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# National Garrett Morgan Sustainable Transportation Symposium — 2003

Mineta  
Transportation  
Institute

Created by  
Congress in  
1991



## **MINETA TRANSPORTATION INSTITUTE**

The Norman Y. Mineta International Institute for Surface Transportation Policy Studies (MTI) was created by Congress through the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) and established in the California State University system at the San José State University College of Business. MTI continues as a University Transportation Center (UTC), reauthorized in 1998 by the Transportation Equity Act for the 21<sup>st</sup> Century (TEA-21).

MTI is unique among UTC's in two areas. It is the only center with an outside, internationally respected Board of Trustees, and it is the only center located in a College of Business. The Board provides policy direction, assists with needs assessment, and connects the Institute and its programs with the international transportation community. The Institute'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. MTI applies the focus on international surface transportation policy and management issues in three primary areas:

### **Research**

The Institute aims 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: security of transportation systems; planning and policy development; interrelationships among transportation, land use, the environment, and the economy; financing of transportation improvements; 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 publication available both in hardcopy and on the Institute's website.

### **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 the College of Business at San José State University, offers an AACSB accredited California State University Master of Science in Transportation Management and a Graduate Certificate in Transportation Management that will prepare the nation's transportation managers for the 21st century. The masters 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 broadcast videoconferencing 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's third responsibility is to develop and maintain electronic information systems to store, retrieve, and disseminate information relating to surface transportation policy studies. The Institute's website, *TransWeb*, enables transportation professionals, students and individuals worldwide to access information relating to surface transportation research and policy. *TransWeb* is found at <http://transweb.sjsu.edu> and delivers regional, state, national, and international transportation information. The Institute also maintains a library of periodicals and other unique publications for transportation research in cooperation with the San José State University Library system. MTI is funded by Congress through the United States Department of Transportation Research and Special Programs Administration (RSPA), the California Legislature through the Department of Transportation (Caltrans), and by private grants and donations.

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**MTI Report S-02-01**

**National Garrett Morgan Sustainable  
Transportation Symposium  
May 2, 2003**

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<p>16. Abstract</p> <p>On May 2, 2003, the Mineta Transportation Institute joined numerous authorities in the surface transportation industry with several middle and elementary schools to discuss the topic of sustainable transportation. The purpose of this forum was to expose the students (from Maryland, Virginia, and California) to the many opportunities available to them in transportation-related careers, and to discuss the utilization of many natural resources to develop alternatives to current modes of transportation.</p> <p>Each of the schools participated in a videoconference to present projects for sustainable transportation options for the future. Their ideas included powering buses, cars, light rail, and ultra-light rail systems with solar energy, fuel cells, and wind. The symposium concluded with a question and answer session at the end.</p> <p>This publication is an edited version of the May 2 Forum.</p>			
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The Mineta Transportation Institute would like to thank the following individuals for their assistance in organizing and delivering the 2003 National Garrett Morgan Sustainable Transportation Symposium on May 2, 2003.

- Rod Diridon, Executive Director, Mineta Transportation Institute
- Daniel Duff, Chief Counsel and Vice President, American Public Transit Association
- Ms. Sue E. Edwards, Principal, and teachers Diane Buchanan and Susan McBirney, and their students at Jones Middle School in Hampton Roads, Virginia
- Ross A. Kearney, III, Public Relations Manager, Hampton Roads Transit
- Mr. Randall Landrith and students at Meadows Elementary School in San Jose, California
- Ms. Kimberly McLurkin-Harris and students at Argyle Middle School in Silver Springs, Maryland
- The Honorable Norman Y. Mineta, Secretary of Transportation
- Joseph Niegoski, Director, Educational Services, American Public Transit Association
- Michael S. Townes, President and CEO, Hampton Roads Transit

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

Thanks to technicians from Virginia, Washington, D.C., and SJSU's Academic Technology Network (Media Production and Delivery).

Special thanks goes to Dr. Dongsung Kong of San José State University, and his student, Hao Luu, for their time and effort in coordinating this forum, and MTI Research Director Trixie Johnson for her assistance with arrangements for this year's videoconference, and for so ably facilitating the student project introductions. MTI's Office Manager Amy Yan arranged the award and travel for this year's project winners.

MTI would also like to thank the following individuals for their hard work and dedication in publishing this forum: Research and Publications Assistant Sonya Cardenas; Communications Director Leslee Hamilton; Transcriber Kim Rose; Graphic Designer Shun Nelson; Webmaster Barney Murray; Student Editor Kaylee Wambaugh and Editorial Associate Catherine Frazier.

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## FOREWORD

As part of Mineta Transportation Institute's ongoing efforts to promote dialogue addressing surface transportation issues, it is my pleasure to share this edited transcript of the Mineta Transportation Institute's third annual National Garrett Morgan Sustainable Transportation Videoconference Symposium. Conducted on May 2, 2003, the videoconference linked schools in Hampton Roads, VA; Silver Springs, MD; and San Jose, CA, with San José State University.

These symposia were conceived to encourage young students across the nation to focus on innovative solutions to surface transportation problems. They also were designed to plant seeds that could germinate in a choice to focus on a college education in math, science, or engineering, which could someday enable students to contribute to sustainable transportation solutions. A sustainable transportation curriculum was created and distributed to each of the teachers participating in the 2003 symposium. The Garrett A. Morgan Technology and Transportation Futures Program, established by the Honorable Rodney Slater, former Secretary of the U.S. Department of Transportation, inspired the theme of the curriculum.

Experts from the transportation field, as well as teachers and their students, provided a unique and interesting perspectives on current issues and emerging solutions in the field of sustainable surface transportation. Each class discussed its region, its unique efforts to encourage the use of public transportation, and thoughts about the future of transportation in the United States.

This year's students were treated to a keynote address by the Honorable Norman Y. Mineta, Transportation Secretary, United States Department of Transportation. I would like to personally thank Secretary Mineta for taking the time to speak to tomorrow's transportation leaders and innovators.

This event was the result of many people's efforts as previously acknowledged, including MTI staff and editors.

The Mineta Transportation Institute has three primary functions: research, education, and information transfer. It is in this last role that MTI organized and presented this annual symposium. We are certain that this edited transcript, available on our website at <http://transweb.sjsu.edu>, will contribute to an

understanding of the issues and possible solutions, not only for those in our community, but also for anyone interested in sustainable surface transportation.

The student workbook and teacher's guide used for this year's symposium is available at *TransWeb* as well.

I believe that this edited transcript will provide a fascinating look into the transportation ideas and solutions that will inspire the next generation of surface transportation leaders.

We invite readers to send any comments regarding this transcript directly to MTI.



Ron Diridon

Executive Director

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## EXECUTIVE SUMMARY

### **Purpose**

The third National Garrett Morgan Videoconference Symposium presented by the Mineta Transportation Institute (MTI) was held on May 2, 2003, with hook-ups between the San José State University (SJSU) campus, Hampton Roads, VA., and Washington, D.C. This videoconference was part of the Garrett A. Morgan Technology and Transportation Futures Program, which was established by the Honorable Rodney Slater, former Secretary of the U.S. Department of Transportation. Teachers and students addressed the topic of sustainable transportation and proposed innovations for the surface transportation industry. The purpose of the symposium was to stimulate the minds of middle school-aged young people and to encourage them to excel in math and science in school, which could lead to careers in engineering and transportation planning and innovation.

### **Operations and Broadcast Sites**

There were three broadcast sites for the videoconference: Jones Middle School site, which was sponsored by Hampton Roads Transit of Virginia and hosted by Michael Townes; Argyle Middle School site, which was sponsored by the American Public Transportation Association (APTA) and hosted by Daniel Duff; and the Meadows Elementary School site, which was sponsored by SJSU and hosted by Rod Diridon.

### **Activities and Event Highlights**

Symposium participants were treated to a keynote address by the Honorable Norman Y. Mineta, Transportation Secretary, United States Department of Transportation. Secretary Mineta reminded students about the importance of innovation in transportation, and challenged youngsters to become the transportation designers and policy-makers of the future.

The morning's activities included a presentation of each participating school's original ideas for innovation in surface transportation.

- Jones Middle School made two presentations:
  - Solar-powered rail transit for ultra-light rail and light rail, and buses fueled by solar power and hydrogen fuel cells

- Hydrogen fuel cell-powered light rail vehicles
- Argyle Middle School made three presentations:
  - Hydroelectric-powered automobiles
  - New laws for drivers and transportation safety
  - Improved bus safety
- Meadows Elementary School's two presentations included:
  - A proposed the car of the future, the WHISPER (Wind, Human, Incredible, Solar-Powered, and Electricity-Run)
  - An ultra-light, hydrogen fuel cell light rail vehicle

After all schools made their presentations, a comprehensive question and answer session followed. The symposium ended with closing remarks from MTI's Rod Diridon and Trixie Johnson, and SJSU's Dr. Dongsung Kong. Students were encouraged to continue seeking creative transportation solutions and to stay in touch with MTI through the website at [www.transweb.sjsu.edu](http://www.transweb.sjsu.edu).

Following the videoconference, Dr. Kong, Mr. Diridon, and Ms. Johnson selected the winning project: Jones Middle School's solar-powered rail transit. Representatives of the students, faculty, school district, and parents attended the MTI banquet on June 14, 2003 at SJSU. Jones Middle School was presented with a \$500 check and the project poster was displayed in the reception area.







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## WELCOME AND INTRODUCTIONS

Participating schools and speakers of the third National Garrett Morgan Videoconference Symposium were welcomed by Rod Diridon, Executive Director of the Mineta Transportation Institute. Diridon reminded the middle school-aged participants that the purpose of the symposium was not only to introduce young people to the opportunities available in the transportation industry, but to make students aware of the importance of science and math in the curriculum, even in junior high school.

The objective of this symposium is to introduce young people to the subject of transportation as a possible career field... and to prepare yourself by taking the technical classes in high school—that's math and science—so that you can take the courses in college that will allow you to become professionals in the transportation area.

Diridon then introduced the three participating classes and their moderators to each other:

- Michael S. Townes, President, Hampton Roads Transit (HRT) in Virginia, with Jones Middle School in Hampton Roads, VA. With Mr. Townes were Sue Edwards, Principal of Jones Middle School; Hampton School Department Central Office representative Rose Martin; and teachers Diane Buchanan and Susan McBirney and their students.
- Daniel Duff, Chief Counsel and Vice-President of the American Public Transit Association (APTA), and Joseph Niegoski, Director of Educational Services, APTA, with teacher Kimberly McLurkin-Harris and her class from Argyle Middle School of Silver Springs, MD.
- Trixie Johnson, Research Director of the Mineta Transportation Institute, with teacher Randall Landrith and his class from Franklin-McKinley School District's Meadows Elementary School in San Jose, CA.



**Figure 1: Students at Jones Middle School in Hampton Roads, VA. listen to a presenter via videoconference technology**

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## KEYNOTE ADDRESS—THE HON. NORMAN Y. MINETA

### Transportation is an Everyday Necessity

U.S. Secretary of Transportation Norman Y. Mineta challenged the students to think of the various transportation modes they utilize on a daily basis. Without buses, cars or even bicycles, how difficult would it be for everyone to get around?

“Think about how difficult it would have been for you to get to school or back home or to your favorite shopping mall, if we didn’t have safe and reliable forms of transportation,” asked the Secretary.



**Fig 2: Norman Y. Mineta,  
Secretary of Transportation**

### Some Startling Transportation Statistics

The National Garrett Morgan Videoconference Symposium was created in part to challenge young people to think of ways to maintain and innovate environmentally-friendly transportation systems for the future. Secretary Mineta offered the following transportation statistics:

- “Three years ago, commuters in many of the nation’s largest urban areas spent more time stuck in traffic congestion than they did in 1982.”
- Many motorists spend 40 hours a year in traffic jams, which is the equivalent of one work week.
- In the year 2000, traffic congestion caused 3.6 billion hours of delays, and wasted 5.7 billion gallons of gasoline. That wasted gasoline would fill a half-million tanker trucks, and if those trucks were lined up end-to-end, would stretch from California to New York and back again. That wasted gasoline cost every driver an average of \$1,000.

### **Not Just Your Parents' Problem**

The Secretary reminded the students that the problem of being stuck in traffic gridlock would soon be their problem. "Many of you will be getting your learner's permits within the next several years. I am sure that the last thing you want is to be stuck in traffic on your way to a party or a ballgame," said Secretary Mineta.

He also said that people working in the transportation industry need to think about not only how to move people and goods safely, but also think of ways to protect the environment.

### **Many Opportunities in the Transportation Industry**

There are many different facets in the transportation industry. A person could work designing airplanes or bridges, or they could have a job driving buses or piloting airplanes, or they could even find themselves the secretary of transportation someday! People who have graduated from college and are now working in the transportation industry usually have jobs with an entry-level salary of over \$40,000 a year. Some transportation policy makers and engineers can earn over six figures a year. Secretary Mineta encouraged the participants to check out the Garrett Morgan website, which is located at [www.education.dot.gov](http://www.education.dot.gov).

### **Driver Safety**

Secretary Mineta parted with words of advice for tomorrow's drivers.

When you finally get to drive, please be sure to always buckle up and drive safely. Your family and your friends love you too much... I just saw the other day that the largest cause of death for young men between the ages of 18 and 34 is traffic accidents. We want you to be able to learn how to drive and to learn how to drive safely.

Rod Diridon offered his thanks to Secretary Mineta, and the Secretary returned the thanks by acknowledging the work that Diridon and the Mineta Transportation Institute have done in preparing tomorrow's transportation professionals via the Masters in Transportation Management and Certificate in Transportation Management programs at San José State University.

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## PROJECT PRESENTATIONS

Rod Diridon next turned his attention toward introducing MTI's Research Director, Trixie Johnson, who would be facilitating the presentation of the three participating schools.

Johnson felt that she had the best job of the session—that of introducing the schools and their projects to each other. Each project was given seven minutes to make its presentation. First up was Jones Middle School in Virginia.

### **Jones Middle School—Solar-Powered Transportation.**

Diane Buchanan and Susan McBirney's students proposed several solar-powered transportation alternatives, including solar cell-powered ultra-light rail trains, solar buses, and a ferry, for use in their community of Hampton Roads, VA. Solar cells work by absorbing the sun's rays to heat electrons that are located on semiconductors. The semiconductors in turn run faster and create electricity, which is then wired as either a DC or AC current. The solar electricity can also be stored in batteries, and that stored electricity can be used to power the train, bus or boat. If there's no sun, all of the vehicles could be run via a back-up ethanol generator.

Solar electric rail is based upon existing solar racing car technology. One municipality currently considering the possibility of adding light rail to its transportation system is Santa Cruz County in California, and there is much public support for ultra-light rail.

Advantages and interesting facts about ultra-light rail:

- Train cars are shaped like a teardrop for maximum aerodynamic efficiency.
- Each train costs approximately \$100,000.
- The cars can carry about 40 people, and will be changed for easy accessibility for persons with disabilities.
- Solar electric light rail is smokeless and noiseless so it won't affect public health.

The students also discussed the development of solar buses. Some interesting facts about solar buses:

- Solar-powered buses will cost about \$175,000.
- The average bus could hold up to 15 adult or 30 child passengers.

The costs are as follows of converting a bus to solar power are as follows:

- An 80-watt solar panel, which is 36 cell panels, would cost \$1,182.
- A 100-watt solar panel, which is 42 cell panels, would cost \$1,462.
- The MPPT, a regulator for solar cells, would cost \$1,010.
- The PV mounting frame would cost \$260.
- The total cost per bus to convert to solar fuel cell is \$3,914 per bus.

Buses would be used to pick people up in their neighborhoods and take them to the ultra-light rail trains or other destinations. There will be numerous bus stops near homes within reasonable walking distances and the buses will make stops at museums, theaters and malls. The naval and other military bases would also have numerous stops. The Newport News Shipyard would have its own route.

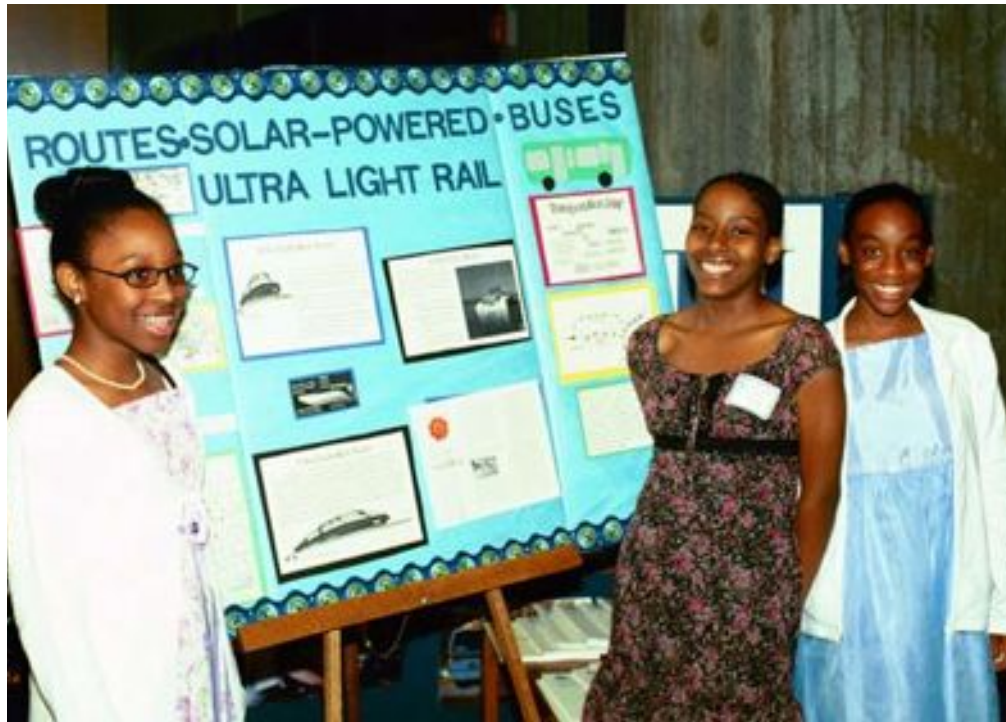
It is also hoped that by having many different types of bus destinations, tourism would increase in Hampton Roads. Specific tourist destinations include Norfolk, Langley Air Force Base, and Virginia Beach.

The class shared a proposed map of transit stops for their proposed mass transit system. The route runs between Virginia Beach Pavilion and Beach Street U.S.A.

The young planners also stated they would employ ultra-light ferry boats to shuttle passengers from the peninsula to Norfolk and the eastern shore. They also prepared a model of a solar powered ultra-light train, showing its versatility and accessibility for handicapped transit riders.

At the conclusion of the presentation, Michael Townes joked that he was ready to go forward with the students' project and was waiting for Secretary Mineta to send funding. Secretary Mineta in turn joked that funding was on its way.

Attention was next turned to Argyle Middle School from Silver Springs, MD.



**Figure 2: Jones Middle School students with their project**

### **Argyle Middle School–Hydroelectric-Powered Automobiles**

Kimberly McLurkin-Harris' class project was presented by four students—Megan, Miracle, Pritha and David.

Pritha talked about the need to reduce the amount of carbon dioxide gas in the environment. Today's internal combustion engines have caused much damage to the earth already, specifically the ozone layer.

Some interesting facts about the ozone layer and carbon dioxide:

- The ozone layer prevents the sun's harmful rays and radiation from the sun reaching the earth.



- Without the ozone layer, all the radiation from the sun will reach the earth. This will cause more types of skin cancer, causing more deaths.
- Carbon dioxide causes acid rain which causes damage to ancient relics.
- Acid rain also releases toxins into the water supply.
- One of the most damaging types of gas that is made by humans is chlorofluorocarbons, also known as CFCs.

There is ongoing research about the harm that carbon dioxide is having on the environment. There are many different organizations doing the research, including the Albany Research Center (ARC), Arizona State University, Science Application International Corporation, and the Department of Energy National Technology Laboratory.

Research in Mauna Loa, Hawaii reveals that between 1955 and now, the amount of carbon dioxide in the atmosphere has increased. Also, between the years of 1880 and 2000, the annual mean global temperature has been abnormal, showing increases at least since the beginning of the 20th century.

The ARC has been investigating mineral carbonation as a process to convert carbon dioxide into a geologically-stable solid form. The Argyle Middle School group proposed developing a carbonation system that would reduce carbon monoxide released into the environment.

Another option is hydroelectric power for use in a fuel cell. Megan presented the group's idea on how a hydroelectric-powered car could run, and David offered suggestions on how a hydroelectric car could help ease the need for fossil fuels.

Megan suggested the hydroelectric car utilize plastic hydrogen tanks which would lower the vehicle's weight by 40 percent. As Megan explained:

The fuel cell relies on chemistry and not combustion to produce power. It is power that makes the vehicle run, not gasoline as most people believe. In these fuel cells, oxygen passes over an electrode and hydrogen, and then passes over the next electrode and hydrogen, generating electricity, water, and heat. This makes the vehicle mobile.

David pointed out that hydrogen is being heavily researched as a source of fuel. For example, in Iceland, researchers are working toward becoming a hydrogen energy society in 30 to 40 years. Right now there are plans to equip

their city buses with fuel cells. By the year 2040, Iceland expects to be fossil-fuel-free.

### **Argyle Middle School–Rules of the Road**

The second group from Argyle Middle School–Michael, Parsi and Annette–offered their opinions regarding laws they feel should be implemented to improve and promote sustainable transportation.

Michael showed a model of a solar-powered bus, and stated that by using solar power, other natural resources would not be wasted.

Parsi and Annette outlined what they feel should be new rules of the road:

- A person over the age of 80 should not be allowed to drive alone. If such a person is caught, they must accept whatever penalty the judge deems fit.
- An overweight truck cannot drive on the highway, and if it is caught, it will face a fine of \$400.
- The speed limit through a neighborhood should not be more than 10 m.p.h.
- Larger cars and trucks are not allowed to drive on narrow roads. They must take wider roads to prevent accidents or face a penalty of \$150.
- You must use a headset or pull off the road to use a cell phone. The fine should be \$230 if you are caught using a cell phone while driving.
- Everyone must have a spare tire at all times or face a police warning.

### **Argyle Middle School–Transportation Safety**

Finally, Myra and Maya offered their recommendations on improving bus, bicycle, and automobile safety.

First, Myra and Maya thought that every bus should have more seats and seat belts. They observed that on Saturdays, the buses are full and that all of the people deserve a place to sit. The girls believe that everyone on the bus should use a seat belt, not just the driver. They stated their belief that the reason buses did not have passenger seat belts was to save the bus company money.

Myra and Maya stated that there were 196 bus accidents in Sweden and that 225 people have died because of bus accidents. The girls also think that it would be a good idea to have an adult sit at the back of every school bus, or

have a camera there so the driver can see what is happening. The bus driver should be responsible for checking the bus' tires and gas.

Bike riders could be safer if they had a spare bike tire, and automobiles could be safer if there were airbags not only in the front of the car, but also on the side.

After Myra and Maya's presentation, Ms. Johnson told the students that over 40,000 people die each year in car accidents, and that some of the Argyle Middle School students' ideas might help to save lives.

Next the videoconference traveled to California.

### **Meadows Elementary School–Wind, Human, Incredible, Solar-Powered, and Electricity-Run Vehicle (WHISPER)**

Meadows Elementary School students Monica, Donna, Liz and William created an idea for a car of the future, built to meet the needs of today. The WHISPER would be a high-tech, high-luxury, and high-safety car, complete with tempered glass to prevent break-ins, luxurious leather seating, front doors that open up not out, and sliding doors in the back seats. The design of the doors would prevent dents and scratches. Options would include a card lock entry system rather than a traditional key, and a global positioning system (GPS).

What would make the WHISPER totally revolutionary is its use of sustainable energies: wind, human, solar, and electricity. Wind turbines would propel the car and recharge the battery. There are also solar panels that would run the car and create electricity for the battery. Finally, if all other energy sources fail, there would be pedals in the front seat for the driver and passenger to use to move the car.

The students' pitch for the affordable car continued:

The earth would be healthier, the ocean would be cleaner, and the air would truly smell better. The occurrence of illnesses like asthma would decrease. The passengers would get good exercise by using the pedals, lowering the obesity rates. This car would truly impact the world's economy.

The WHISPER would be the ultimate non-polluting, comfortable, and safe car.

### **Meadows Elementary School–Ultra-Light Rail Vehicles**

A second team of Meadows Middle School students made their pitch for ultra-light rail in San Jose. The students outlined their design plan for the cars. Each car will be teardrop shaped for maximum aerodynamic efficiency, and materials used would be Kevlar and carbonfibers. The trains would be powered by a centrally-located, 2kw solar-powered battery. The cars would of course weigh less and require less power to propel the train.

There would also be 10kw solar charging panels at each station.

Another option would be hydrogen and wind power.

Ultra-light rail would help the environment because it is not noisy, is non-polluting, and is sustainable. Because of the renewable energy sources, there is no need for purchasing additional electricity.

The action then transferred back to Virginia.

### **Jones Middle School–Hydrogen Fuel Cell Light Rail**

Light rail is the revised version of the trolley car and it runs on nonpolluting electricity. It can run as a single car or as a train. It is a combination street car and rapid transit system.

The students described their light rail system:

Light rail cars hold up to 250 passengers, including standees, and they can add more cars to suit the crowd. Light rail is practical for urban environments because of its abilities to operate in different traffic settings. When not in the above traffic conditions, it can travel up to 60 miles per hour. Light rail is ADA compliant. A ramp that folds down will allow disabled people to board.

The proposed system is based on hydrogen, and the only exhaust from burning hydrogen is water vapor. The new system is friendly to the environment and economical to run.

Because it is time consuming to make multiple stops, the students propose utilizing buses to make frequent neighborhood stops. Those buses will be solar

electric buses and have various sizes to meet the different demands on the transit system throughout the day.

For days when solar power will not work, the buses will also be equipped with a hydrogen cell. A team member, April, explained how the hydrogen fuel cell worked.

Hydrogen fuel is sent into anodes, which is a negative gas distributor of the fuel cell. Oxygen exits the fuel cells through the cathode, the positive gas distributor. Encouraged by a catalyst, the hydrogen atoms split into a proton energy selection, which takes different paths, to the cathode. The proton passes through the electrode light. The electrodes create a separate current that can be utilized before they return to the cathode, to be reunited with the hydrogen and the oxygen in a molecule of water.

The bus system will be accessible to people with physical handicaps. There will be a lift at the back of the bus, and for sight-impaired people, a bell will announce when the bus is about to stop. For deaf people, a light will let them know the bus is about to make a stop.

The team members also made safety recommendations for their transit system and for bus driver health.

- There need to be crash tests every so often to check for bus safety.
- All drivers are drug tested when they are hired and at random.
- Bus drivers must have a heart and physical exam every month or so.
- Each bus must carry a first aid kit, a cell phone, and flares.

After all of the presentations were done, Ms. Johnson congratulated all for their hard work and innovation, and said each and every group was a winner. She promised to have the contest judged within a week so the winners could be announced and make plans to attend MTI's 12th Annual Scholarship Banquet on June 14.

## QUESTIONS AND ANSWERS

Rod Diridon acted as moderator for the lively question and answer discussion.

### **STUDENT, MEADOWS ELEMENTARY SCHOOL**

My question is, since we have the technology to produce cars that use solar power, can't we get the solar power in circulation worldwide?

### **DANIEL DUFF:**

We all like the notion of solar power, and it is efficient; it doesn't pollute; it is the wave of the future. I think the problem right now is the technology and the cost of the technology. As with all new technologies, there are a lot of developmental costs involved. I think if you looked at a curve, the more research and money you spent on this new technology, it becomes cheaper and cheaper to produce the engines that can power cars all around the world. So I think in a short time, we may have access to that world technology.

### **STUDENT, MEADOWS ELEMENTARY SCHOOL**

Why is it that we evolved at first using fossil fuels for fuel?

### **ROD DIRIDON:**

Any of the students care to make a comment on that first?

### **STUDENT, JONES MIDDLE SCHOOL**

The reason why I think that they started using those fuels first, was because that was the first thing that they found. Back then they didn't really have the technology to find a better source that they could use, so it was easier to use the gasoline and petroleum, and they didn't how to use the solar power, so that's probably why they used that.

### **STUDENT, JONES MIDDLE SCHOOL:**

I have a question about solar-powered cars. Mr. Mineta mentioned earlier all the time sitting in traffic that was wasted. How would solar-powered cars help reduce traffic?

**ROD DIRIDON:**

That's a very interesting question. Does anyone have an answer to that question in any of the locations? Maybe I'll give it a try, then. The answer to that is that solar-powered cars aren't going to reduce congestion. We still will have the congestion but we won't have the pollution, because solar-powered cars use electricity that's generated directly from the sun, so they don't have to burn anything that would create pollution. So solar-powered cars don't reduce congestion, but they certainly do reduce pollution, which is one of the problems in transportation today. We have a question here. Yes, ma'am?

**STUDENT, MEADOWS ELEMENTARY SCHOOL:**

I wanted to ask a question about what if people are deaf and couldn't talk or are blind?

**ROD DIRIDON:**

How to get those people to travel? Okay, the question here from Meadows School in San Jose is, "How do you take care of transportation for people who are deaf or blind?" Do we have an answer to that question?

**STUDENT:**

The solution to that is when a person's deaf, there will be a light that says this stop is their stop, so they'll know, and if they're blind, a bell will ring telling them and a voice will come on, telling them this is their stop.

**ROD DIRIDON:**

That would work with mass transportation like light rail that you presented, wouldn't it? Very good. In terms of operating in an automobile though, it's not possible with any technology we know of to allow a deaf or blind person to operate an automobile safely.

**STUDENT, ARGYLE MIDDLE SCHOOL:**

My question is, "What's a good way to reduce traffic?"

**STUDENT, JONES MIDDLE SCHOOL:**

First of all, we're supposed to be doing something on mass transit. If you have simple cars that each person can drive around, it's not mass transit; so that would still bring out the congestion. So the light rail that we had done, it would be great to reduce congestion, because it is only one train that goes around the town. There will be other trains also, but there will be no congestion with that, because they will not be able to run into each other on their different tracks.

**ROD DIRIDON:**

The point is that although you can design an automobile to reduce air pollution, if you have individual automobiles, you're still going to have traffic congestion. So if you try to develop something that relates to mass transportation, where more people use vehicles that either take up less space on the road or on rails, then you do reduce traffic congestion and air pollution. So mass transportation is an important opportunity for us all in the future. We have a lot of questions now from Virginia; let's go to the lady in the black outfit with her hand up.

**STUDENT, JONES MIDDLE SCHOOL:**

I have a question for the students at Meadows Elementary School in San Jose. How would your car, the WHISPER, be cost efficient?

**STUDENT, MEADOWS ELEMENTARY SCHOOL:**

As I said, the long-term expenses will make your costs low, because gas will not be needed, which will save you money; plus maintenance will not be needed also, because the car can take care of itself; and the security also, like with the tempered glass, the thieves won't break anything and nothing will be stolen.

**STUDENT, JONES MIDDLE SCHOOL:**

How much exactly would it cost to buy the car?

**STUDENT, MEADOWS ELEMENTARY SCHOOL:**

Around \$25,000.



**STUDENT, ARGYLE MIDDLE SCHOOL:**

The Department of Transportation leads their team to find better materials for road pavement, because every time there are storms or snow, there usually are big potholes in the pavement.

**ROD DIRIDON:**

The question is, “Is the Department of Transportation looking for better material for pavement, because pavement tends to wear out with weather and it creates potholes?” Do any of the students at any of the centers have an answer to that? Maybe I can help a little bit there, because I’m also on the Transportation Resource Board.

Let me try to give you an answer to that. The answer is yes, the Department of Transportation spends millions of dollars every year researching pavement to try to figure out a way to make it more durable, less polluting—because indeed pavement does have petroleum in it, and water runoff does create a little bit of pollution—and to make it more resilient, so that it’s easier to drive on. One of the ways they’re using now to do that is to use ground-up rubber, from worn-out rubber tires, in the pavement, to have the pavement stick together better and to be more resilient and to last longer. [It] costs a little bit more, but by grinding up rubber from rubber tires and using what’s called crumb rubber, putting that underneath the pavement and putting the pavement down on the road, they are able to last longer and it is more resilient and easier to drive on for your tires. It’s a good question.

**STUDENT, ARGYLE MIDDLE SCHOOL:**

When will solar-powered buses come out in the city?

**ROD DIRIDON:**

The question from Washington is, “When will solar-powered buses come into the cities and be used?” Anyone have an answer to that question around the nation? Any estimates? We had a project proposing solar-powered buses—when do you think your project might be out on the street?

**STUDENT, JONES MIDDLE SCHOOL:**

As soon as we get the funding for them.

**STUDENT, JONES MIDDLE SCHOOL:**

We already have the funding, we already have that.

**ROD DIRIDON:**

So who would like to respond to that from Virginia?

**STUDENT, JONES MIDDLE SCHOOL:**

To answer the question, we already have buses, so I was thinking that we could add on to the buses, to take the buses that aren't as efficient, and add on the other motors that are less polluting, the other equipment like the solar-powered panels and the hydroelectric-powered fuel cells.

**ROD DIRIDON:**

That's a very good idea, and it may be that we could retrofit and get some power that would augment the other power on the buses.

**STUDENT, MEADOWS ELEMENTARY SCHOOL:**

I've got a question for Virginia. You said that you're going to make a bus equipped with solar power, and I'm questioning that. If the solar bus can hold a large quantity of people, how can the bus move faster and will that make more congestion?

**STUDENT, JONES MIDDLE SCHOOL:**

Yes, there will be enough power. The sun will always be there for it to be able to use except on cloudy days. When it's not there, our back-up power is the hydroelectric fuel cells, which provide a lot of movement.

I have a question for the Argyle Middle School in Maryland. If carbon dioxide is poisonous, is harmful to the air, how come plants breathe carbon dioxide and it's a proven fact that carbon dioxide makes plants healthier, the more carbon dioxide in the room?

**ROD DIRIDON:**

That's a very interesting question, Plants do indeed thrive on carbon dioxide. Human beings and mammals exhale carbon dioxide, as do petroleum fuel-powered vehicles. So how is this? Does anyone have an answer to that from any of the classes?

**STUDENT, ARGYLE MIDDLE SCHOOL:**

The emissions from the cars are too much for the plants to take in all at once; therefore, the oxygen is not being changed over and most of the carbon dioxide is being admitted into the atmosphere and ruining it.

**STUDENT, ARGYLE MIDDLE SCHOOL:**

I think you mean carbon monoxide.

**STUDENT, ARGYLE MIDDLE SCHOOL:**

Carbon monoxide, sorry.

**ROD DIRIDON:**

Actually, Argyle Middle School is accurate in that automobiles and petroleum combustion emit both carbon monoxide, which is a deadly poison, as well as carbon dioxide, which plants consume. Her point is very good, in that plants in the world are disappearing. We're cutting down the rain forests in Brazil and the other countries, we've cut down most of the forest in the United States, and as a consequence, there aren't enough plants left to consume all the carbon dioxide that we're emitting now. We have more carbon dioxide than the plants can consume, so the cycle that has been in existence from the beginning of time—where mammals exude carbon dioxide and plants consume the carbon dioxide, and the plants then create oxygen—that cycle is interrupted because we're creating more and more mammals, and more and more petroleum engines, and we're cutting down the rain forest, so there are fewer and fewer plants. We're becoming out of balance, so we have to reduce the amount of carbon dioxide that we're creating in order to get back into balance.

I hope that was clear.

Let's go now to a question from someone who hasn't had a chance to ask a question. There's a young lady in Virginia, way in the back on the right hand side, with the red outfit on. Please come forward.

**STUDENT, JONES MIDDLE SCHOOL:**

My question is, you talked about using cars, what about for those who can't afford cars? How do you intend on making your plan succeed, when most of the people won't be able to afford it?

**ROD DIRIDON:**

That's a good point. Do we have any answers now from the students around the country? How do we provide mobility for people that can't afford a car? There are a lot of people in the United States who can't afford a car. We have an answer from San Jose.

**STUDENT, MEADOWS ELEMENTARY SCHOOL:**

Bikes are cheaper.

**ROD DIRIDON:**

That's a very good point. The gentleman from the middle school in California noted that bikes are inexpensive and most people can afford bicycles. Remember that as much as we kind of laugh about that in the United States, throughout the world, many people have only a bicycle. In China, and in other of the emerging countries that are not industrialized as heavily, a significant portion of the population only rides bicycles. Of course, that's nonpolluting, because you don't use any energy except your muscles. So that's a good answer, but in the United where many people use automobiles and some people, many people, can't afford them, what alternative do we have to using an automobile? Is there another alternative? Would someone like to try to answer that question?

**STUDENT, JONES MIDDLE SCHOOL:**

There is another alternative.

**ROD DIRIDON:**

Okay, come forward and offer the alternative.

**STUDENT, JONES MIDDLE SCHOOL:**

The alternative would probably be a bus or a train, and they are a lot cheaper.

**ROD DIRIDON:**

[This student] says that the alternative for those people who can't afford a car is to use some kind of mass transportation, like a bus or a train. Of course, that assumes that your community has built a mass transportation system for those people who don't have access to automobiles. That's a good answer, very good answer. We have time for only one more question. Let's see if we can go to someone who has not yet asked a question. Anyone in Washington?

**STUDENT, ARGYLE MIDDLE SCHOOL:**

The oil industry and the gas companies produce and sell mostly gas and diesel, so if the industry is very powerful, how can we get them to support the production and sell the hydrogen fuel for use in the future cars?

**ROD DIRIDON:**

That is a very good question you're asking, good job. You're asking the question that many of us ask every day, and that is, "Since the petroleum industry, the gasoline industry, and the automobile industry are so powerful, in terms of lobbying and advertising, how do we get them to be interested in and willing to provide less polluting kinds of cars, and provide nonpolluting fuels like hydrogen, and work with solar technology?" Does anyone have an answer to that question?

**STUDENT, JONES MIDDLE SCHOOL:**

I have an answer for that.

The average car or truck gets anywhere from 10 to 25 miles per gallon, and on a fuel cell, you get anywhere from 60 to a 100 miles per gallon, and that's a lot more help.

**ROD DIRIDON:**

That sure is a good reason for doing it, but how do we persuade the oil companies that make money off of selling petroleum to go to that technology and to support that technology with hydrogen fueling stations and so on? We have only a few minutes left, so let's see if we can go to the young man in the back in the blue shirt. He hasn't had a chance to say something yet, so let's have him come forward and introduce himself. What's your answer to that?

**STUDENT, JONES MIDDLE SCHOOL:**

As of now, several petroleum and car companies are researching hydrogen fuel cells for use, because they are more economical for the general public, and the public would more likely consume these types of products; and they're running out of oil in general.

**ROD DIRIDON:**

That's a very hopeful and logical response. I hope that the oil companies agree with that. Can we go to Daniel Duff? Because he works with this subject continuously, he may have a more insightful, politically involved answer. Dan, do you care to share a thought?

**DANIEL DUFF:**

Thank you, Rod; I think those were good answers. As with anything, I think one of the key issues is cost. Right now, some of this new technology is more costly. But the young man had it right, if the automobile manufacturers are beginning to look at these new types of engines, they're doing that because they can be more efficient and more effective.

Maybe the government could provide some incentive by way of national legislation that would encourage the automobile manufacturers to move there a little quicker, but I think they're beginning to move there and think it's just a question of time before we get there.



## CONCLUDING REMARKS

Rod Diridon offered his thanks to all of the students for their presentations, and promised that the presentations would be judged and the winner announced within the week. The winning presenter will earn \$500 for their school, and a team member will be invited to attend the Mineta Transportation Institute's 12th Annual Scholarship Banquet on June 14, 2003.

He then sent his thanks to Daniel Duff from the American Public Transit Association for his work with Argyle Middle School, and Michael Townes from Hampton Roads Transit in Virginia and his work with Jones Middle School. Thanks were also offered to San José State University for their assistance with Meadows Elementary School.

Trixie Johnson stated that much of the material and ideas presented are potentially great college projects, and that much of the students' research was very encouraging. She offered the suggestion that the students consider taking the classes they need so they can attend college and pursue careers in the transportation industry.

She observed that the high school students who participate in MTI's Summer Transportation Institute learned that people who work in the transportation industry enjoy their work, and hoped that because of symposium participation, this year's participants will think of transportation as a good place to work someday.

Dr. Dongsung Kong, organizer of the Garrett Morgan Videoconference and Political Science professor at San José State University, echoed Rod and Trixie's sentiments and remarked that he was "happy and proud to envision that America's transportation will be more sustainable."

And the winners are...





**Figure 3: Jones Middle School Students in Hampton Roads, VA.**



**Figure 4: Jones Middle School Ultra-Light Rail Project Winners at MTI's 12th Annual Scholarship Banquet honored by MTI's Research Director Trixie Johnson**

## ABBREVIATIONS, ACRONYMS AND TERMS

ADA	Americans With Disabilities Act
APTA	American Public Transportation Association
ARC	Albany Research Center
CFCs	Chlorofluorocarbons
Garrett A. Morgan Technology and Transportation Futures Program	A program established by former Secretary of Transportation Rodney Slater in honor of Garrett Morgan, an African-American inventor and transportation innovator. The program is designed to: 1) Build a bridge between America's youth and the transportation community; 2) To support the development of improved educational technology that provides better ways for people to acquire new skills; and 3) To ensure that America's transportation workforce for the 21st century is technologically literate and internationally competitive. See <a href="http://education.dot.gov/">http://education.dot.gov/</a> for more information.
GPS	Global Positioning System
HRT	Hampton Roads Transit
MPPT	Maximum Power Point Tracker: a charge controller for use in solar power systems
MTI	Mineta Transportation Institute
PV	Photovoltaic
SJSU	San José State University
WHISPER	Wind, Human, Incredible, Solar-Powered, and Electricity-Run Vehicle proposed by Meadows Elementary School



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