen in an internal combustion engine.

Female voice: Hydrogen is a low-cost alternative to fossil fuels, and can be produced from a wide range of sources such as wind, solar or nuclear. Using electrolysis of water, hydrogen can provide quantities great enough to compete with traditional energy sources at lower cost.

Male student: Salt water: The earth is made up of 70 percent ocean, which is saline water. There's a large amount of salt water available. It can be used to power vehicles with the help of hydrogen energy instead of gasoline. There's a shortage of fresh water, especially in California, where there is a fresh-water crisis.

Female student: Vanpools: Vanpools allow people to travel together from home to work and back by driving in the same vehicle. It is similar to carpooling but on a larger scale, because vans can carry more people. Vanpools reduce stress, time, gasoline usage and pollution. Using a vanpool will save money on commuting costs. There are social benefits, because you will meet new people that you would have never met if it wasn't for the vanpool. Vanpools reduce traffic and the number of vehicles on the road, as well as the amount of pollutants and emissions into the atmosphere.

Male student: Our hypothesis: A solar hydrogen saltwater-powered vanpool will reduce smog causing emissions and traffic congestion.

Female student: The materials needed for the engine is a fuel cell, solar panel, battery, tubes, saltwater, salt tank, saltwater container, heater, radio-wave generator and electrolysis system.

Male student: The engine: The engine of our vanpool includes a heater, saltwater container, salt tank, tubing, fuel cells, radio-wave chamber with a radio-wave generator. First, the salt water is kept in a chamber, which is then heated until the water is separated from the salt. The salt is then drained into another tank. The water vapor is then transferred to another chamber. In that chamber, the radio-wave generator condenses the vapor back into its liquid state.

Female student: Electrolysis of water. The liquid form is then sent through the electrolysis system, where the electrolysis of water begins. Electrolysis of water occurs when water is decomposed into oxygen and hydrogen gas due to electric current being passed through it. It then goes through the fuel cell and is sent back to the heating chamber.

Male student: This is our engine model. I will start off by talking about our salt-water container. It's heated so the salt and the water are separated. The salt is drained into the salt

tank, which is of heat-proof plastic, because salt does corrode metal, and the heater might heat up the salt tank. And the water is soon water vapor and goes into the next container.

Male student: In this next container, radio waves will condense the water back into its liquid state and then send it through our electrolysis system. When it has been sent through the electrolysis system, it will go to the fuel cell, thus producing power for the vehicle. When this has been sent to the fuel cell, it would go back to the salt, the heating chamber, and set for another cycle.

Female student: The battery will be charged by solar energy. The solar panel will capture the sun's energy, and convert it directly into electric energy. The battery will power all the features in the car, including the heater and the radio-wave generator in the engine.

Male student: In conclusion, the solar hydrogen salt-water-powered vanpool will create a healthier environment for everyone by decreasing the amount of smog-causing emissions that gasoline-powered vehicles create. The air we breathe will be cleaner. The vanpools will not only reduce traffic congestion, but they will also increase the economic and social benefits that solo commuters do not have.

Female student: Thank you to the Orange County Transportation Authority for sponsoring our class to compete in the Garrett Morgan Sustainable Transportation program. Our entire class has enjoyed and learned so much from this project. It will definitely make a difference in our lives and our future career choices.

Ms. Maurillo: Thank you very much, St. Callistus School.

Woman's voice: We still have a tabletop demonstration.

Ms. Maurillo: Okay. For questions. Edna Brewer Middle School? Do you have a question for this team? Sorry.

Edna Brewer Middle School student: What would be the estimated cost to set up a vanpool? And how would that money be obtained?

Female student: We still have a tabletop demonstration…and we'll do it now.

Ms. Maurillo: Oh, I'm sorry. Go ahead!

Female student: Here is a model of our engine, not a model of our vanpool. This model of our engine is to show that we can use saltwater to power an engine. In order to start the electrolysis process, we charge the fuel cell using this solar panel. And once I switch the switch, the salt water will power the… Now Kevin will tell us more about the process of the electrolysis.

Kevin: When the electric current is being passed through the water, the water is decomposed into its hydrogen and oxygen parts, and then the hydrogen will be sent to the fuel cell, to the engine, which then turns the motor to power the car. This kind of car, this toy

car, has sensors that, when it hits an obstacle, it would reverse and find its way through any path.

Female student: Thank you.

Ms. Maurillo: Thank you very much. Is that the end of your presentation?

Students: Yes!

Q&A for St. Callistus School

Ms. Maurillo: Okay. Thank you very much! Okay. We'll start with questions again. Edna Brewer Middle School, Oakland, California, do you have a question?

Edna Brewer Middle School student: Yes. What is the estimated cost to set up a van-pool?

St. Callistus School student: The cost will be low.

Ms. Maurillo: Excuse me. Could you repeat the answer?

Man's voice: The cost will be low.

Ms. Maurillo: Okay. Thank you. Okay. Monument Middle School, Rio Dell, California, do you have a question?

Monument Middle School student: What do you do with the excess salt?

St. Callistus School student: We just send it back to a plant where it's sent back to the ocean.

St. Callistus School student: We will send it to our processing plant, where it will be treated back with the water, and it will combine back with the water, and then we can hose it back into the ocean.

Ms. Maurillo: Thank you. Morada Middle School in Stockton, California, do you have a question?

Morada Middle School student: Yes. By using the salt water as a resource, how will this affect the environment, such as our oceans?

St. Callistus School student: We have a processing plant where we take the water out, where we will process the fish, and if any fish get in, we will let them go back into their natural habitat. So we will not hurt anything, any of the [unintelligible].

Unidentified female student: That wasn't an answer to the question.

St. Callistus School student: Okay. That wasn't the answer.…

Woman's voice: What was the question?

Female student: What was the question?

Morada Middle School student: By using the salt water as a resource, how will this affect the environment such as our oceans?

St. Callistus School student: It won't.

St. Callistus School student: Because there's a lot of ocean water.

Unidentified female student: It affects our oceans.

St. Callistus School student: It will not affect our oceans, because we have so much of it.

Morada Middle School student: What if there's a point that the water runs out? Because there will be a point that water will run out, because there's many transportations such as cars and buses, and if we use too much of that water, it will run out eventually.

St. Callistus School student: But it won't run out of salt water, because 70 percent of the world is saltwater. There's so much of it, it won't run out.

Morada Middle School student: But there's a lot of cars.

St. Callistus School student: There won't be that many cars where the saltwater will run out.

Ms. Maurillo: What school was that asked that question?

Female voice: Morada.

Ms. Maurillo: Was that Morada?

Female student: Morada Middle School.

Ms. Maurillo: Okay, thank you. Redland Middle School in Rockville, Maryland, do you have a question for this team, please?

Redland Middle School student: How will the materials for the engine be supplied? And was the material included in the car model the same as the production model?

St. Callistus School student: They were basically the same type of materials except the real vanpool will be in a van.

Ms. Maurillo: Tupelo Middle School, first team, do you have a question?

Tupelo Middle School, Team #1 student: Yes. What if people don't want to vanpool?

St. Callistus School student: Our engine can go in cars and doesn't have to be specifically for vanpools. We can make car models for it.

Ms. Maurillo: And final question: Tupelo Middle School, second team, do you have a question?

Tupelo Middle School, Team #2 student: If using saltwater for fuel, how will states that do not have access to the ocean get the water? Also, what environmental impact [has] been considered by using this resource?

St. Callistus School student: We can give saltwater to the inner places that are not near oceans by traveling it by truck and giving it to them. And our engine can also process any type of water. It doesn't just have to be ocean water or saltwater.

Ms. Maurillo: Okay. Thank you very much. That was St. Callistus School in Garden Grove, California.

Ms. Maurillo: Okay. We're running up against the clock here, so we are moving to Tupelo Middle School's first team at the US Department of Transportation's site in Washington, DC. They're from Tupelo, Mississippi. Please commence with your presentation.

TUPELO MIDDLE SCHOOL, TEAM #1

Male student: Before we begin our project, we would like to thank DOT and AASHTO for being our sponsors.

Our project will be known as the Mississippi Railroad Trak. It is produced by Davin Chau, Ryan Spivey, Micah Milne, Cameron Hunt, and Noah Hunt. Our train will run along the Mississippi River. It will be powered by three different sources known as the solar panel, windmill, and waterwheel.

Figure 7. Students from Tupelo Middle School's first team created a sustainably powered train.

Male student: Our locomotive will weigh approximately 3 million pounds, and will be 10 meters long. The train has an efficiency of 0.80 percent, to make it cost approximately $3.4 million. The solar panels, windmills, and waterwheels, however, will cost $2.8 million. The train runs along the Mississippi River holding 85 passengers. It has efficient brakes that stop immediately for emergencies. The track latches around the trains, and this is how we transfer the energy directly from the track to the train. This would also prevent derailing. The train's motor would need about 270 watts to be powered per mile.

Male student: We will be using Soltech solar panels to help produce electricity for the Mississippi River Trak Train. Each solar panel is 65 inches in length, 39 inches in width, 2 inches in depth, and weighs 53 pounds. They are made of monocrystalline silicon, and produce 235 watts per hour, which means you would put 5,377,021 solar panels in each of the following states: Mississippi, Tennessee, and Arkansas.

Male student: We shall be using Windmax windmills. Each one will have a capacity of 1.8 megawatts. Each one should also produce about 4.7 billion watts of electricity each year. According to these calculations, about 10 windmills for every region would be enough to power all the trains that come by. Any extra electricity that we may gain from the windmills would go into storage for later.

The windmills will start generating electricity once the wind reaches 10 miles per hour. They would generate electricity at their rated capacity once the wind reaches 25 miles per hour. They will completely stop making electricity once the wind exceeds 55 miles per

hour, for safety reasons. We will also have cement at the bottom of each windmill just in case something like this may occur.

The blades on the windmills, which will be made out of glass-reinforced epoxy, will be 135 feet long. The actual windmill, however, will be 260 feet tall. This height will assure it more wind access.

Male student: We will be using Pelton-type waterwheels for our waterwheel. We are using this type of waterwheel since it is one of the only types of waterwheel that can be purchased with multiple nozzles, which allows more water to have a greater impact on the runner. It will produce 4,500 watts per hour, and has a permanent magnet alternator which creates electricity whenever it spins. A load dump shall be used in order to regulate the battery voltage.

Male student: On the screen, you will see some pictures of our model, but I shall bring it over here to point them out to you in real life. Here you see we have the solar panels, and here's the waterwheel. The windmills are in use. Here's the train, and there is a service station.

Male student: Thank you for listening to our project. And do you have any questions?

Ms. Maurillo: Thank you very much. That was the Tupelo Middle School first team. Okay. We'll start at the top again with questions. Edna Brewer Middle School, Oakland, California, do you have any questions for this team?

Q&A for Tupelo Middle School, Team #1

Edna Brewer Middle School student: Yes. What if the windmill were to be damaged?

Tupelo Middle School, Team #1 student: There will be a professional there that would check on it daily, and he would fix it.

Ms. Maurillo: Monument Middle School, Rio Dell, California, do you have a question?

Monument Middle School student: Do you guys already have a track for this train?

Tupelo Middle School, Team #1 student: No, we don't, 'cause we have a special kind of track that, when it, the train, runs along it, it powers the train.

Ms. Maurillo: Morada Middle School, Stockton, California, do you have a question?

Morada Middle School student: Yes. Why did you decide to make a train that fits 85 passengers and can only travel short distances, as stated in your presentation? And why would this – and would this type of transportation only work in water-type areas?

Tupelo Middle School, Team #1 student: The train is mainly used for the Mississippi River, and, as is said in the PowerPoint, or presentation – wait. [Whispering] Restate the question, please?

Morada Middle School student: Why did you decide to make a train that fits 85 passengers and can only travel short distances?

Tupelo Middle School, Team #1 student: The "short distance" is mainly because the train would have to travel … if it did travel long distances, the Mississippi River has different parts, and some parts are small, some parts are long, and you'd have to stop occasionally, and let off … maybe even switch, to other parts of the track.

Ms. Maurillo: Redland Middle School, Rockville, Maryland, do you have a question?

Redland Middle School student: What if the windmills are in the place of migrating birds and kill them and damage the environment?

Tupelo Middle School, Team #1 student: We would have to … have some people … come, bring them … We would probably have to have some vet person come and bring them to another environment.

Ms. Maurillo: St. Callistus School, Garden Grove, California, do you have a question?

St. Callistus School student: Yes. Where will you – where will your service stations be located? Would they be in one city, one state, or around the country?

Tupelo Middle School, Team #1 student: They will be located at specific intervals where we feel they will need to be placed.

Ms. Maurillo: And finally, Tupelo Middle School second team. Do you have a question for this group?

Tupelo Middle School, Team #2 student: When do you expect the system to be first used?

Tupelo Middle School, Team #1 student: Whenever it's approved, if it does get approved.

Ms. Maurillo: Okay. Thank you very much. That was our last question. Thank you, Tupelo Middle School, first team!

TUPELO MIDDLE SCHOOL, TEAM #2

Ms. Maurillo: And finally, we have Tupelo Middle School's second team, also from Tupelo, Mississippi, presenting from the US Department of Transportation site in Washington, DC. Please go ahead with your presentation.

Figure 8. Tupelo Middle School's second team invented a flying airport.

Male student: My name is Achintya Prasad.

Male student: My name is Justin Russell

Male student: My name is Kievonte Smith.

Male student: And we're here to present to you the flying airport. Before, the moon was vast and unexplored; then humans landed on it. Before, astronauts spent little time in space; now there is a space station. And now we're here to present to you the future of long-range air travel, the flying airport.

Air travel normally means long and uncomfortable flights. On the flying airport, you simply take off from a small aircraft on the ground, and land at the flying airport. There, you can enjoy things like the atrium on board. When your destination arrives, you'll simply board another plane, and land back down on earth.

Male student: The plane will have a wingspan of two miles, and will be 6,000 feet long. The plane will use liquid-hydrogen jet engines to keep it aloft in the air.

Male student: Currently, transportation creates some of the most airborne pollution. The aviation industry can contribute about 20 percent of that.

Male student: Technically speaking, the flying airport is not very aerodynamic. Therefore, we depend on power and lift to keep the plane aloft in the air. The plane, empty, will weight half a million tons; completely full, over a million tons.

Male student: The energy for the flying airport will come from solar panels and runway shock absorbers.

Male student: Aerodynamics are important for all aircraft. The runway and atrium doesn't offer very good aerodynamics; therefore, we plan to design the wings for the maximum lift for the flying airport.

One problem we faced in building a flying airport was weight. The parts weight, passengers, the smaller aircraft, and the wings, together, will be heavy; therefore, the air frame and building materials are light and durable.

Male student: A couple design challenges we had in the flying airport was how we're going to get our sustainable power. Liquid hydrogen, our main fuel, will come from methane in nearby air. Electricity will supply the airport from solar energy; that will create as much power as 1.5 petawatts, or 1.5 quadrillion watts.

As you see, in a flying airport, we're going to have [an] onboard power transfer that would transport power to our flying airport. Some power will be transferred by Bluetooth.

Male student: As you see here in the chart, our electrical engine production will be 75 percent solar energy, and 25 percent will come from runway shock absorbers.

Since our flying airport will be extremely hard to fly, a fly-by-wire or auto-pilot, which mainly everybody calls it, will help fly the plane. Thrust vectoring or [unintelligible] exhaust the other engine will control the plane precisely.

Male student: The runway and landing bay is a fusion between aircraft carrier and airport technology. Underneath the runway there will be a suspension that will convert kinetic energy, which is produced by the small airplanes' landing, into potential energy. The flying airport will use advanced ground support systems. Freight elevators will rise up from beneath the runway, and claim your baggage. Jet bridges, which will resemble vacuum sealers, will connect to the planes and let the passengers out. All ground support vehicles will be electric-powered and run off of a track system.

Food, oxygen, and water are all part of the atrium self-sustaining life-support systems. Water will go through a purification system and be supplied throughout the aircraft. Food will be grown and supplied to the restaurants as well as oxygen being produced by the plants.

Male student: With the flying airport, there will no longer be a need for long-range aircraft. The largest aircraft to land on our runway is the Boeing 737-600. Amenities for the passengers will mostly revolve around the atrium. However, other amenities will be located in the wings.

Male student: The Transrapid 09 is the preferred tram system and uses "Maglev" [magnetic levitation] technology. It will transport you to the atrium as well as other locations in the aircraft.

Male student: We would like to thank our sponsor, MDOT and AASHTO. Over here, we have model of the flying airport. The flying airport will mostly revolve around the runway, which is designed to be 6,000 feet long. The plane will have a wingspan of 2 miles to keep it in the air. Around the back, you will see the 64 liquid-hydrogen jet engines which will keep the plane aloft in the air. On top is an atrium roof, which will shield the atrium, and give natural sunlight.

In the front is a cockpit section, where the pilots will keep constant watch over systems. Now are there any questions?

Q&A for Tupelo Middle School, Team #2

Ms. Maurillo: Thank you very much, Tupelo second team (applause) We'll start again…in alphabetical order with Edna Brewer Middle School. Do you have a question for this team?

Edna Brewer Middle School student: Are there any safety precautions that should be handled?

Tupelo Middle School, Team #2 student: The flying airport will have multiple backup systems in case of any emergencies, but if there was such an emergency which would compromise the safety of the aircraft, all passengers would get into safety zones located around the aircraft. Then the plane will ditch into the water.

Ms. Maurillo: Thank you. Monument Middle School, Rio Dell, California, do you have a question for this team?

Monument Middle School student: How are you going to keep it fueled while in the air?

Tupelo Middle School, team #2 student: The liquid hydrogen that will be powered – that will power the engines – will come from methane. The methane, which is creating the airborne pollution, will be collected from the air. Then the methane will be extracted – or the liquid hydrogen will be extracted – from the methane, which will be then changed into liquid hydrogen through a process.

Ms. Maurillo: Thank you very much. Morada Middle School, Stockton, California, do you have a question for this team?

Morada Middle School student: Yes. If the average citizens boarded the aircraft, wouldn't these people come back to earth with health issues, since astronauts have to go through physical training to be able to withstand these weightless conditions up in space?

Tupelo Middle School, Team #2 student: This aircraft will simply be flying at normal airplane altitude.…There will be no need for any specific training.

Morada Middle School student: That wasn't the question.

Tupelo Middle School, Team #2 student: Will you please repeat it, then?

Morada Middle School student: If the average people boarded the aircraft, wouldn't people come back to earth with health issues? Since their bodies have been exposed to weightless conditions, astronauts usually go through physical training to be capable to withstand these weightless conditions.

Tupelo Middle School, Team #2 student: This plane won't be in space. There will be gravity. It will just be like being on the ground except it's in the air. There won't be any "health issues" or anything like that.

Ms. Maurillo: Thank you. Redland Middle School, Rockville, Maryland, do you have a question?

Redland Middle School student: My question is, how big would the runway have to be for the aircraft carrier if it is supposed to be two miles wide?

Tupelo Middle School, Team #2 student: The runway will be 6,000 feet long. As Justin said earlier, the 737-600 needs 6,000 feet to land. The wingspan is two miles to keep it in the air.

Redland Middle School student: I meant for that thing. How – how long, and how – how big of a runway would be [needed] to get the aircraft carrier off the ground?

Tupelo Middle School, Team #2 student: To keep the plane – to take the plane off the ground, what we would probably need at least 50 to 60 miles of runway located in the Pacific Ocean. Simply, then, it will take off, and never land again.

Ms. Maurillo: Okay. St. Callistus School, Garden Grove, California, do you have a question for this team?

St. Callistus School student: Yes. Are there any dangers of planes – when the planes land on this airport – isn't it dangerous for a plane to land on something that is already flying?

Tupelo Middle School, Team #2 student: True. It is very dangerous. However, we've taken the inspiration from an aircraft carrier, which is a Navy vessel which already moves in the air … which moves in the sea, and planes simply land on there. It's the same concept here, except in the air.

Ms. Maurillo: Tupelo Middle School, first team, do you have a question for this team?

Tupelo Middle School, Team #1 student: How will it be protected from terrorism or stormy weather?

Tupelo Middle School, Team #2 student: Stormy weather can be answered by simply saying that the plane will be flying above all clouds and weather. Terrorism is an already-important problem which happens on any flight. You just have chances, really. You'll have security on the ground and onboard the aircraft.

Ms. Maurillo: Okay, that was the last question and the last presenting team. I would like to thank everybody. And I'd like to say you all did a very impressive job. I could tell that there was a lot of hard work that went into every one of these presentations.

And I especially would like to say thank you to the teachers, because my daughter is a teacher, and I know firsthand how hard they work, and I know this was an extracurricular activity, which means more time in a teacher's already really-packed schedule. So thank you to all the teachers who helped their students. And I would like to turn this over to Rod Diridon for his final comments.

FINAL REMARKS

Mr. Diridon: Donna, thank you to you, for all of the coordinating that you put into this, to make sure that this twelfth annual Garrett Morgan program was our very best.

Ms. Maurillo: Thank you.

Mr. Diridon: And thank you also to US DOT, to AASHTO, to AAPTA, to Caltrans Districts 1, 4, and 10, and to OCTA, for sponsoring teams. They all did very, very well. The judging is going to be difficult, and thank you for making it difficult! We'll look forward to hosting one of you at the annual Mineta Institute banquet on June the 23rd.

Ms. Maurillo: We'll notify you in a week.

Mr. Diridon: Donna said we'll notify you of the winner within the coming week, and we wish you very good luck in your education and your future careers, and we hope those careers will be in transportation. This session is adjourned.

APPENDIX A: ABOUT GARRETT MORGAN

GARRETT AUGUSTUS MORGAN, 1877–1963

Garrett Augustus Morgan, 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 11 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.

Figure 9. Garrett Augustus Morgan as a young man.

Despite his humble beginnings and lack of formal education, Mr. Morgan made a great impact on the transportation industry. But it was only after his death in 1963 that Mr. Morgan was awarded a citation by the U.S. government for his significant inventions.

Not only did he invent the zig-zag attachment for sewing machines, but he also invented the first successful gas mask and used it himself to rescue several men trapped in a tunnel. Many fire departments ordered the mask, but when they found out that the inventor was a black man, they canceled their orders. He had to hire a white man who pretended to be Garrett Morgan so people would buy the masks.

In 1923, Mr. Morgan invented and patented a successful traffic signal. It was during this time that automobiles were becoming common, sharing the nation's streets with bicycles, horse-drawn vehicles and pedestrians. Collisions were frequent and often bloody. After witnessing such an accident in Cleveland, Ohio, Mr. 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.

At night, or when traffic was minimal, the Morgan signal could be positioned at half-mast, alerting approaching motorists to proceed through the intersection with caution. This technology was the basis of the modern-day traffic signal and was a significant contribution to what we now know as Intelligent Transportation Systems.

The Mineta Transportation Institute presents an annual symposium by videoconference as part of its mission to provide technology transfer, education and research on current issues and emerging solutions in 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 address the topic of sustainable transportation and propose innovations for surface transportation. The purpose of the symposium is to stimulate the minds of young people and encourage them to excel in mathematics and science, which could lead to careers in transportation engineering, transportation planning, environmental science, public transit, and innovations in transportation safety and security.

Through the work of many people, this event and this publication add to the spirit of transportation innovation and progress that Garrett Augustus Morgan personified so well.

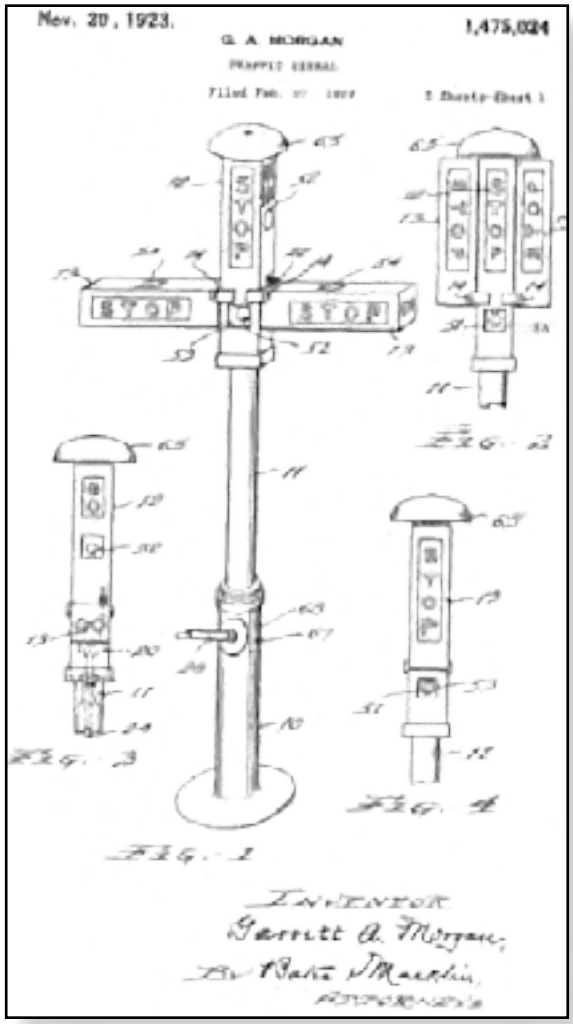

Figure 10. Garrett Morgan's Traffic Signal

MINETA TRANSPORTATION INSTITUTE

The Norman Y. Mineta International Institute for Surface Transportation Policy Studies was established by Congress in the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). The Institute's Board of Trustees revised the name to Mineta Transportation Institute (MTI) in 1996. 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.

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