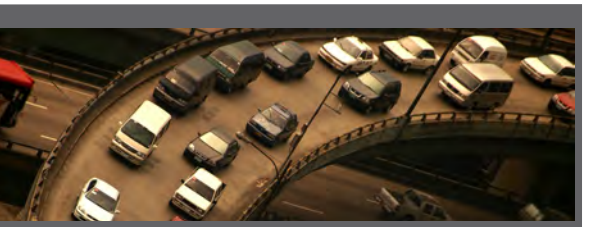
Thirteenth Annual Garrett Morgan Sustainable Transportation Symposium

MTI Report S-13-01



MINETA
TRANSPORTATION INSTITUTE
MTI

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.

REPORT S-13-01

THIRTEENTH ANNUAL GARRETT MORGAN SUSTAINABLE TRANSPORTATION SYMPOSIUM

September 2013

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16. Abstract

On April 9, 2013, the Mineta Transportation Institute (MTI) continued its support of the U.S. Department of Transportation's Garrett A. Morgan Technology and Transportation Futures Program by conducting the Thirteenth National Garrett Morgan Symposium and Videoconference on Sustainable Transportation.

The ongoing mission of this national videoconference is to stimulate the minds of young people and to encourage them to pursue challenging academic programs including mathematics and science—an education course that will prepare today's students for tomorrow's challenging transportation careers.

Participating schools were: Eagle Prairie School, Rio Dell CA (two teams); Juan Crespi Middle School, El Sobrante CA; Morada Middle School, Stockton CA (two teams); St. John the Baptist, Costa Mesa CA (two teams); and Tupelo Middle School, Tupelo MS. Cardozo Senior High School, Washington DC, demonstrated a class project to inspire the younger students about their opportunities in high school.

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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 Thirteenth Annual Garrett Morgan Sustainable Transportation Symposium, which was held on April 9, 2013. 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 Malcolm Dougherty; Caltrans Deputy Director Bijan Sartipi, District 4; Caltrans Associate Transportation Planner Christine Azevedo; American Public Transportation Association (APTA) CEO Bud Wright; American Association of State Highway and Transportation Officials (AASHTO) President and CEO Michael Melaniphy; United States Secretary of Transportation Norman Y. Mineta (ret.), and current Secretary of Transportation Ray LaHood.

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: St. John the Baptist, Irvine CA, teacher Jeff Urbaniec, sponsored by Heidi Hsing of Orange County Transportation Authority (OCTA); Tupelo Middle School, Tupelo MS, teacher Julia Smith, sponsored by Linda Clifton of AASHTO; Eagle Prairie Middle School, Rio Dell CA, teacher Cheryl Steiner, sponsored by Brenda Bowie of Caltrans District 1; Juan Crespi Middle School, El Sobrante CA, teacher Gail Pavlich, sponsored by Alfonso Miles of Caltrans District 4; and Morada Middle School, Stockton CA, teacher Aason Sass, sponsored by Jessica Belen of Caltrans District 10; and Cardozo Senior High School, Washington DC, coordinator Shirley McCall, sponsored by Mariah Stanley of APTA.

Sincere thanks to the technicians at each videoconference site, including Jeff Smith at US DOT; Cora Medearis at OCTA; and Cherice Luckey, Tim Day, David Louie, and Sharon Ward at Caltrans. Their technical know-how and troubleshooting enabled this coast-to-coast video-conference.

Special thanks to the engineers from Caltrans, who mentored the students with their projects. They include Sheri Rodriquez from District 1; Brian Rowley from District 4; and Pat Robledo, Omar Zarzuela, and Sinaren Pheng from District 10.

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 Tech Transfer Donna Maurillo, Student Assistant Donghoh Han, Research Support Manager Joseph Mercado, and Webmaster Frances Cherman. 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 Thirteenth Annual Garrett Morgan Sustainable Transportation Symposium, held April 9, 2013. This event is central to the Mineta Transportation Institute's goal to provide information and technology transfer. Middle school students are the target audience for this competition because they will become transportation's future leaders and innovators.

Transportation is a growth industry in both the public and private sectors. Our nation has a critical interest in improving and expanding public transportation, in repairing and improving its existing highway and rail systems, and in creating sustainable transportation. These needs will offer opportunities in all areas of transportation planning and management, 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 were 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 required of transportation professionals—math, physics, chemistry and other sciences, and of course, excellent communication and presentation skills.

MTI is happy to congratulate all students because they met a difficult challenge. MTI also extends its thanks to those individuals included in the acknowledgements section. Without each of them, this educational opportunity simply would not have happened.

Rod Diridon, Sr.
Executive Director
Mineta Transportation Institute

EXECUTIVE SUMMARY

On April 9, 2013, 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 Thirteenth 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 US Secretary of Transportation Rodney E. Slater. The program has three cornerstone components:

- To establish a partnership among the US 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:

- Eagle Prairie Middle School, Rio Dell CA (two teams)

- Juan Crespi Middle School, El Sobrante CA

- Morada Middle School, Stockton CA (two teams)

- St. John the Baptist, Irvine CA (two teams)

- Tupelo Middle School, Tupelo MS

- Cardozo Senior High School, Washington DC (demonstration only)

Event Highlights

The students were welcomed by MTI's Communications Director Donna Maurillo, American Public Transportation Association President and CEO Michael Melaniphy; American Association of State Highway and Transportation Officials Director of Meetings and Member Services Monica Russell, and Caltrans Director Malcolm Dougherty. Retired Secretary of Transportation Norman Mineta introduced the current Secretary of Transportation Ray LaHood, who addressed the students. Each school was allowed to ask one question of Secretary LaHood, who engaged with the students and provided encouragement to complete their educations. Ms. Maurillo moderated the program.

She reminded the students that the day's activities 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.

A lively question and answer period followed the presentations, with classes asking questions of each other. Extra points were awarded to schools for each answer that was managed well.

The winning team from Juan Crespi Middle School was announced a week later. Teacher Gail Pavlich, Caltrans District Four sponsor Alfonso Miles, a group of students, and parents 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.

The videoconference, in its entirety, can be viewed at www.dot.ca.gov/research/planning/garrett_morgan_symposium/garrett_morgan_progam.htm

THE PROGRAM

Note: Due to technical difficulties with the national connection, the first ten minutes of the program were not recorded. What follows is a transcript from that point onward.

Q&A with Secretary Ray LaHood

Sec. LaHood:…We will wrap up. Yes?

Female Student: Hello. My name is Keivonte. Can you just describe for us or give some examples of how the Department of Transportation interacts with other federal, other offices in the federal government?

Sec. LaHood: Very good question. How are *we* working cooperatively with other federal agencies and other cabinet members? I think the best example I can give is the work that we did with the Environmental Protection Agency, EPA. The President asked the EPA administrator, and myself, to work together to raise gasoline standards for automobiles. When you look at a car, you can look on the sticker and see whether you might get 20 miles per gallon, 22 miles per gallon, how much combined you'll get. And what the President asked us to do was to work with the automobile manufacturers to get those gasoline standards much higher by the year 2025.

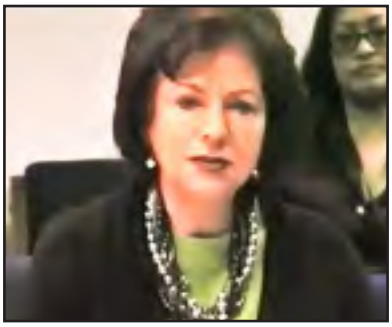
So we worked for four years with all the car companies that make the cars, and with the EPA, and we reached an agreement that all cars, and all light trucks will get 54.5 miles per gallon by 2025. That means they have to make cars that are a little bit lighter, that use different kinds of materials than they do right now. But that's a way that we [worked together], because the President told us to, because he wants people to get good gas mileage so that we use less gasoline, the air is cleaner, our cars are still safe. But people don't have to, and we know gasoline prices are not going to come down. They're expensive. So that's an area where we worked.

Male Student: Mr. Secretary, you have stressed air and ground and possibly even water transportation. But what I'm wondering is more about the distant future of transportation.

What are the budget and safety requirements that you're going to set for space transportation, as there are companies such as SpaceX that are looking forward to actually taking tours into space?

Sec. LaHood: We actually had a meeting with Richard Branson, who's very interested in space travel, and he talked to us about his ideas for the kind of vehicle that he wanted to send up into space, and we talked with him about his ideas. It's more visionary, and more aspirational, rather than any kind of a practical solution, but he's developing it. He's selling opportunities for people to become passengers on that vehicle, and so we will continue to work with him on his vision for not really putting a man on the moon, but more travel in outer space. And we're working more with the private sector on that, rather than our own resources. As you know, when President Obama came in, he really wanted the private sector to be more involved in space travel, and with NASA, and that was a big change that is now being accomplished.

Well, again, thank you all for coming to the department. Norm, thank you for your leadership, and for encouraging young people to get involved in transportation. I think this is my fourth or fifth visit that we've been invited to participate in this program. We appreciate all of you. And we hope all of you will look at transportation as a good opportunity. Good luck, everybody! (applause)



Ms. Maurillo: Thank you, Mr. Secretary. This is Donna Maurillo. I am the communications director at the Mineta Transportation Institute, and I want to thank everybody for participating. We are going to have to adjust our schedule a little bit because of the technical issues. So, we'll just jump right into this here. I would like to invite APTA CEO Michael Melaniphy to say a few words. Michael is on our board of directors at the Mineta Transportation Institute, and he is also head of the American Public Transportation Association in Washington. Go ahead, Michael.

Mr. Melaniphy: Thank you very much, Donna. We appreciate that. Good morning, everyone! What a great opening, wasn't it? To hear Sec. LaHood and to hear Sec. Mineta. It was fantastic. Great, great, to hear from them this morning.

I want to thank the Mineta Transportation Institute for sponsoring the session this morning. We certainly appreciate all their leadership in this field for so long, and I certainly thank Sec. Mineta for his leadership in transportation, and inviting young people to get engaged and involved in it, to be our future here in transportation.

I'm very pleased to introduce the students from the TransTech Academy at Cardozo Senior High School. APTA is a proud sponsor of this school, and it was the first transportation-related high school in the DC school system, and something we're very proud to be associated with. In fact, we are very pleased to have with us today a 2008 graduate of that very program who now works at APTA on our staff, Ms. Mariah Stanley, a graduate of your high school. She now works here at APTA. Congratulations, Mariah! (applause)

You all represent the very best of the next generation of leaders in the transportation industry. You have the talent and the enthusiasm to advance public transportation. And I want to send a special shout-out to the students out in California. I began my education in the public-school system in San Diego, and that's where I got my first inspiration for transportation. And here I am, leading the association for public transportation in this country.

We have a very active youth program at APTA, an outreach-and-awareness program designed to promote careers in this exciting industry, and we have two major initiatives that are coming up. On May 16th, we'll hold our national public transportation career day to introduce students in K-12 to the public transportation industry. We feel it's important to expose you to the breadth and diversity of future job opportunities in the public transportation field.

And in June, we're hosting a youth summit for junior- and high-school students right here in Washington DC, and you may want to consider participating in a few years. Remember, public transportation is cool. We build big projects that last for generations and move millions of people every day. It's a great field to be involved in.

And now it's my pleasure to introduce our official host for today's event, Miss Monica Russell. Monica is director of meetings and member services for the American Association

of State Highway and Transportation Officials, otherwise known as AASHTO. Monica, please take it away!

Ms. Russell: Thanks so much, Michael, and I'm honored to be here. As Michael mentioned, I am the director for meetings and member services for AASHTO, and it's exciting to be hosting and sponsoring this year's Garrett Morgan Symposium. I'm also joined today by Jack Basso, who is the former US Department of Transportation assistant secretary for budget and programs, and he's also recently retired from AASHTO after 12 years.

You are all winners today, and, again, I'm excited about being here. I commend you for the creativity, the teamwork, and the vision that you have displayed in developing your sustainable-transportation projects. Our future depends on young people like you who have the ability to identify problems and develop solutions.

Just as Garrett Morgan began as well-known innovator of the traffic light, and other inventions that save lives and change the world and transportation, you, too, can be a catalyst in changing the future of transportation. AASHTO is pleased to host the Garrett Morgan Symposium today, and we wish you all the best in the competition this year.

Mr. Basso: Monica, thank you, and thank you and the AASHTO staff for the excellent work that you've done in advancing this program, particularly Secretary Mineta. We're grateful to the Mineta Institute.

Now I get to do a task that I was delighted to have the opportunity to do. Bud Wright, who's the new executive director of AASHTO, unfortunately had to be out of town. They're having a chief administrative officers' forum out in the middle of the country. So he asked me to come and sit in for him and to introduce Secretary Mineta, which is a great pleasure for me. You may notice I don't have any notes. I don't need any for this task.

Secretary Mineta really personifies an extraordinary public servant, and I'll describe a little bit of that for you. He also, as importantly, personifies the American dream in his practicality. Secretary Mineta was originally from Northern California, the San Jose area. During World War II -- you've heard of the internment of the Japanese-Americans, perhaps? If you haven't, Secretary Mineta and his family were interned in World War II. He subsequently went on, after that, to rise to become the mayor of the city of San José, California, beginning his public career.

He, from there, was elected to the United States Congress and served on what is now the transportation infrastructure committee, advancing to be the chair. I had the pleasure of working with him in 1990, 1991, as one of the landmark pieces of highway and transit legislation was under his craftsmanship. It was put together, enacted, and went forward. Extraordinary feat.

In addition to that, he later served as a major executive in the private sector, and, from there, he was appointed by President Clinton to be the Secretary of Commerce in *his* administration. Subsequent to that, as many of you know, Secretary Mineta went on to serve as the US Secretary of Transportation in the George W. Bush administration – first term of that, and a little beyond. The rest of the story, though, is even as important, as I said. His rise in this country could only happen in a country like this, where that opportunity is given for those who are willing to take it. So I want you to realize you have great potential and opportunities – all of you! – for the future. You can do the same things.

I'm the product of that. When I got out of high school, I really didn't think I wanted to go to college. I got my mind changed in a hurry after I figured out how the rest of the world worked. But again, great opportunities I've had over the years to serve, and you'll have the same.

The last thing I'll mention about Secretary Mineta: On the absolutely tragic day of 9/11, which is a code word for something all of you know, Secretary Mineta was one of the instrumental leaders that addressed the crisis, managed to bring all the planes down within a matter of an hour. Thousands of planes were in the air. Do it safely. And he went on to lead the creation of the Transportation Security Administration. His architectural work is very much ever-present in government. So with that having been said, it's my distinct privilege to introduce Secretary Norm Mineta.

Sec. Mineta: Jack, thank you for that very generous introduction. But let me at this point, because we're talking about careers and future about transportation, and about all of you,

let me direct the remarks now to Donna Maurillo, who is going to introduce the director of the department of transportation for the State of California. So, Donna, are you on next?

Ms. Maurillo: Yes, Mr. Secretary. I will go ahead and introduce Malcolm Dougherty.

Sec. Mineta: Great. Thanks, Donna.

Ms. Maurillo: Thank you very much, Mr. Secretary. It's a pleasure to have you with us. Malcolm Dougherty is the director of Caltrans. Caltrans is the State of California's Department of Transportation. We are the third-largest state in the country, and the seventh- or eighth-largest economy in the world, so Mr. Dougherty has quite a responsibility in keeping everything moving here in the state. Mr. Dougherty, would you take over, please, and introduce our schools?

Mr. Dougherty: I will! Thank you very much, Donna. And let me also express my appreciation to Rod and the role that he plays in putting this on, and the work that he does at the Mineta Transportation Institute. You all do very good work.

Good morning, and good afternoon to those of you on the East Coast. It *is* my pleasure to be here today and offer up a few words, as well as introduce the schools. This is one of my favorite activities throughout the year because it gives me an indication of what young people are thinking and of the talent that is behind this. It replenishes my confidence that the next generation is going to be in good hands. Through this exercise, if we have the opportunity to just plant some seeds in some of your minds to pursue a career in transportation, then all of us are going to be the beneficiaries.

It is always a treat for all of us who are already in the field of transportation to hear from Secretary LaHood, as well as retired Secretary Mineta. So that is also part of the joy for us.

Now, I work at a department of transportation. I am a civil engineer by trade, which puts me in the field of working on roads and bridges as well as mass-transportation projects. But there are also lots of other careers in transportation that you can think about, as well, on the environmental side, and the right-of-way side, and the project-management side, as well as building high-speed rail, which was mentioned earlier. So there are lots of opportunities in transportation. We hope that you think about that.

With that said, I would like to introduce the schools that we will be hearing from today. First, let me congratulate each one of them for getting here and to wish them luck today.

First, I'll start with the schools that are in Washington DC. The first school is Cardozo High School from Washington DC. As I understand it, they are going to be making a presentation, but not in competition with the seventh- and eighth-graders. Their teacher is Lee Carpenter, and they are sponsored by APTA, who you heard from earlier today, and, specifically, by Maria Stanley. Their academy coordinator is Shirley McCall. So you could all wave and acknowledge yourselves and welcome Cardozo High School from Washington DC.

The next school is actually from Mississippi, and they are presenting here at the same location in Washington DC. It's the Tupelo Middle School eighth graders. The teacher is Julia Smith, and they are sponsored by Linda Clifton from AASHTO, which we already heard from here today. So could you wave and acknowledge yourself? Welcome!

And now I'd like to introduce the schools from the West Coast. Many of these schools are at our different Caltrans districts throughout the state. The first one is from our Caltrans District 1, which is on the North Coast of California. It's Eagle Prairie Middle School seventh- and eighth-graders. They actually have two teams. Their teacher is Sheryl Steiner, and the Caltrans engineering mentor for those teams is Sheri Rodriquez. They are sponsored by Caltrans District 1 and Brenda Bowie. So welcome to Eagle Prairie Middle School, and good luck to each of you. And if you could, please wave and be recognized.

The next school is from Caltrans District 4, which is in Oakland, and represents the Bay Area of California. It is Juan Crespi Middle School eighth-graders, and they are from El Sobrante, California. Their teacher is Gail Pavlich, and their Caltrans engineering mentor is Brian Rowley, and the Caltrans District 4 representative who sponsored them is Alfonso Miles. So welcome to Juan Crespi Middle School, and good luck to each of *you*. And if you could wave and be recognized.

Next, from Stockton, California, which is south of Sacramento, the state capital. That's actually where I'm broadcasting from. There are two teams from Morada Middle School, and they are seventh- and eighth-graders. Their teacher is Aaron Sass, and there are several Caltrans engineering mentors for these schools. First, Pat Robledo, Omar Zarzuela, and Sinaren Pheng from Caltrans. And the sponsor from Caltrans District 10 is Jessica Belen. So if you could each wave and acknowledge yourselves, and welcome and good luck to you.

And lastly, down to our Caltrans District 12 office, which is in Orange County. Actually, they are sponsored by the Orange County Transportation Authority. We have St. John the Baptist [Catholic] School, and they are in Irvine, California. Their teacher is Jeff Urbaniec. Again, they are sponsored by the Orange County Transportation Authority. Somebody who has been very involved in this program was their former chief executive officer, Will Kempton, who recently retired. But I will tip my hat to Will and his efforts. Their coordinator is Heidi Singh, and they also have two eighth-grade teams. So welcome to St. John the Baptist School. And if you could wave and also be acknowledged, and good luck!

So, again, congratulations to each of you. Good luck today in your presentations. I always am impressed by the outstanding job that you all do, and I hope that many of you consider

a field in transportation in the future. And, again, thank you, and I will return the microphone to Donna in Oakland.

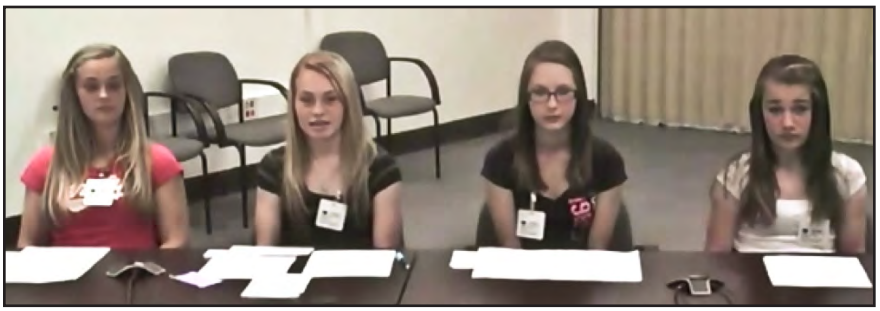
Ms. Maurillo: Thanks very much, Malcolm. Now it's my pleasure to have the students make their presentations, and I will explain the process. Each presentation will be a maximum of 10 minutes. After each presentation, we will rotate through the schools to find out if you have a question. Please take notes during each school's presentation so that you can have a good question because each team will get an extra point for answering each question well.

We have three judges who have no stake in the outcome, so there are no judges from Caltrans or from AASHTO or APTA. So they will be completely neutral. We used to give only one prize each year. But we realized so that so many schools put so much effort in that we decided to give a first, second, and third place prize each year. So first place is $500 for the class. Second place is $300, and third place is $200. Each of those will receive a plaque, and all students who make a presentation will receive a certificate that is personally signed by Secretaries Mineta and LaHood.

I will start with the first school. We have chosen them to go in random order. We used to do alphabetical order, but that always meant that the same school was always last. Also, because some schools have committed two teams, rather than doing those teams consecutively, we have decided to give them a break so that the second team has time to set up. So if a school has two teams, they will be separated by another school's presentation.

THE COMPETITION

Eagle Prairie Middle School, first team



SEKK SM-450 Solar-Methane-Powered Truck

Female student: Good morning! I am Cindy Bishop.

Female student: And Emily Clary.

Female student: Kelsey Day.

Female student: And Kylee Blake.

Ms. Bishop: We are holding this press conference today to introduce a new vehicle that will meet the needs of those individuals and families that work hard and play tough. We, the engineers and designers present you the SEKK SM-450 truck. It's powerful, capable, and fuel-efficient. The SEKK SM-450 is a solar-methane-powered truck, rugged and powerful enough for back roads and hauling trailers, but also smart and fuel-efficient for everyday use.

Female student: "Why a truck?" you may ask.

Female student: We looked at the needs of our area, and other rural areas. Higher fuel costs in the already-tight budget of rural life becomes impossible. Here are some of the factors we looked at.

Female student: Based upon a needs assessment, our general reasons are: We live in a rural area. We have logging, farming, and fishing industries. We have a large percentage of hunters. Forty-five percent of our population owns trucks, and also, trucks have high fuel consumption.

Female student: Our personal reasons are: Our families have trucks, and two of us travel to horseback-riding competitions throughout California.

Female student: And we need the power to pull our trailers.

Female student: This is a blueprint for the first model, or option 1: This truck has the following features. This will be the first of the series of the trucks that we make. We will put solar cells in the glass of the sunroof and the windows of the truck. This will give enough energy to power all electrical equipment that the truck has. The solar energy will power the CD players, charging outlets, seat warmers, TV screens, [air conditioners], heaters, GPSes, radios, and anything else electrical. While the solar is powering the electrical portion of the vehicle, the methane will power the actual vehicle itself.

Female student: So let's take a look at methane gas that will power the truck. Methane can be produced from cow manure. We looked at the sustainable fuel because of the possibility of its production in Humboldt County. Methane gas is a much cheaper form of fuel than gasoline and, if produced in Humboldt, it could be a boost to our economy.

Female student: Harnessing dairy manure for clean energy. Manure from dairy cows can generate enough fuel for 1 million vehicles. Cows alone can produce 150 million gallons of methane gas a year. Methane gas could be produced in Humboldt County. Humboldt County has many dairy farms to accommodate Humboldt Creamery and Loleta Cheese. We have a large number of cattle ranches and farms.

How is cow manure turned into methane gas? Here is the process. The manure will go in through a manure inlet. As the manure decomposes, the biogas rises to the top of the tank, and the active solids fall to the bottom of the tank. The active solids are then released to the effluent outlet and used for fertilization of fields and crops. The bio-gas exits the bio-gas outlet and must be purified to remove other gasses before it can be pumped into vehicles. Not only is this a sustainable fuel, but byproducts from producing methane are beneficial.

Female student: While designing our first model of the SEKK SM-450, we came up with another option. This truck has all the same features as the first option but relies more fully on solar cells to power the truck, with a methane switchover for backup fuel.

This will be the second, more advanced truck that we will invent. The second option will cost more than the first, adds more solar panels, and a more-complex system. The truck will operate on solar energy during the day and methane at night.

The hood of the truck and the roof of the truck will be completely covered in solar panels. During the day, the truck will absorb the sunlight, and the panels will convert it into energy, thus providing power to the batteries that our truck has. Our truck will have several batteries stored throughout the body of the truck that will power the truck. During any time our truck lacks power to operate from the solar energy, the driver will be able to switch over to the methane alternate. It will be as easy as the flick of a switch to change between our operating systems. Just like trucks these days that have dual fuel tanks, you just flick a switch to change between our solar and methane operating systems. Once you change to methane, there will be no lag in power. It will simply keep running as smoothly as before. You can also run methane fulltime, day or night, if you prefer.

Female student: Solar voltaic cells are a key component of our truck designs and engineering. The cells we would use come in a thin film that applies like a very thin skin to the surface of the truck. They are lightweight so as not to interfere with the aerodynamics of the truck. And they are transparent, so they can be applied to the windshield and windows of the truck without obstructing the driver's vision. Let's take a closer look at the solar cell.

The cell has all the capabilities of a regular solar cell, but our version will be cadmium-free, because this element is toxic and not good for the Earth.

We will also use another source for silicon, because pure silicon is tough to find. For our cell, we will have a plant-based semiconductor.

Now let's take a look at the all-important factor, the cost. Our truck is competitively priced. We based our cost estimates on the following factors. Estimated cost: Concepts behind cost. Thin solar film can be produced in large sheets cheaper than regular solar panels. Solar-cell prices have dropped 85 percent in the past 10 years -- supply and demand, increased interest in fuel efficiency.

Female student: Proposed cost per truck. Our estimated cost of the SEKK SM-450 for option number 1 would be $60,000; and for option number 2, it would be $68,000 because of the more complex system.

Female student: So why the SEKK SM-450? Well, like we said at the beginning, it's powerful, capable, and fuel-efficient. Let's take a closer look at the reasons people will jump for joy over this truck.

Female student: It has great performance like your regular truck. It runs on methane, 68 cents per gallon. It's more fuel-efficient. The fuel cost is lower. It's renewable and nicer for the Earth. It has thin and transparent solar film. It helps with fuel efficiency. It's a more environmentally-friendly cell, and it's competitively priced.

Female student: Thank you for joining us this morning. We hope we have sold you on the SEKK SM-450.

Ms. Maurillo: Thank you very much, District 1. We will open the floor now for questions, and we will go in order of the way they will present their projects. So that means District 4, Juan Crespi Middle School from El Sobrante, California, will ask the first question of this team. Who wants to ask that question? Okay. Go ahead.

Q&A for Eagle Prairie Middle School first team

Q: **(Female student)** Yes. My name is Xalli Gordon Chavez, and my question is, what are you planning to do to eliminate the danger of methane gas causing an explosion in your cars or factories?

Ms. Maurillo: Can anybody answer that question? Did you hear it?

A: **(Female student)** It's made out of special materials.

Ms. Maurillo: Thank you. We will go now to Washington DC, to Tupelo Middle School. Do you have a question for Eagle Prairie Middle School?

Q: **(Male student)** My question is, if you wish to mass-produce this truck, just who will your contractor be? Will it be like a Ford? Or will it be GMC? Or is this a private enterprise?

A: **(Female student)** It will be a Chevy, and there will also be more models of the truck, not just one type.

Ms. Maurillo: Thank you very much. We'll go to Stockton now, Caltrans District 10. Morada Middle School, do you have a question for these students?

Q: **(Female student)** Yes. Under the event of a broken solar panel or methane leak, how much will this cost to repair?

Male student: Did they hear that?

Ms. Maurillo: Did you hear the question?

Female student: Can they please repeat it?

Q: **(Female student)** Oh, yes. Under this event of a broken solar panel or a methane leak, how much will this cost to repair?

A: **(Female student)** It would be just like a regular car. It'd cost as much.

Ms. Maurillo: Okay, thank you. We'll go now to Caltrans District 12, to St. John the Baptist School. Do you have a question for this team?

Q: **(Male student)** What chemicals and solutions are being produced within your gas and factories for your process to be turned into fuel? Do you realize that this causes pollution as you burn the gas?

A: **(Female student)** No, it doesn't.

A: **(Female student)** The process doesn't produce pollution.

Ms. Maurillo: Eagle Prairie, does your second team have a question?

Female student: Someone is coming up to the table.

Q: **(Female student)** So our question is, how would the solar cell work exactly? What process would it have to go through, to work? To be used for fuel?

A: **(Female student)** It has to go through the plant. The plant cell. That's what it says here.

Ms. Maurillo: St. John the Baptist, does your second team have a question?

Q: **(Male student)** For the second option, will the solar panels produce enough electricity to run the truck alone? Or will you need some of the methane gas to add to that power?

A: **(Female student)** It could power it alone.

A: Yes. The solar panels could run the truck by themselves.

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

Q: **(Male student)** Yes. Where can the truck owner get methane gas?

A: **(Female student)** It will be made, and then you can just get it like regular gas.

Ms. Maurillo: Cardozo Senior High School in Washington, do you have a question for this team? Is Washington still on the line?

Q: **(Male student)** Yes, we are. Will this product be made domestically or in a foreign country?

A: **(Male student)** Domestic.

A: **(Female student)** Domestically.

Ms. Maurillo: And, finally, Eagle Prairie Middle School. Oh, I'm sorry! You just did the presentation. Okay. We will go here in Oakland. The second team to present will be Juan Crespi Middle School from El Sobrante, California. Okay. Here we go.

Juan Crespi Middle School

Cellulose Ethanol as Fuel

Female student: Got it, Josh?

Male student: Mmhmm.

Female student: Our company, WE, which stands for wood ethanol, believes that making ethanol from wood-waste products is the most effective means of creating a sustainable, long-term transportation fuel. Alice, introduce yourself.

Female student: Oh, I'm Alice Johnson.

Female student: I'm Molly Brannick.

Female student: I'm Xalli Gordon-Chavez.

Male student: I'm Joshua Manio.

Female student: I'm Ariel Tonesi Borrini.

Male student: I'm Kwame Baah here.

Female student: And I'm Neziah Whitson.

Female student: Unfortunately, Talisha Scroggins was not able to make it. She's ill.

Female student: Why is cellulosic ethanol the best choice for future energy needs?

Male student: For one reason, all cars can be made to run on ethanol.

Female student: Cellulosic ethanol is virtually carbon-neutral. In other words, it has almost no carbon footprint and will not affect carbon levels in our atmosphere.

Female student: Wood ethanol reduces air pollution and creates less toxin.

Female student: Two weeks ago, Congress passed a legislation that limited sulfur emissions in gasoline. However, by using wood ethanol, we have honored this legislation because there will be no sulfur emissions.

Female student: It also reduces landfill waste by over 50 percent.

Female student: Instead of wasting all of this valuable resource by burning it, we can make it into ethanol.

Male student: Wood ethanol creates a positive balance of trade, makes the US more energy self-reliant, and opens a wide range of domestic jobs. All imports are only going up.

Female student: Cellulosic biomass is renewable and is abundant throughout the US as well as the entire world.

Female student: Anything that comes from plants is cellulosic biomass. Some examples of cellulosic biomass are newspapers, land clearings, construction wood waste, agricultural residue, and food-processing waste.

Female student: One point four two (1.42) billion bone-dry tons (BDT) of cellulosic feedstock is in the US. The feedstock consists of agricultural and forest residues, as well as municipal solid waste.

Female student: This is how much energy there is in different feedstocks. Hardwood, mixed paper, and corn are all high-yielding ethanol sources.

Male student: With current technology, we can make over 25 billion gallons of ethanol in America. With future technology, we can make over 70 billion gallons of ethanol in the US alone.

Female student: This is the current feedstock potential available in California.

Female student: In California, with current technologies, we can produce about 650 million gallons of ethanol. Our future expectations are to make almost 2 billion gallons of ethanol per year.

Female student: How *do* you make cellulosic ethanol?

Female student: There are six steps to making ethanol.

Male student: The first step of making ethanol is pretreatment. In this step, you increase the surface area of the plant fibers for hydrolysis. This is the most expensive part of making ethanol.

Female student: Hydrolysis is the second step. This is where you break down the cellulose into individual sugars. Once the sugars are free, they can be fermented for ethanol.

Female student: The next four steps of our ethanol-production pretreatment consists of separation, fermentation, distillation, and dehydration.

Female student: Is it cost-effective to make cellulosic ethanol?

Female student: It costs about a dollar more per gallon to make than corn ethanol and gasoline. The reasons? Capital expenses, enzymes, and feedstock.

Male student: The cost of enzymes have decreased by 72 percent in the last five years, and are continuing to decrease.

Female student: Feedstock costs are one-sixth of the total cost.

Female student: Cellulosic waste is either cheap or free. It will come from forest debris, agricultural debris, and municipal solid waste.

Female student: The key to cutting overall operational costs is to locate your ethanol plants near your feedstock sources.

Female student: In a small plant that roughly makes 1,000 gallons a day – that's the equivalent to a wood-chipper truck – you would make 365,000 gallons per year. If sold at $4 a gallon, then, in a year, you would make $1,460,000, and half would be profit. This would go to paying back investors.

Male student: In 2009, oil reached $143 a barrel, and gasoline cost almost $6 a gallon.

Female student: These images show what is currently happening in the United States as a result of drilling for oil.

Female student: Other great minds besides our company have acknowledged that ethanol is one of the most efficient fuels of the future. Let us be reminded that Henry Ford, creator of Ford Motor Company, is quoted as saying, "The fuel of the future is ethyl alcohol."

Female student: Making ethanol plants is a win-win for everything and everyone.

Female student: Can we afford *not* to stop pollution and greenhouse gases? For the sake of our planet, we must. Shall we do the boards?

Female student: Abengoa is a fully-functioning ethanol plant in the Netherlands. It produces 1.4 million gallons of ethanol a year. The Netherlands went from being 99 percent dependent on imported oil to becoming completely independent with renewable energy sources.

These are the ways that the world can be going off the grid. We will use windmills and solar panels. We will also be using methane to use as power for our nearby ethanol plant. We will also be using woodchip electro generators. The small one can make 20 kilowatts.

Ms. Maurillo: Thank you very much, Juan Crespi Middle School. I will go down the list and, in the interest of time, I'm going to have each school ask only one question. I won't do first team and second team, because we need to meet our deadline here for broadcast timing. So we will go first to Tupelo Middle School in Washington DC. Do you have a question for this team?

Q&A for Juan Crespi Middle School

Q: **(Male student)** Yes. My question is, what particular transportation mode do you want to use this ethanol for?

A: **(Female student)** Cars. We would like to use this ethanol, or wood ethanol, to fuel automobiles.

Ms. Maurillo: Okay, thank you. And anything else? Okay. We'll move on to Morada Middle School in District 10. Do you have a question for this team?

Q: **(Female student)** Yeah. How will it affect the wild life?

A: **(Female student)** Well, I'm not sure that there really *is* a way that it's affecting the wildlife because we're using materials from the waste that's already there. So I'm sure that setting up plants might have an effect, but no more than any other kind of plant for a really viable and sustainable source.

Ms. Maurillo: St. John the Baptist School in Costa Mesa, do you have a question for this team?

Q: **(Male student)** Yes, I do. How does cutting down forests affect our ecosystem and economy, [in] which we highly depend on forests.

A: **(Female student)** We will not be cutting down trees. This is made completely out of recycled wood or even wastes that are made out of wood products.

A: **(Female student)** So municipal waste and agricultural residue – things that would just be wasted otherwise. And the forest waste that we're planning on using is already being cut down, and it's just sitting there, being burned.

Male student: Okay. Thank you.

Ms. Maurillo: District 1, Eagle Prairie Middle School. Do you have a question for this team?

Q: **(Female student)** Yes, we do. [Since] the forest debris is needed to renourish the forest, wouldn't this be harmful to the reforesting process?

A: **(Female student)** Well, I'm sure that some of it is definitely necessary for the reforesting process, but the stuff that we're talking about using is not the stuff that would be used for

that. It's the waste material that would be burned otherwise, and not be put to use. And our goals for how much ethanol we want to be making per year [don't] rely on using all of the available material. We're looking at 25 to 50 percent.

Ms. Maurillo: Thank you very much. Cardozo Senior High School in Washington DC, do you have a question?

Female student: No.

Ms. Maurillo: Thank you very much. We will go to our next presentation, then, and that will be Tupelo Middle School from Tupelo, Mississippi, and they are broadcasting from Washington. Can we go there, please?

Tupelo Middle School

Interplanetary Sustainable Spacecraft

Male student: My name's Achintya Prasad.

Male student: My name is Justin Russell.

Male student: My name is Keivonte Smith.

Male student: And we're the interplanetary sustainable spacecraft. During the course of human history, people have tried to further the boundaries of mankind's touch. Space flights such as Sputnik and Voyager have moved our reach to beyond the solar system. However, man himself has only traveled as far as the moon. It has been the goal of illustrious groups such as NASA, SpaceX, the European Space Agency, and the Russian Space Agency to further this boundary. We took this challenge, as well, and created the Interplanetary Sustainable Spacecraft, or ISSC.

Rather than applying sustainable fuel sources to buses, cars, and trains, we decided to apply it to spacecraft. This spacecraft can survive the void of space with very little to no help from Earth. It will carry 10,000 passengers in a large, rotating disk just above the landing pad. It will use liquid hydrogen as a main fuel for its rocket motors. Two solar-panel

pods will create electricity, and it will spin around at approximately two and a half rpm to create artificial gravity.

Male student: Since the dimensions of the craft are so massive, the ISSC will have to be built in space. The design itself is competely modular, meaning it can be built out of hundreds of large custom prefabricated blocks. Modern rockets such as the SpaceX Falcon Heavy and the Boeing Delta IV Heavy will transport these modular pieces to an orbital shipyard, where the ISSC will be built. This process will be similar to the construction of the International Space Station.

Male student: The ISSC will be a heavy craft that will require 15 million tons of thrust to reach a projected speed of Mach 1001 – one thousand and one times the speed of sound. In total, there will be eight liquid-hydrogen rocket engines that each produce 1,875,000 tons of thrust. These engines will be grouped together in pods, four in each.

Male student: Liquid hydrogen is the key fuel in the ISSC. Hydro was chosen because of its very high quantity in the universe and very high efficiency in liquid rockets. The hydro will be captured by a bunch of collectors which are a theoretical device that [traps] hydrogen and extracts it from the near vacuum of space. Afterwards, the hydro will be converted from its gaseous state to a liquid state, and [be] stored into a huge container inside solar-panel pods. When it is liquid, it will be pumped into the engine, where it is burned. The water formed from doing this chemical reaction will be used to create additional oxygen inside the ISSC. This system will render all engines on board completely sustainable and independent from fossil fuels.

Male student: The ISSC will require engines to function on a day-to-day basis. Two pod-container solar panels will be mounted just below the landing pad. These panels will be angled towards the sunlight, thereby giving out an output of 1.5 terabytes, which is enough engine to keep the ISSC independent from any external energy source.

Male student: The ISSC is designed to act as a space cruise ship. However, since the ship is so massive, it would be dangerous and impractical for it to land on a planet or dock on a space station. Instead, smaller spacecraft will land onto the landing pad of the ISSC and deposit guests. The landing pad will be lined with electromagnets that will charge to help recover and launch spacecraft. The landing pad will also have four hangar bays for the space planes, and a zero-g terminal will greet passengers before they reach the habitat ring via a central elevator.

Male student: The habitat ring is a large rotating disk that is located just above the landing pad. It will rotate at two and a half (2-1/2) rpm to create artificial gravity that is similar to Earth's. Inside will be five atriums that will house 10,000 passengers. In the event of an overpopulation of Earth, a fleet of ISSCs could help relieve the overpopulation of the planet.

Male student: As the ISSC ventures around the solar system, smaller spacecraft will bring passengers on board. These smaller spacecraft are designed from the Boeing AS 47B. Each will be a flying wing with rocket motors in place of jet engines. The smaller spacecraft

will be comparable in size to the Boeing 787, but with a wingspan of 200 feet. It will carry at least between 200 to 250 passengers. The layout of the smaller spacecraft will be similar to modern jet aircraft, thereby eliminating the need for passengers to undergo training before boarding.

Male student: We would like to thank AASHTO for this opportunity and for this competition. We'd also like to thank Miss Clifton and Miss Smith for arranging our accommodations, and for helping us throughout this program. Thank you. Are there any questions?

Q&A for Tupelo Middle School

Ms. Maurillo: We will start with Morada Middle School in Stockton, California. Do you have a question for this group?

Q: **(Male student)** Yes. How will your project be funded?

A: **(Male student)** Our project will be funded by a massive group, possibly like the UN. All countries, such as the United States and China, will pool money together to form this massive craft.

Ms. Maurillo: Thank you very much! St. John the Baptist School in Costa Mesa, California, do you have a question for this group?

Q: **(Male student)** We do. How often will fuel have to be transported to the vehicle? And how much would that transportation cost?

A: **(Male student)** The entire spacecraft, as I said before, is completely independent. The material collected on board will create the oxygen or the hydrogen inside. There will be no need for any external craft to bring aboard liquid hydrogen.

A: **(Male student)** Hydrogen in space.

Male student: Okay. Thank you.

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

Q: **(Female student)** Yes. In the case the Earth becomes overcrowded, and people get removed from Earth, how or who do you decide would get to go, to get removed?

A: **(Male student)** It's not a point of decision. Rather, it would just be everyone that can, or rather should, get on board, will. We can leave independent governments to decide who needs to go; but in the end, everyone on Earth could be evacuated, should it become necessary.

Ms. Maurillo: Thank you very much. Cardozo Senior High School in Washington DC, do you have a question for this group?

Q: **(Male student)** Yes. As a passenger on this spacecraft, [what] I wanted to know is there a set limitation of how many years you can remain on the spacecraft? Or do you have to leave after a certain amount of years?

A: **(Male student)** This is not really a time-limit type thing. It's kind of like a hotel or a cruise ship. If you can afford it, you can stay on as long as you'd like.

Ms. Maurillo: And, finally, Juan Crespi Middle School, El Sobrante, California, do you have a question?

Q: **(Female student)** Yes, we do. Because of the cruiser-ship's size, how will it affect the environment when launched?

A: **(Male student)** Well, in comparison to space, this is quite a small craft, so there [are] actually no residual effects onto space or space-time or anything, for that matter. So it's really negligible in terms of any effects on the environment.

Female student: That was my question.

Ms. Maurillo: Thank you very much. I think we've gone through all the schools with questions. The next presenting team will be from District 10, Morada Middle School in Stockton, California.

Morada Middle School first team

Road Star Impact Wind-Up Car

Female student: Hello. My name is Rebekah Landin, and we are from Morada Middle School in Stockton, California. With me are Daisy Contreras, Marisa Vera, Hector Cadena, and Khoby Crisostomo. We are excited to tell you about our idea for a more-sustainable form of transportation. It is called the Road Star Impact. Let's get started.

Female student: Thank you, Rebekah! This year, we really set out to think outside the box. We wanted to use a source of sustainable energy that involved concepts of perpetual motion and tensile forces. Our project has some of the same ideas as a wind-up car but goes far beyond that design.

Male student: The more we looked into this competition, the more we realized the problems that current automobiles cause. First and foremost, the pollution is an ongoing issue throughout the world. Cars are constantly polluting our air, resulting in environmental problems. Secondly, gas is at an all-time high. By summer, gas is expected to be far above $5 per gallon. And, finally, we are continuing to deplete our Earth's valuable resources. Fossil fuels cannot be replaced and are running out. Something needs to be done.

Male student: So here are our solutions. This vehicle uses the idea of perpetual motion, constantly transferring energy from one thing to another. We have designed a wind-up-car style that uses this concept. We are excited to share it with you.

Male student: This is how it works. First, the rear-wheel-drive vehicle is powered by a series of elastic bands wound up by an electric motor. Much like a modern car, our vehicle has a transmission, which allows the user to move forward or reverse. As you move your foot from the brake, the Road Star Impact will then begin to move, and this is caused by the elastic bands releasing their energy on the wheels.

Okay. Here is where things get really interesting. We decided to make our car with six wheels. There will be two in the front for steering, and four in the back to produce the power. However, only two of the rear wheels will be in contact with the ground. The other two wheels will be lifted slightly off the ground by a hydraulic system. They will be wound

up by the power wheels. When the grounded wheels have been used up by the energy, they will be lowered, and the drive wheels, and then the system, will start over again. I have an example. I have removed the wind-up elastic. So, when this is done, it lowers, and it starts over again, and then winds up the other.

Female student: Now I suppose an invention is only as good as its application and benefits, so here are a few. Most importantly, it is, by far, more environmentally friendly than current cars. That is what this whole project is about, right?

In addition, you will be saving more money on gas because it doesn't run on fossil fuels. It runs on its own power. And, for those of you who are commuters, check this out. It would be approved to drive in the car pool lane with extreme silence because there is no engine. It is *amazing*!

Female student: Once again, we would like to thank you for the opportunity to share our ideas. We wish everyone the best of luck. And please rememeber: It is up to us to have a positive impact on our Earth and keep her beautiful. Thank you.

Ms. Maurillo: Thank you very much for your presentation. That was Morada Middle School in Stockton, California, and we will go, for our first question, to St. John the Baptist School from Costa Mesa, California. Do you have a question for this team?

Q&A for Morada Middle School first team

Q: **(Male student)** Yes, I do. I believe that Newton's second law of thermodynamics states that the entropy of any individualized object, including perpetual-motion machines, decreases as time passes by. Therefore, there is no such thing, and it is not possible for a perpetual-motion machine. How does this affect your transportation device?

A: **(Male student)** Well, we have an electric motor that winds it up after time happens. So, when it runs out, the electric motor will wind it up, and the system will start over again.

Ms. Maurillo: Thank you. Eagle Prairie Middle School, Rio Dell, California, do you have a question for this group?

Q: **(Female student)** Yes. What are the elastic bands made of? And what would happen if they break?

A: **(Female student)** The elastic bands are made of a type of rubber, and if they are broken, you would take them to a mechanic, just as a normal car.

Ms. Maurillo: Okay. Thank you very much. Cardozo Senior High School in Washington DC, do you have a question for this group?

Q: **(Male student)** Yes. What would be the effects on gas companies by using your sustainable transportation?

Male student: Please repeat the question.

Q: **(Male student)** What would be the effects on gas companies when using your sustainable energy?

A: **(Female student)** We're not using it.

A: **(Female student)** There would be no effect.

Q: **(Male student)** Your – I mean your sustainable transportation.

A: **(Female student)** Well, we wouldn't need gas companies because of the winding up of the wheels.

Ms. Maurillo: Thank you very much. Juan Crespi Middle School from El Sobrante, California, do you have a question for this group?

Female student: Yes, we do.

Q: **(Male student)** How long would it take to recharge the electric motor?

A: **(Female student)** Well, actually, while one is on the ground, turning, and it's going, one is going to be winding up, because it goes like the opposite way, which causes tension, and it switches off when one has finished charging.

Ms. Maurillo: Thank you very much. Tupelo Middle School from Tupelo, Mississippi, do you have a question for this group from Washington DC?

Q: **(Male student)** Yes. If you plan on using elastic rubber bands on your car, these obviously have to be quite strong. But my question is, how do you plan to use safety in this thing? Because if these things snap, they probably are going to hurt.

A: **(Male student)** Well, if you think about it, if this car catches fire, it won't explode like other cars. So, if you think about it, in some ways, it is safer than the cars we use today.

Ms. Maurillo: Thank you very much. Our next presentation will come from St. John the Baptist School from Costa Mesa, California, and they are in Caltrans District 12.

St. John the Baptist School first team

Magnet-Powered Engine

Male student: We have four people within our group: Kevin, Omar, Luke, and I, Simon. We are all in eighth grade at St. John the Baptist Catholic School in Costa Mesa, in California. And our idea is to generate a fuel source more beneficial than fossil fuel to sustain a transportation device through the efficiency of magnets.

We plan on creating a magnet-powered wheel along with a mounted power turbine, creating electricity with improving the efficiency of our wheels. Our vehicle is called the Magnet-Powered Engine. And these are the basic materials.

Male student: According to Arnold Magnetic Technologies, magnets only lose one percent of their magnetism in the span of a decade, making them last a thousand years. They've also said that magnets can hold up to 1,300 times their own weight.

Male student: According to professors, magnets are recharged if a powerful magnet is rubbed across the depleted magnet, realigning the domains of the magnetism.

Male student: According to the department of physics in the University of Illinois, superconductors prevent magnetic fields from entering the supercconductor's perimeters, meaning if we attach a superconductor around our magnets, they are protected from an outside force. They do not destroy magnetism from inside the conductors, so our magnets can still work.

Male student: Magnets are made in a variety of shapes which determines how the magnetic fields are arranged, affecting the purpose. Many are easily mass-produced from pouring the magnet molds into a container with your desired shape.

Male student: In 1983 and 2010, NASA discovered new ways for use of electric-vehicle-propulsion motors through the efficiency of magnets.

Male student: NASA states that magnets can be used to at least one set of windings and DC motors, stepping motors, and various machines, to generate electricity. That said, these machines are sustainable, universally available, convenient and practical, and cause no pollution whatsoever.

Their machines have produced 50 to 200 kilowatts of electricity. They also state, I quote, "That these motors have the advantage that no electric power needs to be supplied to the motor, which thus remains cooler." These facts support our magnetic turbines and motor-access ideas.

Male student: Wind turbines depend on wind to generate electricity, making it unreliable. Without wind, wind turbines are defective. However, our magnet turbines rely on magets, which last a thousand years, making it reliable. Since our magnetic turbines are able…to be independent and reliable, it will therefore produce more electricity than wind turbines.

Like wind turbines, magnetic turbines don't cause pollution. Car manufacturers estimate electric cars need only 6 kilowatts to drive 40 to 60 miles. Fortunately, magnetic turbines have already been developed by NASA in 1983 and 2010, donating 50 to 200 kilowatts of electricity.

Male student: Hybrid cars are our best solution so far, using half electricity and half gasoline. Unfortunately, we're still using an excessive amount of gasoline with these hybrids. Unlike hybrids, NASA's magnetic turbines generate 50 to 200 kilowatts of electricity, providing an adequate amount to power a car without gasoline. These magnet-powered turbines will not only produce electricity with every rotation, but will also power miscellaneous items such as the radio.

Male student: Within the US, there are approximately 250 million cars, estimated at 1,300,000,000 (1.3 billion) carbon doioxide metric tons annually. We, the US, is reponsible for 20 percent of all global-warming effects. We can be the first to stop this.

Male student: We will be returning to our resolutions subsequently.

Male student: Triple A informs us that, at $3 gallon, an average American spends at least $16,000 a year on fuel, refueling every two weeks. Now gas prices are over $4 a gallon.

Male student: The National Transportation Safety Board has stated, in the 2010 Gulf of Mexico oil explosion, a tremendous 4.9 million barrels were wasted into the ocean, killing an estimate of 7,000 animals since Novermber 2, 2010, and eleven workers. Insecurity of oil has reached its climax.

Male student: According to Toyota, a car lasts about 10 years, with repairs. After the 10 years, you can either buy a newer-priced car, or you can pay for the expensive repairs again.

The main hazard of which many will ask me concerns contact with other vehicles. Like I said, the department of physics in the University of Illinois states that "superconductors

prevent any contact with an outside force." Therefore, if there are surrounding magnetic cars around yours, then these superconductors can prevent any force from moving your vehicle without blocking off the magnet, wheel, and turbine movement.

Male student: Like we said, on our second slide on the magnetic technologies, it states that magnets retain their magnetism for a thousand years instead of a minute 10 years.

Male student: According to my research, NASA has found no source of pollution from magnets. Logically, magnets also don't produce any type of gas by themselves, nor with contact with other materials. Therefore, they cannot produce any gas or pollution.

Male student: Magnets are a one-time fee. According to *The New York Times*, the price of neodymium has dropped down 32 percent, to $20 a pound. Now you say, "This is expensive!" But Arnold Magnetics Technologies has stated that dymium magnets can hold 1,300 times their own weight. Therefore, the magnet-powered engines only need approximately 2.2 pounds to 3 ½ pounds to run the wheels and turbine. Therefore, the maximum price would be $72 per wheel, which is cheaper than Pep Boys' cheapest wheel, sold for $99. Magnetic turbines are also steady as you go.

Male student: There are several materials we use on our axles for the wheels. We first have a holder placed on both sides. Next are the magnets in a "v" formation. The "v" formation helps the rotation's efficiency. The lifters that lift moves the propelling magnet up and down, rotating it more efficiently. The light wheel is where the magnets are placed, which represents our car axis. The propelling magnet is the magnet that repels the primary magnet, which is attached to the light wheel. The bays hold up par types axis.

Male student: Here we have the repeating materials from our last slide. All the same materials apply in our demonstration. After the construction of the prototype, we result with this. As we release the stick, which is punctured through the lifter, and the vice holder, which is connected to the propelling magnet, it begins to spin efficiently. As you can see, with every rotation, the lifter lifts the propelling magnet holder upward, then releasing it down, creating a more-efficient relationship between the propelling magnet and the primary magnets connected on the wheel. The propelling magnet set is long enough to be within the range of all the magnets on the wheel, so that the entire wheel can be used, creating more speed. You can also see that the v-shape supports the rotation of the wheel because the rotation seems to be smooth and at a decent pace. As he began to stop it, he repunctured the stick through the vice holder and lifters, stopping the wheel and any magnetic force.

Like any good scientist, I use math in my experiments and my presentations. So you might think, "Oh, these magnets are too small to power a vehicle!"

Well, let me prove my theory. According to the direct variation formula, it states that Y1 over Y2 equals X1 over X2. Now let's say our prototype is one inch cubed and goes five miles per hour. We want to find how large the magnets have to go, to go 25 mph. So, using this formula, we plug in our numbers. One for our prototype size, five for our prototype speed, 25 for its desired speed, and five for its – Sorry. And x for its desired size. After several

steps, the size of our magnet seems to be five inches cubed to go 25 mph. Therefore, our animated Einstein states that if the magnets were five times as big, the wheel would be five times as fast there.

Male student: Our design has various characteristics. Originality was involved when we discovered NASA's ideas and combined them with our magnet-wheel designs. We also know that magnets are universally available. Why? Because Earth is a magnet itself. Magnet-powered engines are also convenient because NASA stated that it provides energy without overheating.

How is this practical? I have demonstrated our magnetic wheels, and I have given you thorough information through trusted businesses, agencies, such as Arnold Magnetic Technologies. There hasn't been any pollution from magnets found, either, because they don't produce any gas. Through the characteristics of original, universally-available, convenient, practical, and non-polluting, we have also demonstrated that magnets lose one percent of their maximums every decade, resulting in a sustainable transportation vehicle in the 21st century.

Male student: In the conclusion, we will briefly but full-heartedly like to thank you for allowing us to be our nation's future leaders. We couldn't have done it without you and your sponsorship. Thank you, Mineta Transportation Institute, and our sponsor, OCTA.

Ms. Maurillo: Thank you very much. That was excellent. Okay. Do we have a question from Eagle Prairie Middle School for this class from Rio Dell, California?

Q&A for St. John the Baptist Catholic School first team

Q: **(Female student)** Yes, we do. Wouldn't other outside forces interfere with the magnets? And wouldn't the magnets interfere with any cellular devices or computer/electrical components of the car?

A: **(Male student)** Well, actually, I've stated, on my second slide, that superconductors will be surrounding the magnets, which blocks off any outside force, but does not interfere within the inside force which propels our vehicle.

Ms. Maurillo: Thank you very much. Cardozo Senior High School in Washington, DC, do you have a question?

Q: **(Female student)** No.

Ms. Maurillo: Thank you. Let's see. Here in Oakland, Juan Crespi Middle School, do you have a question?

Female student: Yes, we do.

Q: **(Female student)** Will obtaining the materials to make the magnets in mass production harm the environment?

A: **(Male student)** Well, actually not, due to the fact that our planet is actually a magnet. Therefore, magnets can be found within the world. But it does not interfere with the north and the south poles.

Ms. Maurillo: Thank you very much. Tupelo Middle School in Washington, DC, do you have a question?

Q: **(Male student)** Yes. You addressed the issue that magnets can survive tens of thousands of years, and that the super-insulators will keep it from actually interfering with anything else. My question is, as the magnets charge or recharge, they're going to create heat. How are you going to cool the magnets from, say, melting themselves after continuous use?

A: **(Male student)** Well, actually, cars have the same process, in which it has a cooling system. Therefore, it would be a necessity for every car, not just ours, but yours, and the other teams', to have a cooling system to prevent their transportation device from melting or overheating.

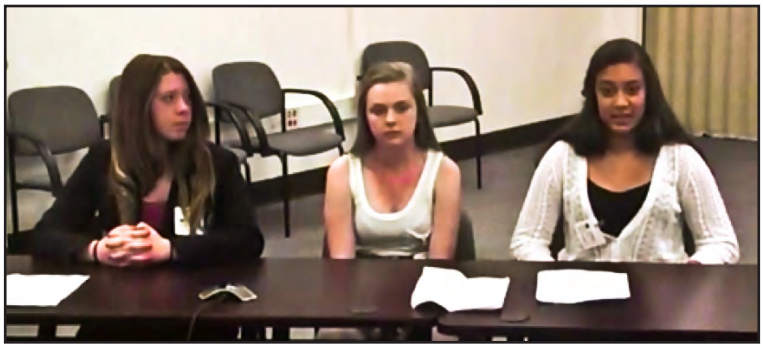
Ms. Maurillo: Thank you very much. Morada Middle School at District 10, do you have a question?

Q: **(Female student)** Yes. We saw the same video on YouTube. Is this your video or someone else's?

A: **(Male student)** Yes, this is our – another man's vehicle; but, we – as we were doing our research, we have found upon that video. But we have actually produced our own vehicle, which is here, and modified it to be more efficient, therefore creating originality within our own design.

Ms. Maurillo: Okay. Thank you very much. We will now move onto the presentation from Eagle Prairie Middle School at Caltrans District 1.

Eagle Prairie Middle School second team



Hydrogen Fuel Cells

Ms. Harper: Hello. I am Victoria Harper, and welcome to Making a Difference, the show that investigates people, organizations, and communities that are making changes, making a difference. Joining us today are Kyra Deveny, our investigative reporter, and Macey Vaughan, our science analyst.

Our story begins on the campus of Humboldt State University in Arcata, California. Nestled in the redwood trees is the Schatz Energy Research Center. It is involved in an alternative-energy lab. The center was founded in 1989 with an interest in hydrogen fuel, the technology and funding resources of businessman Dr. Lewis Schatz. SERC, or Schatz Energy Research Center, is dedicated to not only research in clean and renewable energy technologies, but also educating people about them, in order to have a clean and safe environment, and a better world. Kyra Deveny, our investigative reporter, went to the energy lab to find out exactly how the center is making a difference.

Ms. Deveny: Thanks, Victoria. I had the opportunity to meet and interview Mr. Richard Engel, senior research engineer at SERC. Here's an excerpt from our interview.

> **Ms. Deveny**: (unintelligible) …and do you know what (unintelligible)?
>
> **Mr. Engel**: Yeah. Basically, we have two different kinds of customers for our fuel cells. First is for researchers. The researchers are interested in testing fuel cells on fuel-cell test stations, like the one that's behind you right now, and we've gotten rid of those three test stations, so we usually provide more and more of our fuel-cell stats along with the test station. We provide it to a university or a research center.
>
> The other kind of customer we have for our fuel cells are educators who want to teach students how fuel cells work. We've built kits that are used in high-school chemistry classes, in college engineering classes, to do experiments with fuel cells and electrolizers, since getting one on how to make hydrogen, and how to use the hydrogen fuel cells.
>
> **Ms. Deveny**: Now you're involved in testing hydrogen fuel-cell cars. Can you tell us about this program?

Mr. Engel: Sure. We've been loaned a series of hydrogen fuel-cell vehicles from Toyota. Very interested in seeing how these vehicles operate in real-world conditions. So we have people that drive them around. Some of our employees drive cars home, and keep them with them every day. We also use the one we've got on local outreach and education, and so we can show off to people here in Humboldt County what a fuel-cell car is like, and get them used to the idea of fuel cells in normal (cuts out).

Ms. Harper: So, Kyra, it sounds like the Schatz Energy Research Center is very involved with the technology behind the hydrogen fuel cell.

Ms. Deveny: Yes, Victoria. The center continually works on making improvements to the hydrogen fuel cell and, as Mr. Engel stated, they test hydrogen fuel-cell vehicles also. They presently have two Toyota Highlanders. The center, as you can see, has a hydrogen fueling station on the HSU campus. Mr. Engel shared with us that there are about 100 hydrogen fuel-cell cars in California, and several thousand nationwide. You can see from the cutaway car how the fuel system is set up within the vehicle. Notice where the fuel-cell stacks are located, as well as the hydrogen tanks. For further explanation on how a hydrogen fuel cell works, I will turn it over to our science analyst, Macey Vaughan.

Ms. Vaughan: Thanks, Kyra. The hydrogen fuel cell is also called an electro-chemical energy conversion device. The cell converts the chemicals, hydrogen and oxygen, into water and electricity. In this cell, oxygen from the air fuses with hydrogen, which creates energy for the battery of the vehicle with a very small amount of water. I can show you very simple examples of this electro-chemical reaction.

So, with a cup of water, and a small amount of salt, you put two pencils in, and connect them to a battery. And the pencils form bubbles on one side, the hydrogen, and on the other, oxygen. Although changes have been made on the hydrogen fuel cell and hydrogen fuel-cell vehicles, there is still room for improvement. Kyra, I think you disuccsed this with Mr. Engel.

Ms. Deveny: Yes, Macy. Mr. Engel talked about one of the major problems, which is cost. Some components are costly, like the PEM, the proton-exchange membrane. The metal catalyst has been made from platinum, and other precious metals. This metal also needs to be durable and stable at high heat, sub-zero temperatures, and in low-hydration situations.

The other uncertainty surrounds hydrogen storage, transportation, and safety. I believe Macey has some input on these problematic areas.

Ms. Vaughan: Well, much research has been done on the PEM, or proton-exchange membrane. Probably one of the best alternatives for the metal plate is carbonized steel or aluminum. This lightweight metal is reasonably priced, and would meet the challenges of hot and cold temperatures, as the same material is used in making aircraft. Carbon can improve electric – ah! Excuse me! – electrical properties needed for the catalyst.

As far as the fuel questions, a new nanocomposite material looks like the solution for storing hydrogen fuel in the tanks. The material in nanocomposites will stablize hydrogen during storage and transportation, making it safer. This is also a plus for the hydrogen tanks in the hydrogen fuel-cell vehicle.

Ms. Harper: It seems to me that the other question about the hydrogen fuel would be its availability. There are hydrogen vehicles on the road, but how accessible is hydrogen? Is there any information on this, Kyra?

Ms. Deveny: Besides the hydrogen vehicles being tested, the only other hydrogen cars are those being leased. These vehicles are only available in Southern California. However, Toyota announced that a hydrogen vehicle will be on the market in 2015.

Ms. Vaughan: I think the best way to answer that question is that, as far as *any* fuel, once the demand is there, supply will happen. It's happened with all previous gas choices, as seen on the map. Once the people want it, it gets there. The consumers make the difference.

Ms. Harper: That sums it up perfectly. Thank you, Kyra and Macey, for your input. Thanks to all of you for watching. And this is Victoria Harper and remember to make a difference in your life.

Q&A for Eagle Prairie Middle School second team

Ms. Maurillo: Thank you very much for your presentation. We will now proceed with the questions. Cardozo Senior High School in Washington DC, do you have a question for this group?

Female student: No, we do not have a question.

Ms. Maurillo: Okay, thank you. Juan Crespi Middle School, do you have a question here?

Q: **(Female student)** Yes. Would this hydrogen cell be affordable to middle-class people?

A: **(Female student)** Yes, this would.

Q: **(Male student)** How?

A: **(Female student)** They are coming out with one in 2015, and the more – the more models they make during that time, because they've been making newer models, the more the costs will go down into them. So they will be able to go down into middle cost.

Ms. Maurillo: Thank you. Tupelo Middle School, from Tupelo, Mississippi, broadcasting from Washington, do *you* have a question for this group?

Q: **(Male student)** Yes. My question is, how efficient will a hydrogen fuel cell be?

A: **(Female student)** Very efficient.

A: **(Female student)** Well, seeing as it uses only hydrogen and oxygen from the air to make this energy, it would be pretty efficient.

Ms. Maurillo: Thank you very much. Morada Middle School at District 10, do you have a question?

Q: **(Male student)** How does this affect our environment in relation to gas-powered vehicles?

A: **(Female student)** The by-product is water, so it really doesn't affect it badly as gasoline does. It doesn't create as much pollution.

Ms. Maurillo: Thank you very much. St. John the Baptist School at District 12, do you have a question?

Q: **(Male student)** Yes, we do. Where will you obtain the salt water as used in your demonstration? And if it is taken from the ocean, won't it harm the ocean's ecosystem?

A: **(Female student)** Well, the salt is added into the water, so it can be either like regular table salt. It's not taken from the ocean. It's simply mixed together.

Male student: Okay. Thank you.

Ms. Maurillo: Okay, thank you very much! And we will proceed with the presentation from St. John the Baptist School, second team, in Costa Mesa, California. They're broadcasting from Caltrans District 12.

St. John the Baptist Catholic School second team

Tribrid Electric Biofuel Vehicle

Male student: Good morning, ladies and gentlemen. Today, my team and I from St. John the Baptist in Costa Mesa, California, would like to present to you our ideas and thoughts about creating a new and sustainable transportation system that is good for both the environment and our pockets.

Male student: Our idea is called the Tribrid EBV, which stands for Tribrid Electric Biofuel Vehicle. Before we begin to explain why our vehicle has this title, however, my team and I would like to first introduce ourselves. My name is Blake, and I am the environmentalist for this particular event. Here next to me is Evan, and I will allow him to introduce himself.

Male student: Hello. As Blake already stated, my name is Evan, and I am the facilitator of my team, as well as my team's engineer.

Male student: My name is Brendan, and I am my team's record keeper. My job is to keep track of all my team's ideas and how they change, combine, and develop.

Male student: My name is Daniel. I am the financial director in charge of figuring out how much our Tribrid EBVs cost. I am also in charge of the marketing aspect of this project.

Male student: In this presentation, we will address the following: The problem/question that we had to ask ourselves and answer through this project, the solutions to the problems/questions that we came up with, how our Tribrid EBV works, the design improvements we made to attain this final vehicle, the environmental impact of our vehicle, and its affordability.

Male student: For this project, we had to ask ourselves the question, "Can we create an original, innovative, and sustainable form of transportation that will have a positive influence on the environment, and is both convenient and practical?" Our answer is, "Yes, we can."

Male student: We were able to come up with a sustainable form of transportation, a form of transportation that meets the needs of the present without compromising the ability of future generations to meet their needs. We came up with the great idea of using the axles of our vehicles to generate electricity. It is designed to work on both electricity and a secondary fuel source, algae oil. Any vehicle with wheels can utilize this system as an alternative for gas.

Male student: Our Tribrid EBV consists of three changes to our current car. First, we decided to use magnetic axles with coils of wire which surround them to create electricity. When the axles turn, the magnetic field rotates inside the coils of wire, which creates electricity in the coils. We also placed magnetic shields, which redirect the strong magnetic fields of the axles, to stop the axles from having such a powerful magnetic pull and push outside of the coil of wire, and therefore, keeping the car safer.

The idea of spinning a magnet between two coils of wire to create electricity is the same concept used to power a crank flashlight such as this one. When I pull the handle, the magnet spins between the two coils of wire, creating the electricity to power the flashlight. In our vehicle, the electricity would then be used to turn the axles and continue running the car.

We also decided to use algae oil as our secondary fuel, since algae oil is environmentally friendly and can be easily grown and transferred to fuel. The algae oil would be used to start the vehicle and to keep it running if the axles do not create enough electricity.

We also included a solar panel on the top of our vehicle to power and charge miscellaneous devices such as the radio or a cellphone. It can also be used to generate emergency electricity.

This is a diagram of the Tribrid EBV that shows all of its components. On both sides of the vehicle in the diagram, you can see the magnetic axles, which are surrounded by the coil of wire and magnetic shields. On the far left, you can also see the battery that stores all electricity created by the vehicle. On the top of the vehicle is a small solar panel that is not too heavy. And near the center of the vehicle, at the bottom, is the fuel tank for algae oil.

Male student: We had to make many design improvements to reach the design that we are presenting to you today. Our first design improvement was the placement of a battery on the vehicle because this battery would be pivotal to the storing of any electricity created by the coils and axles.

Our second design improvement was adding an extended battery capacity so that we could get the vehicle to run the most efficiently out of the room we had to work with. This extra battery capacity helps to ensure that no electricity is wasted.

Next, we improved the axles by adding magnet shields around the coils to help the vehicle be safer for the passengers inside it. We also inlcuded a secondary fuel source in the vehicle because we knew that we will lose some electricity as it goes through this path of

turning the axles and generating more electricity. So we had to create a secondary fuel source, and we chose algae oil.

Finally, we also added solar panels, our third source of electricity, to power other devices in our vehicle. We included all of these solutions to our problems to ensure that our Tribred EBV has the best performance it can possibly have. If our design goes beyond this point, we hope that professionals will continue to improve our design.

Male student: As we all know, there are many issues with today's forms of transportation. One problem with using fossil fuel to power our vehicles is that it is non-renewable. Fossil fuels like coal and oil were formed from decayed plants and animals that lived millions of years ago. Since it takes such a long time for a living thing to become oil or coal, fossil fuels are considered non-renewable, which means they cannot be replenished.

Another problem that comes with burning fossil fuel is acid rain, which forms when a chemical reaction between the oxides of nitrogen and sulfur dioxide occurs. These two chemicals react with the moisture in the air and produce the nitric and sulfuric acids present in acid rain. Acid rain can harm nature significantly.

First, acid rain depletes the nutrients in soil, and can pollute bodies of water as well as harming the animals that live there. It also could possibly affect human health. Our idea is an electric vehicle which produces no harmful emissions. Our vehicle utilizes turbines that create electricity that is much more environmentally friendly than that of the pollutants released by engines that run on gasoline. Although our car does rely on a secondary fuel source, algae oil, to start, about half of its power comes from electricity created by the car in this fashion. Algae oil is also environmentally friendly, 'cause it does not release harmful pollutants or odors into the air as the result of being made up of natural deposits. The algae is a practical secondary source because it is easy to grow at little expense for a large quantity.

Our third source of energy, a solar panel, was placed on the top of the vehicle. The solar panels are environmentally friendly, as well, because they use energy from the sun's rays to produce electricity.

Male student: While the price to build this vehicle differs between $35,000 to $50,000, which is a little above the affordability of some buyers, this vehicle will quickly pay for itself. Over the years, as gas prices soar above tolerable amounts, you would have to spend a whole lot on the…fossil fuel sold on every street corner. Instead, if you invest in our Tribrid EBV, you will save money because your vehicle is creating the electricity that it needs to drive all by itself. The only expenses are that of the new battery and algae biofuel. But the algae oil is much cheaper than fossil fuels.

Hybrids that use gasoline and electricity to run can be converted into Tribrid EBVs; and, although it might cost a bit to convert, it will pay off in the end, and it would still be cheaper than buying a whole new car. In the end, the vehicle pays for itself, and is better for the environment.

Male student: During this presentation, we covered the problem/question given to us by MTI, our solutions to that problem, including using the axles that generate electricity, how our vehicle works, the modifications made by our team, such as adding algae oil as a secondary fuel, the environmental impact of both our current cars and our Tribrid EBVs, and the affordability of our vehicle.

We would like to thank MTI and our sponsor, OCTA, for enabling us to present today. Thank you for taking the time to listen to our presentation.

Q&A for St. John the Baptist Catholic School second team

Ms. Maurillo: Thank you very much! We'll proceed now with questions. Cardozo Senior High School in Washington DC, do you have a question for this team?

Q: **(Female student)** Yes. You mentioned that converting the algae oil into energy would cost a lot of money, but it would pay off at the end. If it doesn't pay off in the end, are there any gas alternatives?

A: **(Male student)** Well, algae oil is much cheaper than gasoline, and it runs about the same. It's – It has the same—about the same—miles per gallon as gasoline. So it would save you money and it would pay off your car in the end.

Ms. Maurillo: Thank you very much. Juan Crespi Middle School here in Oakland, do *you* have a question for this team?

Chorus: Yes!

Q: **(Male student)** Earth isn't a reusable resource. Eventually, you'll run out of earth's resources for magnets. How will you compensate, especially as the demand increases?

A: **(Male student)** Well, we will have – Well, since earth is a magnet, we will – there is a lot of magnets in the earth, and I think that we will be able to provide enough magnets for the vehicles needed in the world.

Q: **(Male student)** Won't it eventually hurt the environment, especially since there are so many people in the earth, and so many people who will want to buy it? And it's – the population is still increasing, and it's not reusable.

A: **(Male student)** Maybe mining for the magnets will cause some environmentally – or won't be as environmentally friendly as it could be, but the – (unintelligible chatter)

Ms. Maurillo: Are you completed with your answer?

Male student: Yes.

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

Q: **(Male student)** Yes. You mentioned that the primary source for your vehicle will be using a generator, basically, that is powered off the axles. My question is, your secondary source is the algae fuel and the solar panels. Will they be sufficient to bring your car up to speed, to a speed where the axles are good enough to create electricity?

A: **(Male student)** Yes, they will, because any time that the magnet moves in between the coils of wire, it will be creating electricity, and the algae oil will assist the magnets in creating the elec – in creating the power to run the car.

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

Q: **(Male student)** Yes. What material are magnet shields made out of? And where would we find this material?

A: **(Male student)** I'm not sure.

Ms. Maurillo: Okay, thank you. St. John the Baptist School in Costa Mesa, do you have a question?

Male student: That is us!

Ms. Maurillo: Oh, that's right. Okay. I'm sorry. Eagle Prairie Middle School, do you have a question?

Female student: Yes.

Q: **(Female student)** Wouldn't a large, heavy solar panel interfere with the aerodynamics of the vehicle and make it less efficient?

A: **(Male student)** The solar panel on our vehicle will not be large. It will be smaller, about the size of a sunroof, and it won't weigh too much.

Ms. Maurillo: Okay, thank you very much. We will now proceed to the second team at Morada Middle School in Stockton, California; and then, after that, we will wrap up with the non-competing team, Cardozo Senior High School, who will give us a demonstration of their project. So go ahead, Morada Middle School at Caltrans District 10.

Morada Middle School second team

Electric Future 3000

Female student: Hello. My name is Jewel Wise, and we are Morada Middle School. We would like to share the Electric Future 3000 with you. We are really excited about it, so let's begin!

Male student: As you know, sustainability is a key idea in creating a better future. So we kept it at the center of our discussions when coming up with our concept. We decided to use an energy source that is in our back yard. We designed a boat that utilizes wave energy from a water source to give it power.

Male student: As many of you know, Stockton, as well as neighboring communities, are home to the San Joaquin Delta. Here you can see a map of how large it is.

Female student: This waterway runs from Stockton out to San Francisco Bay. We get countless ships from countries as far as China. It is a valuable trading avenue. Additionally, people use the Delta for recreation activities such as wake boarding, water-skiing, and even fishing. It is one of the valley's most wonderful resources.

Female student: But we are starting to see many problems as people continue to use this waterway. First of all, gasoline is becoming more and more expensive. This fuel source is rapidly deteriorating and cannot be replaced. Additionally, carbon emissions are spread into our atmosphere, and pollutants are being leaked into the water. As fish become exposed, they either die or pass on the pollutants to other consumers such as wildlife or even humans. This is becoming a high-level epidemic.

Female student: We intend to fix this problem with our design, the Electric Future 3000, a boat that uses water current to give it power. As the boat moves, the water will pass through a turbine. Inside the turbine is a grouping of magnets that will spin within insulated wires. Essentially, this will cause an electric current to power batteries inside of the boat, which can also be charged by plugging into a 110-volt output. As mentioned before, this boat will be fully electric.

Male student: By using government grants and private funding, we would hope that this revolutionary form of water transportation takes hold on the San Joaquin Delta. Think of the benefits.

It will save you money on gas, and is far more friendly to our environment than current engine-run boats.

If you want to be a leading pioneer in electric boat power, please contact us. We would love to get this idea moving.

Female student: As you can see here, water passes through the turbine, creating an electric charge that charges up the battery which the boat runs on.

Male student: Finally, thank you so much for listening to our ideas. If we all give a little effort, we can make our world a better place to live. And remember, daring ideas are like chessmen moving forward. They may be beaten, but they may start a winning game. Thank you.

Ms. Maurillo: Okay. Thank you very much! So we will go through our questions here. Cardozo Senior High School, do you have a question for this team?

Q: **(Female student)** Hello! Suppose something clogs the turbine. How much would it cost to unclog?

A: **(Male student)** Actually, there will be a screen protecting the turbine, which will not cause anything to get *to* the turbine, to stop the boat.

Ms. Maurillo: Okay. Question number two will come from Jaun Crespi Middle School here in Oakland.

Q: **(Female student)** How will this benefit the rest of America, let alone the world?

A: **(Male student)** Because this is just for boats only.

A: **(Female student)** It will cause no pollution to the world, and it will save money on gas, as well.

Q: **(Male student)** But how will you use it?

Q: **(Male student)** In other places besides on waterways?

A: **(Female student)** Well, we do use ships to trade other merchandise, as you could tell, but we do ship in from China and other countries, so there will be no pollutants in the water.

Ms. Maurillo: Okay. Thank you very much. Next question will come from Tupelo Middle School, broadcasting from Washington.

Q: **(Male student)** My question is, as boats get larger, they require more power; and if you put strain onto a propeller, it requires even more energy. So my question is, what is the size limit for this energy source? As eventually you will get to a point where this energy, this turbine, will not be able to create enough power for a boat.

A: **(Male student)** Actually, we are still developing on that idea. We will get to you later.

Ms. Maurillo: Okay. Next question, from St. John the Baptist School at Caltrans District 12.

Q: **(Male student)** If the wires carrying the electricity break, won't it electrify the water, killing or harming animals living in it?

A: **(Female student)** Well, actually, no, because the wires are insulated, so they don't give off any harmful charge.

Q: **(Male student)** But what if they are –

Q: **(Male student)** Yeah, but then the boat will be electrified.

Q: **(Male student)** What if they are broken?

A: **(Female student)** It won't break! (laughter)

Male student: Okay. Thank you! Eagle Prairie Middle School from District 1, do you have a question?

Q: (Female student) Yes. How can you guarantee that there will be no pollution in the water?

A: (Male student) Obviously, there will be no gas, and there wouldn't – it would not affect the wildlife that is living in the water because of the sheet protecting the turbine.

Ms. Maurillo: Okay. Thank you very much. That concludes our competing presentations, and now Cardozo Senior High School will demonstrate their project, and they will show us what high-school students are up to. Thanks very much. Go ahead.

Cardozo Senior High School (non-competitor)

Go-Kart Building Project

Male student: Good afternoon. I'm Vaughn Green**.**

Female student: I'm Thelma Leggett.

Male student: And Michael Price from TransTech Academy at Cardozo Senior High School. And today we are here to talk about a go-kart that we've built every year starting in 2008. All right.

So, in 2008, TransTech Academy took a step in another direction with sustainable energy by building a go-kart, and every year since 2008, they have challenged a new group of students to enhance the go-kart by making it more safe and get better mileage, so that it will last longer.

Male student: The students will build and demonstrate true electrical-powered vehicles to make them free function. These go-karts will hold one driver. We will explore an alternate source of energy on the fuel. These vehicles will use four 12-volt batteries that will last 30 minutes at a top speed of 30 miles per hour. The top speed is limited to 30 mph due to the lack of a suspension system. If the vehicles make a turn at 30 mph or over, they have the risk of tipping over.

Female student: The purpose of the students' building the go-karts is to showcase their skills they have learned in school. For an example, reading schematics, diagrams, and also circuitry.

Male student: Another means to do this project is to present a vehicle that is able to work with an alternate energy source that is eco-friendly and gives off zero emissions. This alternative energy source also provides a cheaper way to power the go-karts. The use of electrical energy is less expensive than using fuel due to the high gas prices and the short

amount of renewable energy sources. Natural sources that provide electrical energy are wind and hydroelectricity.

Male student: The process of constructing the two go-karts was a nine-week period of assembling and desembling and re-assembling the go-karts, replacing, cleaning, and inspecting all vehicles components, and then troubleshooting and testing the go-karts…

Female student: Here are pictures of students working on the go-kart. What are the benefits? At the end of the program, we will learn to work as a team, time management, patience with others, respect one another, organization, and have diligence. Here are more pictures of students working on the go-kart.

This is a video of us practicing – trying them out, basically, around our track. Basically, we're racing them. There were two teams, one against each other, to see how fast they can go around the track. They are switching. As you can see, they have helmets on, so they can be safe. They have seatbelts, too. Until they have their seatbelts on, they cannot pull off. They had done at least two laps around. There were other students encouraging them. And there's – the race is over!

Male student: Some of our acknowledgments go to the United States Navy, the Federal Highway Administration, the District Department of Transportation, and the US Department of Transportation. Questions? Do you have any questions?

Q&A for Cardozo Senior High School

Ms. Maurillo: Does anybody have questions for the team? We think this is a fabulous project. It looks really interesting! I can't believe that you built a couple of go-karts. That's really fun. Okay. Thank you so much, everybody, for participating. We're especially grateful – Excuse me?

Female student: Question.

Male student: We have a question.

Male student: We have a question.

Ms. Maurillo: Oh, okay. Go ahead and ask a question.

Q: **(Male student)** Can we work out a deal to buy the go-kart from you? (laughter)

A: **(Male student)** It depends on how much you're offering. (laughter)

Male student: St. John the Baptist has another question…

Q: **(Male student)** How long does this go-kart last with the fuel source?

A: **(Male student)** It is 30 minutes after one charge.

Q: **(Male student)** Tops?

A: **(Male student)** Each battery.

Male student: Oh, okay.

Male student: Thank you.

Male student: You're welcome.

Q: **(Female student)** How long does it – How long did it take to make it?

Male student: I don't see how it would be safe.

Female student: Well, they've been working on it for five years.

Closing remarks

Ms. Maurillo: Any other questions from anybody? Okay, great! Thank you very much. This was really nice. I always get a lot of pleasure out of doing this every year, and I especially want to thank the teachers because this is an extra-curricular activity, and I know that it takes a lot of extra effort. So we will have the results within a week. We will let you know about the winners, and thank you very much!

APPENDIX A: ABOUT GARRETT MORGAN

GARRETT AUGUSTUS MORGAN, 1877–1963

Garrett Augustus Morgan, for whom the US 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 1. 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 US 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 US Department of Transportation.

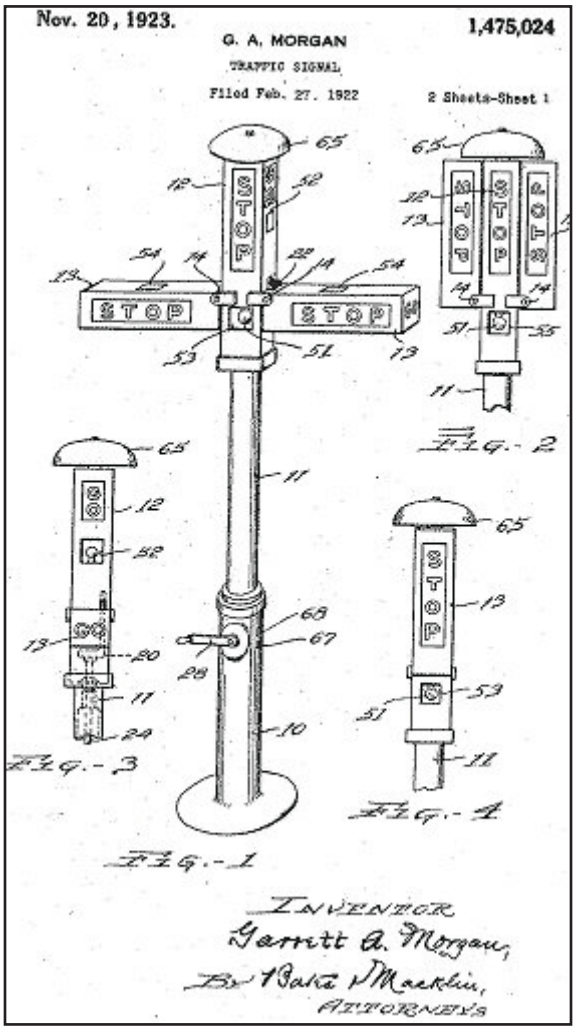


Figure 2. Garrett Morgan's Traffic Signal

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.

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