

National Garrett Morgan Sustainable Transportation Symposium

March 23, 2007

A Video-conference of the
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The Mineta Transportation Institute thanks the following schools for their participation in the 2007 National Garrett Morgan Sustainable Transportation Symposium on March 23, 2007.

- Argyle Middle School, Silver Spring MD
- George Flamson Middle School, Paso Robles CA
- Leonardtown High School (two classes), Leonardtown MD
- MacArthur Fundamental Intermediate School, Santa Ana CA
- Oakland High School, Oakland CA
- C. Vernon Spratley Middle School, Hampton VA

Thanks to all transportation professionals who participated in the videoconference either directly or indirectly (in alphabetical order, except for the Secretaries):

- Mary Peters, U.S. Secretary of Transportation
- Norm Mineta, U.S. Secretary of Transportation (ret.), Vice Chair, Hill & Knowlton
- Pam Boswell, Vice President of Education Programs, APTA
- Nannette Bouknight, Communications Development Coordinator, Hampton Roads Transit (for Michael Townes)
- Rod Diridon, Executive Director, MTI
- John Horsley, Executive Director, AASHTO
- Tate Jackson, Conference host, National Manager, Track Program, AASHTO
- Will Kempton, Director, Caltrans
- Rich Krumholz, Director, Caltrans District 5
- Ruby Louie, Deputy Director, Caltrans District 4
- Bill Millar, President, APTA
- Larry Orcutt, Chief, Division of Research and Innovation, Caltrans

- James Pinheiro, Deputy District Director, Caltrans District 12

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FOREWARD

As part of Mineta Transportation Institute's ongoing work to promote dialog addressing transportation issues, it is my pleasure to share this edited transcript of the Institute's Seventh Annual national Garrett Morgan Sustainable Transportation Videoconference Symposium. The national videoconference was conducted on March 27, 2007.

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 desire to take college majors in math, science, or engineering, all of which could lead to careers in sustainable transportation. MTI created a curriculum on that topic and delivered it to each of the teachers participating in the 2007 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 perspective on current issues and emerging solutions in 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.

The event was made possible by the many people who devoted their time, ideas, and energy, 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 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 teachers' guide for this year's symposium are available here online, as well.

I believe this edited transcript will provide a fascinating look into the transportation ideas and solutions that will inspire the next generation of leaders – whether they work directly in the field, vote on transportation issues, or make their own choices about which methods of transportation they will use.

Please send any comments about this transcript to MTL.

Rod Diridon
Executive Director

EXECUTIVE SUMMARY

Purpose

The seventh annual National Garrett Morgan Videoconference Symposium presented by the Mineta Transportation Institute (MTI) was held on March 27, 2007, with hook-ups among several sites. The videoconference was part of the Garrett A. Morgan Technology and Transportation Futures Program established by the Honorable Rodney Slater, former Secretary of the U.S. Department of Transportation. Teachers and students addressed sustainable transportation and proposed innovations for the surface transportation industry. The symposium is intended to stimulate the minds of middle school students and to encourage them to excel in math and science. This could lead them into careers in engineering and transportation planning and innovation.

Activities and Event Highlights

Symposium participants were treated to a keynote address by the Honorable Mary Peters, Secretary, United States Department of Transportation. Secretary Peters reminded students about the importance of innovation in transportation, and she challenged them to become transportation designers and policy makers.

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

- Leonardtown High School in Leonardtown MD made a presentation on the "Magnetic Levitation Bus"
- Argyle Middle School made a presentation on "Polymer Electrolyte Membrane Fuel Cells"
- Spratley Middle School of Hampton VA made a presentation on "The Tubulator"
- Oakland High School ninth grade in Oakland CA made a presentation on "Solar Trains, Inc."

- Flamson Middle School fifth and eighth grades in Paso Robles CA made a presentation on “Converting Your Car to Alcohol”
- MacArthur Fundamental Intermediate School in Santa Ana CA made a presentation about “Coffee Grounds as Fuel”
- Leonardtown High School of Leonardtown MD made a presentation on “The Corn Ferry”

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. Students were encouraged to continue seeking creative transportation solutions and to stay in touch with MTI through its website.

Following the videoconference, the judging panel evaluated and scored the projects, awarding the honor to Oakland High School and Argyle Middle School.

Representatives of the students, faculty, school district, and parents attended the MTI banquet on June 30, 2007 at SJSU. Both schools received a \$500 cash award, and their project posters were displayed in the banquet’s reception area.

WELCOME AND INTRODUCTIONS

Participating schools and speakers of the National Garrett Morgan Videoconference Symposium were welcomed by Rod Diridon, Executive Director of the Mineta Transportation Institute. Mr. Diridon explained the objectives of the Symposium – that it is to expose pre-high school students to technical-background information on mass transportation and highways that will encourage them to begin careers in transportation once they've completed their college. He stressed the importance of transportation for the nation, and he said that the Mineta Transportation Institute has been given the responsibility by Congress and the California Legislature to run these kinds of programs.

Mr. Diridon then introduced the schools and their site sponsors on the East Coast:

- John Horsley, executive director of the American Association of State Highways and Transportation Officials in Hampton Roads VA, with Leonardtown High School of Leonardtown MD. Tate Jackson hosted at the AASHTO site.
- Bill Millar, president of the American Public Transportation Association in Washington, D.C., with Argyle Middle School of Silver Spring MD. Pam Boswell represented Mr. Millar at that site.
- Michael Townes, president and chief executive officer, Hampton Roads Transit in Hampton Roads VA. He is also past president of the Mineta Transportation Institute board. Spratley Middle School of Hampton VA was hosted at that site.

Mr. Diridon then introduced Will Kempton, executive director of the California Department of Transportation in Sacramento CA. Mr. Kempton is also a member of the Mineta Transportation Institute board of trustees. He said Caltrans was proud to sponsor the California schools, and he expressed gratitude for the Hampton Roads success with the Garrett Morgan program. He congratulated the participating schools and said that some of the students could become the next Garrett Morgans. He also

explained that Garrett Morgan was the son of former slaves and that he patented a kind of early traffic signal.

Mr. Kempton then introduced all 12 of California's state district directors of transportation, who were present to observe the program. Then he introduced the three California schools:

- Oakland High School's ninth grade in Oakland CA, sponsored by Caltrans District 4 office in Oakland
- Flamson Middle School's 5th and 8th grade in Paso Robles CA, sponsored by Caltrans District 5 office in San Luis Obispo.
- MacArthur Fundamental Intermediate School in Santa Ana CA, sponsored by Caltrans District 12 office in Orange County.

Mr. Kempton said the students now know more about sustainable transportation than most adults, and he hoped they would consider Caltrans and the other departments of transportation around the country as a place to work in the future.

Mr. Diridon then introduced the Honorable Norman Y. Mineta, the founder of the Mineta Transportation Institute and the past Secretary of the U.S. Department of Transportation. He explained how Secretary Mineta began his public service as mayor of San Jose CA, proceeded on to become the chair of what is now the House Transportation and Infrastructure Committee, how he authored the Intermodal Surface Transportation Efficiency Act, and how he later became Secretary of Commerce under President Clinton, and then Secretary of Transportation under President Bush. Mr. Diridon said that Secretary Mineta is now vice chair of the board of Hill & Knowlton, the largest public-relations firm in the world.

Secretary Mineta expressed his pleasure at introducing Secretary Mary Peters, who has had a lifelong interest in transportation issues. He explained that Secretary Peters

started her career with the Arizona State Department of Transportation, where she rose to the top of the department, becoming its director. He also described her career in Washington as director of the Federal Highway Administration, how she returned to Arizona for private-sector experience, and how she then was selected as the next Secretary of Transportation, following his own retirement.

Secretary Mineta praised Secretary Peters as a very hands-on operator who knows the programs – that she wants to know how programs work and how they impact on the economy, businesses, and individuals.

“Now it makes me feel so good to have such a competent person replacing me, and so now I have to work to live up to *her* standards in terms of what *she's* doing at the Department of Transportation, and what *I'm* doing now in the private sector. But I'm so proud to have Mary as the Secretary of Transportation, and to have the honor and privilege of introducing her to all of you.”

Secretary Mineta told the students that Secretary Peters was a great role model for setting high goals and achieving them. He then presented her to the students.

KEYNOTE ADDRESS - THE HON. MARY PETERS

Secretary Mary Peters praised her predecessor for being a great mentor and thanked the transportation officials who are encouraging young people to follow a career path in transportation. She told the students that it would offer tremendous opportunities for advancement.

Transportation Is at the Core of Freedom

Secretary Peters said that service to your country may not always seem like the most glamorous career, but it is what makes this country very strong. She is always glad to see young people show an interest in public policy, and show an interest in how they can change things and make them better.

She said that transportation is at the very core of the freedom we enjoy in America.

- It's the freedom to go where life takes us, to settle where we choose, to live where we choose, to go to school, and to pursue happiness in our lives. But too often in our country today, reliable and safe transportation is taken for granted.
- It's not until a problem severely disrupts our transportation system, such as the recent incident when passengers were stranded on planes for hours in winter storms, have we realized how important transportation is to our lives and how much we *do* take it for granted.
- We don't often stop and think when we go get our latest UPS delivery at our house, or we get a new video game or other products at the store. But our transportation system is truly fascinating and very complex.

Transportation delivers billions of dollars in merchandise each day. Here are some interesting facts about it.

- Americans travel 11 billion miles every day.

- By 2015, a little more than 100 years from the birth of flight, 1 billion domestic passengers are expected to fly every year.
- Road congestion wasted 2.3 billion gallons of fuel in 2003.
- Public-transit ridership has increased by 30 percent since 1995.
- In 2006 alone, it increased by nearly three percent.

How the Department of Transportation Operates

Transportation drives our way of life and our freedom of movement. But moving all of these people and merchandise requires a very powerful transportation system and a great deal of effort behind the scenes. The U.S. Department of Transportation is a key player in making sure that our system *is* reliable, efficient, and safe.

The Department of Transportation:

- Employs more than 66,000 professionals
- Has an annual budget of more than \$60 billion
- Helps ensure that everything from people to cargo can move safely and efficiently across the United States, across our borders, by land, by air, and by sea
- Helps find solutions to traffic jams on roads, in the skies, and on railroads
- Pushes for energy-saving fuel efficiency for cars and trucks
- Helps save lives by reminding people to buckle up, to put their young children in child-safety seats in the back seat of the car, and to stay away from drugs and alcohol *all* the time, but especially when driving
- Inspects trucks, railroad tracks, airplanes, transit systems, and pipelines to ensure that they meet the highest safety standards

It's a Hands-on Responsibility

Secretary Peters said she has been all over the country to check on the Department's progress in this work, and she learned what's happening with local transportation. She has:

- Visited Caltrans, which has a huge challenge in meeting transportation needs in California, the sixth-largest economy in the world
- Toured major businesses, railroads, public-transit projects, and safety-inspection facilities
- Met with the President, governors, mayors, and other elected officials
- Met with business leaders
- Most importantly has met with everyday Americans

The common theme was that transportation and freedom are the same thing. We achieve and strengthen freedom by innovation, by continually improving our transportation systems and technology as we have throughout the history of our nation, and as young people will help us do in the future of our nation.

Transportation Issues Have Changed Dramatically

We started with horse-drawn carriages, and then moved to subway trains, from hand-drawn maps to GPS systems. "I met with a company that told me that they can track traffic by the signals that our cell phones send out... That's incredible, the amount that technology has contributed. And we're going to have to keep innovating if we want to keep moving because congestion is threatening our freedom and our mobility."

- In 2003, traffic congestion cost consumers and businesses over \$65 billion
- It also cost 3.7 billion hours of wasted time and wasted money, not including the wasted gas
- To address this challenge successfully, it's time to get creative, just as Garrett Morgan did

Who Was Garrett Morgan?

He was an early African-American inventor who's the inspiration for the U.S.

Department of Transportation's program that helps sponsor student activities through the Mineta Transportation Institute. Mr. Morgan is an example of American creativity

and ingenuity, and the President often talks about him. He invented the first three-signal traffic light. Until then, there were only two signal lights -- red for "stop," and "green" for go. Drivers didn't know that the light was going to change, so they'd proceed into the intersection, and there was a crash. So this three-signal light helped improve safety because people knew when the light was going to change.

Mr. Morgan was a pioneer in traffic safety and in the fight against congestion. These are still the most important priorities that we have at the U.S. Department of Transportation, and we're still using Garrett Morgan's invention as we tackle them.

By combining his good idea with 21st Century technologies, we have lights that automatically stay green longer when there's more traffic, and lights that "talk" to people who can't see them by making a sound to tell them when the light is changing and it's safe for them to cross the intersection.

As transportation becomes more and more high-tech, there is no telling what creative new ideas people can come up with to make our lives better in the future. That's why the President is encouraging students like you to study math and science. These are going to be the "core skills" that you need to have good, high-paying jobs in the twenty-first century, and they're also important for transportation. This is going to sound incredible, but one in seven jobs in America today is transportation-related.

Mary Peters finished by saying that she "hopes that what I've shared with you today gives you a better understanding of how important transportation is, and how the work we do at U.S. DOT, and what Will, Michael and Bill Millar do at the state departments of transportation; and how we help the transportation system in America be strong and help ensure our freedom here in America." And a quote from Ronald Reagan, who said said, "There is no limit as to what a man or a woman can do, or where he can go, if he doesn't mind who gets the credit." She went on to stress how there is *so* much that can be accomplished when a group of energetic and bright individuals get together, and

hoped that the students experience with the Mineta Institute will inspire them to pursue careers in public transportation, or in the public sector, to help relieve congestion and keep people and businesses successful and moving forward toward the future.

INTRODUCTION OF STUDENT PRESENTATIONS BY TRIXIE JOHNSON

Trixie Johnson, research director of the Mineta Transportation Institute, was the moderator of the student presentations and the following question-and-answer period. Mrs. Johnson described the procedures to be followed by each of the schools, established the order of the presentations, and set a 10 minute time limit per school. Mrs. Johnson also informed the audience that a teacher, a student, and a parent from the winning class would receive all expense-paid trips to San Jose, and would attend the annual banquet, on June 30th. At the event, master students will be graduating, and there will be people from all over the country who are leaders in transportation.

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

The distinction of being first to present went to Argyle Middle School, in Washington, D.C., at the APTA site. Pam Boswell, Vice President of Education Programs for APTA, proudly introduced assistant principal of Argyle Middle School, Mrs. Kimberly Harris, and the student's science teacher, Ms. Franklin, as well as the students from Argyle Middle School.

STUDENT PRESENTATIONS

Argyle Middle School: "Polymer Electrolyte Membrane Fuel Cells for Buses"

Project Team: Cory Morfield, Christopher Kittleberger, and Guyman Nowazi

Instructor(s): Ms. Franklin, Kimberly Harris

Sponsor: APTA, Pam Boswell, Vice President of Education Programs

The title of the Argyle Middle School's presentation was "Polymer Electrolyte Membrane Fuel Cells for Buses," and their objective was to create a fuel source for vehicles that is both economical and safe for the environment.

To do this, they used a process called electrolysis. Electrolysis uses electricity to split water into two main substances, hydrogen and oxygen. These two substances will go into the fuel cell and be combined with oxygen from the air to create the fuel source. The exhaust is composed of only heat and water.

The students used a slide show demonstrating the process of electrolysis, and they explained that in the electrolysis tank, the electricity will go down the cathode and into the water. It will split the water into two substances, oxygen and hydrogen gases. The hydrogen gases will float up to the hydrogen outlet and will be split by the first catalyst into electrical current and positive hydrogen.

The group concluded their presentation by explaining that Polymer Electrolyte Membrane Fuel Cells, also called proton exchange membrane fuel cells, deliver high power density, and offer the advantages of low weight and volume. They also contain a platinum catalyst that only needs hydrogen, oxygen, and water to operate. They also operate at relatively low temperatures, around 80 degrees Celsius, or 176 degrees

Fahrenheit. The low temperature allows them to start quickly, with less warm-up time, and that hydrogen powered vehicles can travel the same distance as gasoline-powered vehicles.

Oakland High School: "Solar Trains, Inc."

Project Team: Kevin Ha, Alfredo Hernandez, Jeffrey Lam, Kayla Abdulla, Ana Turner, David Liu, Collette Walker, and Ivan Tajinovitch

Instructor(s): Kevin Jordan, Tom Scott

Sponsor: District 4, Ruby Louie, Deputy Director

The Oakland High School group began with a quote from David Thoreau: "Most men and women lead lives of quiet desperation and go to their graves with a song still in their heart." They explained that those who are unwilling to be bound by restrictions placed on them by society and by themselves have proven to be the greatest scientists, innovators, artists, and thinkers.

The student's stated goal was: "Clean sustainable transportation from clean sustainable energy." They explained that energy for transportation falls into two categories: clean, sustainable sources and polluting and unsustainable sources. Sustainable and clean energy include solar and wind energies. Polluting and nonrenewable energy sources include fossil fuels. Solar and wind energy are sustainable and clean because they don't pollute the environment or cause global warming. Fossil fuels are nonrenewable, so they are not sustainable and also cause pollution so they are not clean sources.

The Oakland High student's hypothesis was that trains can be run with solar power and that 30 degrees from flat with the earth would be the most effective position for solar panels to take in sunlight.

To complete their study they constructed a solar powered train out of Legos, Burton solar panels (4.4 watts), rechargeable double-A batteries, an adapter for the solar panels, a battery charger, and the sun.

The students then explained how they constructed four Lego trains and a large circular track and how they used the solar panels to power the trains' rechargeable batteries, with two solar panels lying flat and two solar panels at thirty degrees. They found that the trains ran for extended periods on the solar powered batteries, proving that trains can run on solar energy; although they couldn't establish that having the solar panels at one particular angle was better than any other angle.

In conclusion, the Oakland students listed a number of possible experimental errors such as the possibility that objects or weather could have blocked the sun from the solar panels or that the friction of train's tracks may not have been equal. In addition, they discussed how the solar powered train could be taken "From Model to Real World." According to Christopher Hill of San Francisco Muni, the cable car system in San Francisco takes a thousand kilowatts for the motors to pull the cables. This means that 834 1.2-kilowatt solar panels would be needed to power all of the motors for the cable car system in San Francisco. Each 1.2-kilowatt solar panel is 12 feet by 12 feet, so the total area needed to power the system would be 10,008 feet by 10,008 feet.

Once their presentation was complete the students held a successful demonstration of their train running on solar energy.

Leonardtwn High School: "Magnetic Levitation Bus"

Project Team: Zachary Llewellyn, Henry Kolb, and Will Moeller

Instructor(s): Miss Musser

Sponsor: AASHTO, Tate Jackson, National Manager of the AASHTO Track Program

The students of Leonard High School presented their project titled: "Magnetic Levitation Bus." They proposed to create city transit buses powered by magnets, giving the buses the power of levitation. The purpose their magnetic vehicle is to eliminate the use of fossil fuels such as gasoline or oil by replacing the common transit bus, yet have it still be able to transport numerous citizens.

They then outline past, present and future technologies that contribute to their project, The first motorized bus invented by Frank J. Sprague in 1887, the solar panel which was first patented by Russell Ohl in 1946, and the maglev train in Shanghai, China, which uses magnetic levitation and can travel up to 268 miles per hour.

The magnetic bus will consist of a fiberglass body, with three magnets, one on the bottom, front, and back of the vehicle, a solar panel attached to the roof of the bus, and a multiple high-powered fans (powered by the solar panels). There will be fans on the front (to act as a brake), back (for propulsion) and sides (for stability). In turn, the asphalt will be mixed with liquid neodymium magnets which repel the magnet under the bus, causing it to hover. The bus's steering mechanism will include sheet metal under the bus which the steering wheel will turn, which creates a steering mechanism.

To prevent accidents there will be a nose magnet and a rear magnet. These will all be polarized positively so that vehicles will repel each other. The bus will also have a stabilization system: which will include sensors that detect where the bus is in relation to the road, and fans on the sides of the bus that kick in to negate the effect of any shifting or drifting.

The Leonard High students concluded by stressing the "Environmental Affectivity" of their vehicle: because the bus will run on solar energy it will not emit any greenhouse gases caused by the burning of oil, coal, or gasoline. In addition, the levitation from the magnets will eliminate tires, which leave tar on the road and runoff into our waterways.

Flamson Middle School: "Converting Your Car to Alcohol"

Project Team: Frank Dugan, and Nicole Vogelpohl

Instructor(s): Ayen Johnson

Sponsor: District 5, Rich Krumholz, Caltrans Director

Nicole Vogelpohl and Frank Dugan introduced their project, titled: "Converting your car to alcohol." They began by asking the audience a rhetorical question: "Did you know, almost any gasoline-powered engine can be made to run on alcohol?" The answer, they informed the audience was that all that is required is minor and inexpensive modifications to the engine. Furthermore, anyone with reasonable mechanical skills and common hand tools can make the modifications. In addition, distilling of alcohol can be done on a small scale by individuals or on a large scale by companies. Over 2 million cars per year are set up to run on E85; and this makes it a viable fuel alternative to gasoline.

Next the students discussed what E85 is and how it can be used as an alternative fuel source. E85 is comprised of 85% ethanol and 15% gasoline, and it is a 102 octane and thus burns clean with less carbon buildup. The types of alcohol typically used for alternative fuel sources are ethanol and methanol. Methanol, distilled from wood or petroleum, is the type of fuel used in Indy-type race cars. Methanol is very toxic and poisonous if it is ingested and while methanol is one of the possible sources of fuel for a car, it provides less energy than ethanol does. Thus, Ethanol is the superior alternative

fuel choice to run a car when burned it is virtually pollution-free, with the byproducts of combustion being only water and CO₂. It is created from sugars gained from a number of types of organic materials, such as wheat, corn, rice, beets and sugar cane.

Next, the Flamson Middle School group talked about the practicality of using ethanol to fuel cars: Industrial ethanol can be obtained from a wholesale chemical supply company and while the price per gallon varies widely, according to the quality purchased, bulk quantities are more economical, and you can purchase ethanol for as low as two-twenty-five a gallon. In addition, the Flamson students assured the audience that the modifications required for the engine are quite feasible, and can be tailored to the amount of ethanol that will be used in the engine.

In conclusion, Frank and Nicole presented a model of an ethanol engine, showing where the ethanol is housed and where it is run through the tubes and into the engine to burn.

Spratley Middle School: "The Tubulator"

Project Team: Chris Nelson, Ryan Onduluz, Chimar Wayne. Michael Usher, Ta Nguyen Tranh, Sabrina Brooks, and Olivia Jones

Instructor(s): Lawrence Taylor

Sponsor: Hampton Roads, Michael Townes, president

The Spratley Middle School students introduced their project called the "The Tubulator," which is a subway-like system using magnetic levitation. Their presentation included detailed plans and images of the "Tubulator" and a discussion of its specs. The external tube of the "Tubulator" is 10 feet in diameter, with lines forming the track guide which will create the magnetic force for levitation. The transporter itself is 28 feet

long and 9 feet tall. The length of the seats from front edge to back is 27 inches, and the height from the floor to the top of the seat is 36 inches.

There will be boarding stations where people exit and board the Tubulator which are 30 feet long. The “Tubulator” will have a 10-foot wide opening, where many passengers can board simultaneously, creating an efficient way to board and exit.

In conclusion, the Sprately students discussed how the “Tubulator” would reduce greenhouse emissions, and what maintenance it would require. Greenhouse emissions will not be created due to the natural magnetization of metals, which do not require the burning of fossil fuels to function; and maintenance would have to be performed periodically as needed.

MacArthur Fundamental Intermediate School: “Coffee Grounds as Fuel”

Project Team: Aronza Dien, Marisa Torres, Jocelyn Solado, and Sal Galvin

Instructor(s): Emily Thelmer, Marvin Smulowitz

Sponsor: District 12, James Pinheiro, deputy district director

Next, the MacArthur Fundamental students presented on their project which found that a combination of coffee-grind waste and ethanol can be used as a replacement for gasoline. They then asserted that using this product will be beneficial by reducing pollution and keeping our air free of smog and because this alternative fuel is made from an organic renewable source.

The MacArthur students pointed out that ethanol and used coffee grinds are considered natural organic waste, which is typically discarded. In order to utilize this waste the coffee grounds will be mashed into a powder, which will then be combined with

ethanol using thermal conversion. For ethanol to be used as a fuel, water has to be removed. Petroleum waste makes up about 50 percent of total yearly waste in the United States. If we use this type of fuel, we won't pollute the air as much, and reduce the amount of petroleum related waste.

Next the MacArthur students discussed the feasibility of using coffee grounds. Not many modifications need to be made to a vehicle's engine for it to be run on a grinds/ethanol combination and coffee grounds can be obtained from many sources: Starbucks, coffee houses, restaurants, households, etc. For ethanol, the production depends more on the availability of land area, soil, H₂O, and sunlight; but it may offer long-term environmental and economic advantages. One of the negatives that the students spoke on was that there would have to be a chain of factories used to produce ethanol, but that this would still probably be better than having a million cars creating pollution.

In conclusion, oil dependency and landfill problems will be less of a problem if a coffee grinds/ethanol solution is used as an alternative fuel. Since people consume one to six cups of coffee a day, collecting coffee won't be much of a problem.

Leonardtwn High School: "The Corn Ferry"

Project Team: Michael Shea, and Alex McTholowitt

Instructor(s):

Sponsor: AASHTO, Tate Jackson, National Manager of the AASHTO Track Program

The second Leonardtown High School team introduced their project, which concerned the creation of an ethanol-powered ferry, AKA the "Corn Ferry." First, they discussed the present technologies that will be used in its construction: ethanol is already used in

many countries and in many forms of transportation. Most new cars can run on at least 15 percent ethanol and most can easily be converted into pure ethanol vehicles. Thus, ethanol can be used without major changes to the current system for fuel distribution.

The students then gave the audience an overview of ethanol. Ethanol is used in liquid form, which simplifies storage, transportation, and makes it compatible with existing structures, so it can be used in oil, fuel lines and gas tanks. When development and price can be reduced to a competitive level with traditional fuels it could become a very viable fuel source. When burned ethanol is biodegradable and produces fewer greenhouse gases, so it has the potential to reduce pollution in the future. Ethanol is also high-octane and is thus easier on engines and increases the life of an engine, reducing future costs.

Ms. McTholowitt: The average cost of ethanol fuel today is about \$2. The average price of gasoline is about \$2.50 right now. It's estimated to be about \$3 in the summer. The cost to build an ethanol engine is \$15,000, and the ferry would be \$130,000. The cost to operate a ferry in San ... Francisco is about \$1 million, but with ethanol fuel, it will decrease the cost and increase the revenue.

Mr. Shea: Environmental Effectiveness: Ethanol is very effective and much safer for the environment than fossil fuels. Ethanol is renewable, unlike diesel fuel, and is easily made using corn, switch grass, and many other vegetable-like materials. There is much less greenhouse gas or CO₂ created when ethanol is used, thus decreasing the release of greenhouse gases which cause global warming. Ethanol is also biodegradable, thus avoiding disasters like the Exxon Valdez.

Ms. McTholowitt: In order for ethanol to be used commonly, all the diesel engines used by the ferry company have to be modified in order to use ethanol fuel. Pure ethanol fuels would need to be manufactured. They would have to be powerful enough to power traditional ferries, carrying 100 to 200 people without creating a lot of pollution.

Mr. Shea: We hope you've enjoyed our presentation and thank you very much.
(applause)

QUESTION AND ANSWER SESSION

Student Questions for Other Presentations

Ms. Johnson: We've now had six presentations, and it is possible for each of the teams now, and we'll move around to various sites, not necessarily in the same order, because there will be a little back-and-forth now, but you can now come up with questions. Each team can come up with a question for one of the other teams. This is a way you can challenge them, to see if they know exactly what they were talking about. You can question them about anything you want about their system, and we'll see how well they respond, and we'll be judging how well they respond. So I'm just going to start, because we happen to be with you there, with the APTA site, and if you folks could start if you've got a question ready for one of the other teams.

Mr. Jackson: Well, if you-all have a question for one of the other teams, we could ask them.

Male voice: Yes. I have a question for Oakland High School: "Solar Trains, Inc."

Q: Does your train run at night?

A: The train is going to run at night because, in the day, the solar is storing the energy in batteries so it can run at night.

Q: But wouldn't that increase amount of batteries and require an increase in the weight?

A: Well, the weight doesn't really matter, as long as the train can move, so we already have batteries inside, so that's how we moved ours, our little train model.

Ms. Johnson: We have one set of questions and answers, so I'm going to ask another school. If you've got a question, we'll come to you if you start talking. The system will switch for you, let's go to one of the Caltrans schools down south. How about Santa Ana? Have you got a question for somebody?

Female voice: We have a question for Paso Robles.

Q: Wouldn't burning the alcohol cause a fire?

A: (**Ms. Vogelpohl**) Burning the alcohol wouldn't cause a fire. It's E85, which is - Eighty-five percent ethanol, which is all made out of [organic] stuff, like [organic] materials, sugars, and it is made out of 15 percent gasoline, which runs our cars today, and isn't causing fires.

Ms. Johnson: While we're there with you, have you got a question for another school, Paso Robles?

Ms. Vogelpohl: Yes, we do. We have a question for Argyle Middle School.

Q: What is the cost of all the materials needed for your hydrogen fuel-cell-powered car?

Ms. Johnson: Argyle, do you have a response?

A: All we know is that the bus is also going to be cheap, because it costs about \$125 per kilowatt to run the fuel cell, so it only costs \$125 per kilowatt.

Ms. Johnson: All right. They had an answer. Argyle Middle School, to whom will you present your question?

Male voice: This is a question for Leonardtown High.

Ms. Johnson: Okay. Which team? Which project?

Male Voice: The first team that presented.

Ms. Johnson: All right. What is your question?

Q: (female voice) Okay. Our question is wouldn't all the solar panels weigh down the bus?

A: The solar panels *would* weigh down the bus, but the bus is floating, no matter how much it weighs, because of the magnetic force fields. If you've ever tried putting two magnets together at the same pole, they don't touch. You can't make them touch without shifting. So it's going to weigh more but that is not going to affect the bus. It won't weigh it down as much to the extent as it would touch the ground.

Ms. Johnson: All right. They had an answer based on their technology. Leonardtown number one, do you have a question?

Male voice: Yes, we have a question for Argyle Middle School.

Q: The hydrogen in your engine, are you going to be burning it? If you're going to be burning liquid or gas, I don't understand how you're going to keep the gas from leaking, or the liquid refrigerated. Can you explain it?

A: We are not using gas, but the electrolysis will split the water into hydrogen gas and oxygen gas, which will go into the fuel cell.

Ms. Johnson: Okay. We got the answer. Thank you. I know we have a question here in Oakland, if you would like to ask your question, please. Who are you asking?

Male voice: (young man on audience left) We have a question for AASHTO, for Leonardtown one.

Q: Our question is, how much energy will the tanks consume, and how much surface area will be needed for the solar panels to provide that energy?

A: The entire top of the bus is going to be covered in solar panels. We didn't calculate exactly how much surface area there's going to be, in square inches. Is that what you mean: the exact square-inch measurement of the solar panels?

Q: Yes, we do.

A: Well, we don't know the square footage will be. We don't know the exact square footage of how much solar panel we're going to use. It's going probably cover most of the roof of the bus, and you just need enough to grow things.

Ms. Johnson: Now I'm trying to think who we've missed in terms of asking a question. Who has not yet asked a question?

Male voice: Leonardtown two.

Ms. Johnson: Leonardtown two has not asked a question yet. Do you folks have a question for one of the other teams? Oh, wait a minute. I take it back, they did have a question. Let's see. Flamson Middle School or Paso Robles. Do you have a question for someone?

Ms. Vogelpohl: We have already asked a question.

Ms. Johnson: Who have I missed? I'm asking my staff person back here who I've missed.

Male voice: Hampton Roads.

Ms. Johnson: Hampton Roads! Okay. Hampton Roads.

Male voice: We have a question for Leonardtown High School, team number one

Ms. Johnson: Okay. And your question is?

Q: I was wondering if the fans that were to stabilize the bus in case the magnets shifted, what if they failed? What would catch the bus if they failed?

A: (young man to audience left) The stabilizing system uses sensors that stabilize, that detect where you are on the road. If it failed, then you would just have to get it replaced. I mean it would crash if they failed, but its maintenance issue that you're going to have to make sure *you* take care of. It's not going to be the responsibility of the maker. It's just like any other car maintenance that you're going to have to deal with.

Student Questions for Transportation Professionals

Ms. Johnson: Is there anyone I've missed who did not get a chance to ask a question? Anyone? I think we're good. The next round of questions -- and you were all asked to prepare something in advance. At each of these sites, you have a number of professional people who are in the transportation field. You were all asked to prepare at least one question for one of these transportation experts, about a career, or about what they do in their job, or how they feel about some aspect of transportation. If you all have

your questions ready, I'm going to do those in the order that you originally spoke. So we're going to go first to Argyle Middle School. Argyle Middle School, do you have a question for one of the professionals that you have heard about today?

Q: (young man at laptop, audience right) What does a general manager do in a transit agency?

Ms. Johnson: What does a general manager do? I think that sounds like a question for Hampton Roads.

A: There is not a general manager here right now. (laughter)

Ms. Johnson: You can answer *for* him! (talkover)

A: Well, I'm assuming you're talking about our president and CEO. Or are you talking about business? Is that what you're talking about?

Ms. Johnson: Yes, that would be fine.

A: Well, basically, his responsibility is oversight of the company. He deals with a lot of the political aspects, traveling to and from, to, you know, make sure that our company is secure financially, and, you know, just -- just basic day-to-day running of the company while managing the -- while managing the internal staff that's directly under him, to make sure that each part of the company is -- is functioning properly.

Ms. Johnson: And I understand, Tate Jackson, that you also kind of filled that position, and so I'm going to throw that question to you, as well, and Argyle, when we leave you, could you mute your mic, please? Thank you.

Mr. Jackson: This is Tate Jackson. I have to apologize. Could you repeat the question, please?

Ms. Johnson: Yes. They wanted to know what a general manager of a transit of a transit agency does.

Mr. Jackson: The general manager of a transit agency would be responsible for the day-to-day operations of, you know, any kind of event that was going on within the transit industry, making sure that the vehicles ran on time, where the different modes of transportation interface, and make sure all that happened on time. You know, make sure that maintenance was up to speed. They would schedule maintenance. That sort of thing. So basically, the day-to-day operations of the transit agency would be what the general manager would do. Does that answer your question?

Ms. Johnson: Sure. They're busy people, I think, is part of the answer.

Mr. Jackson: (talking at same time) Exceptionally busy people.

Ms. Johnson: Pam Boswell is with the American Public Transit Agency, and you have lots and lots of members who are general managers. Did you want to add anything to that?

Ms. Boswell: The only thing I would add is that they *are* responsible for the day-to-day operations, and for making sure that the facilities and the services run smoothly and efficiently. They're also the key spokespersons at a transit agency, making sure that there's an image out there of the public and understand they give customer service, and they are responsible for managing that. So they are the key person that keeps that transit system operating.

Ms. Johnson: It's a good job to aspire to, I might say, although you're always on the hot seat, I think. It's a very *visible* position, as Pam said. They're in charge of being the face to the community for the district, as well. We're going now to Oakland High School here in District 4. And do you have a question for one of the transportation professionals around the country?

Q: (female voice) Yes. What are two or three entry-level jobs or careers for 18-year-old high school graduates?

Ms. Johnson: If someone is 18 years old and just leaving high school, what kind of job can they do in transportation? Who wants to take that question?

A: (**Mr. Krumholz**) I think some of the careers that students graduating might consider would be along the lines of transportation planning, which would be the process of planning strategies or documents for various transportation projects. Certainly, jobs like surveying or road work in the field, or perhaps landscape maintenance, would be a few careers to consider.

Q: (**Ms. Johnson**) Pam, could a high school graduate become a bus driver? Or a mechanic?

A: (**Ms. Boswell**) Yes, they would be able to be a bus operator, then go into front-line supervision, and then get into management, depending on how many years of experience they have. There's definitely a career path in transit

Ms. Johnson: Let me throw a question as a follow-up on that.

Q: Are there more jobs in transportation if you have a college degree, either a two- or a four-year, or more, than there are if you just have a high-school graduation diploma?

A: **(Mr. Krumholz)** Well, this is District 5 once again. I think that with, you know, our agency, CalTrans, being as large as it is, that there are numerous positions for students who have a college background. At the same time, there are a number of jobs where the college education is not required. So I think that both are possible.

Ms. Johnson: Hey!

A: **(Ms. Boswell)** This is APTA again. I think, with the changes in technology, more and more, the two- to four-year degrees are not going to be the pre-requisites. We'll be looking at people who are coming from technical colleges, community colleges. Because of the nature of the changing technology, that we're going to need people who are positioned that way.

Ms. Johnson: Pam, we have another response here in Oakland.

A: (female voice) Good morning! I'd like to respond very briefly that Caltrans, and the State of California, hosts a student-assistant program which allows college students with six, nine, or 12 semester units to come to work at Caltrans, and allows them to be exposed to careers in transportation. So that is certainly an option for you all when you graduate from high school and enter college, whether it be community college or whether it be a university.

A: **(Mr. Krumholz)** Could I also add, here in District 5, that certainly the technical skills are necessary and are required, but I would suggest to all of the young people involved in this program today to also not forget about their managerial skills, their ability to multi-task, and their ability to work with a diverse group of people. So I think those true people skills also come into play in our professions each day.

Ms. Johnson: And we have one more professional who'd like to jump in. Ruby?

A: **(Ms. Louie)** I think that we are all emphasizing basically the college-related requirements for those students who are interested in continuing on to college, but I think I need to also emphasize that, in the last few years, we have great emphasis, especially from the construction industry itself, that are asking for students who may not be interested in going to college, because they are in great need of a workforce at this time, in the very near future, in the construction industry, and I think that any students interested, they should contact major prime contractors and subcontractors that are *in* the industry that are very interested in basically growing their own, providing a career for those who may not be interested in continuing on to college. And I think that's especially very important right now in the transportation area.

Ms. Johnson: Yes. We are, in California, going to be doing a lot of construction. We just passed a bond, so we're going to be doing a great deal of that. Oh, we have one more who'd like to weigh in?

A: **(Ms. Bouknight)** This is Nannette from Hampton Roads Transit, and I would like to address that question, also. I believe someone already touched on this, but, you know, experience is a very valuable starting tool for any position or career in any field, transportation included, and even if you're planning to go to college, if you wanted to start in the transportation industry as, you know, like someone said earlier, a bus operator, or a mechanic, or even in the administrative field, that's a way to gain valuable experience, and to see the in's and out's of the transportation field, or industry, and then, as you're getting your education, you can gain that experience to go along with it, which will help you as you move up the ranks. So I just wanted to say that experience is also a very valuable tool to gain entry into the transportation industry.

Ms. Johnson: I think we also had a mention of internships, too, which is another good way. You still have to be in school when you're doing your internship, but it's another good way to get experience, and sometimes find out, you know, if you really like doing the job before you invest a lot of time in -- in the education that leads you to it.

I'm going to now move on to a question from the AASHTO site, and let's see if Leonardtown number one has a question for one of our professionals here.

Q: (female voice) Yes, we do. We would like to know what the typical day of an entry-level job would consist of.

Ms. Johnson: "Typical day." "Entry-level," say, of an engineer, or a planner, or someone like that?

Q: (female voice) Yeah, like an engineer.

Ms. Johnson: What would an entry-level engineer be doing, okay? Who would like to answer that one? I think maybe District 5 might come closest to that, if we've still got Rich there.

A: (male voice) I think that our director, Rich Krumholz, is back in the director's meeting. You know, I can't really offer too much. I'm in the public-affairs, public-information section, so I'm going to pass on that one.

Ms. Johnson: Have we got any engineers in the group here who could deal with that question? Larry Orcutt. Larry Orcutt is the deputy director with Caltrans. Not "deputy director." Pardon me. He is the chief of the Division of Research and Innovation for Caltrans, and Larry is an engineer. Larry, if we can get you to answer that question. What would an entry-level engineer be doing in transportation?

A: **(Mr. Orcutt)** Well, let me see if I can remember. It's been a while. But we have a lot of entry-level engineers. In fact, last year and this year, we're trying to recruit somewhere around a thousand people to come to work for Caltrans, and it's probably going to go up, because we're going to be doing more work in California to improve our transportation system. But we generally have our engineers come in, and they do a rotation program, so you rotate through different areas like design, construction. Those are the two primary areas. You might go to traffic, some of the other areas like that.

But if you're in construction, generally what you're going to be doing is making sure that the contractor builds the projects according to the plans and specifications. You're documenting what the contractor's doing. You're basically negotiating with them. Sometimes there's disputes, those kinds of things. But essentially you'd be out in the field watching the contractor work, documenting their actions, and then also administering the contract if you have a change order. Those kinds of things are what we'd be having a person in construction do.

In design, you would be in a project team working on putting together the project plans for producing transportation improvements.

So, just generally, I think, in engineering, one of the things I remember one of my mentors telling me is that, when you get out of college, that's about 30 percent of what you need to know. And then, when you come to work for a company, they're going to train you on how they do engineering in their company. That's why I think Caltrans is a great place, because we have a rotation program, where, really, you get to know how Caltrans does business, and I'm sure other companies have that, also. Is there anything you wanted to add, James?

James: No, Larry. I think you covered it nicely. Thank you.

Ms. Johnson: So you don't come out of school knowing everything. And actually I think any adult here would say you keep on learning every day you're at work.

Okay. I am now going to move to the next school, which would be down at Paso Robles. And what question do you have for one of the professionals?

Q: (male voice) How many people are there involved in a highway project?

Ms. Johnson: How many people does it take to build a highway? Who wants to take that one on? Larry?

Mr. Orcutt: Do you want me to answer that one, also?

Q: (Ms. Johnson) What would a typical highway project require in terms of the number of people working on it?

A: (Mr. Orcutt) So you're talking about to actually build the project? Is that the question?

Ms. Johnson: Well, heck. Let's start with how you have to design it, first.

Female voice: Planning.

Ms. Johnson: Plan it.

Mr. Orcutt: Okay.

Ms. Johnson: Design it. Build it.

Mr. Orcutt: Well --

Ms. Johnson: Maintain it.

A: **(Mr. Orcutt)** -- In Caltrans, we have a little over 22,000 people. Roughly 5,000 to 6,000 of those folks are in the maintenance arena, but the rest of those people would be working on developing. You have to go through, essentially, an environmental document to justify that it's okay to build the project. You're going to have minimal impacts to the environment. There are people that do that. There are planning people that look at how transportation impacts local development. There's really a large group of people. The biggest thing, when it comes to transportation improvements, is how we interact with the communities, because transportation does have a big impact on communities, so there's public hearings, those kinds of things, on significant projects.

Once you get the environmental document done, you have to go through a design phase, so you need surveyors to go out and tell you, you know, what is out there in terms of what you're trying to construct, because most of the construction we are doing is not new construction. So you're trying to build a project around another project, so there are traffic impacts. So you have to have traffic engineers looking at the traffic-management aspect. There's also people that have to care of the financial piece, which is the programming and making sure that we produce the right projects. Once you get all those things done, then you have to put it out to bid. You have people that prepare specifications and actually the bid documents. After that, you have construction inspection, and resident engineers, basically contract-administration people.

Then, when you get all done with that, then you have the people that actually have to maintain it. So, for California, our budget is somewhere between \$7 and

\$10 billion a year, and we have, like I said, 22,000 people, and about 5,000 that actually maintain it. But then there's a whole bunch of other people that are involved in transportation that aren't areas that we deal with, like transit, local development. So, really, there's a lot of people involved whenever you build a transportation project.

Ms. Johnson: I think one of the most important things Larry just said was, it isn't just the people that are out there doing the building. There's a whole lot that happens before the building, and a lot of different kinds of skills that are needed in a transportation project, and so, in a way, it's almost anything you'd like to do, you could do it in the transportation field. And Larry just mentioned a whole slew of things that you can do, and all of them take different kinds of education and different skills, and take you in different ways. Some of them will be strictly inside, at-the-desk jobs, and some of them will be more outside jobs. So there are lots of things you consider when you go there. And I guess the answer basically for the person from Flamson Middle School is that it takes a whole lot of people to build a highway project.

Okay. We're going to move on to Hampton Roads. And what is your question for the professionals?

Q: (male voice) We would like to know, are there internships available for middle- and high-school students in the transportation field?

Ms. Johnson: Internships for younger people. Who can answer that one? Okay. We have an answer over here in Oakland.

A: (Ms. Louie) Yes, not to put a plug in for Caltrans, but I will, since I have the opportunity to. We offer volunteer programs to high school students. In addition, there are internships that are offered through partnerships with local schools. We actually have partnerships with Oakland High School, and other

schools in the area and in the district. In fact, this project is a result of the partnership we have.

Other internships are paid for through various other organizations that are run through the cities and the counties in the district, as well. My suggestion would be, if you are interested in obtaining an internship, to work with your public-affairs, external-affairs representatives, your equal-employment-opportunity representatives in the area that you live in, and are going to school in, and also visit the Caltrans website at www.dot.ca.gov for further information on our various programs for students. We look forward to seeing you all in one of those programs.

Ms. Johnson: Okay. I think one of the things she said [that] was important is there are people in each of the organizations that are interested in working with outreach to people who are interested in the field.

Ms. Louie: Most definitely.

Ms. Johnson: And that's who you need to find out. Who would I talk to if I'm a student? And you contact the agency or the district or whoever you're talking to, and ask them what's available. And you might be surprised. They really could have something there.

Male voice: Leonardtown two and District 12.

Ms. Johnson: Okay. District 12 is our next question. That's MacArthur Intermediate School in Santa Ana. Do you have a question for one of the professionals?

Male voice: Yeah. We have two questions. I'm going to begin with the first one.

Q: As we plan for our high school careers, what types of classes do you recommend for students interested in pursuing a career in transportation?

Male voice: Good question!

Ms. Johnson: Good question. Okay. Who wants to take that one on? Rod? You haven't any yet!

A: (**Mr. Diridon**) Well, this is Rod Diridon from the Mineta Transportation Institute, and we dwell on this issue quite frequently. The best course of study in high school to prepare for a transportation career would be a college-preparatory course. This would be courses that would include math and science and advanced languages, so that you would have the opportunity of going to college, first of all, because you've taken the college-prep courses, and then that prepare you indeed to do well in those college-preparatory courses.

Now that isn't the only way to do it. You can certainly get into transportation careers directly out of high school, and do the kind of work that's necessary to keep that transportation program running, like a bus driver or a mechanic or a flag person or a person that runs a piece of heavy equipment on a construction project and highway maintenance, and those kinds of things. That does take a different kind of preparation, but remember that if you want to move into management, if you want to become a boss some day in a transportation agency, you probably will have to go to college, and so the best precaution is to prepare yourself for the college so that you can go if you decide to go. If you don't take the math and science in high school, and don't do well in those courses, then it's very hard to go to college later.

Ms. Johnson: I would add that a number of the jobs that are out there in transportation are not necessarily the engineering jobs. I would not have done well in those, even

though I took all the math and science in high school; but there are people who write, who do finances -- well, that would take the math, I guess, yeah. A lot of math. But there are lots of different careers. I would have been very comfortable, for example, in a public-information position, working with the public. Communications. Things that take writing, and I was an English major and a history major. So -- and here I am in transportation. So there are lots of different routes to get there. But I had to go to college to get there, and I took college prep in high school. Very definitely.

Female voice: And we also have careers for those that are interested in planning, in environmental-planning areas. We are also talking about archaeologists, biologists, in the natural sciences, and very simply, also, as Trixie mentioned, too, is that writing. We can't emphasize how important it is. In what career path you use, if you want to be a manager or boss one of these days, we're trying to really emphasize those that are interested in the science and the math. Writing is very, very critical to every area you go into.

Ms. Johnson: Yes. Very much so. Okay. That was a very good question. You said that was your number-one question. What is your number-two question?

Q: (female voice) What skills, in particular, are most useful for people interested in a career in transportation?

Ms. Johnson: Skills! Well, you just heard one of them, writing. Who else would like to answer on that?

A: (female voice) Oral communication is everything, not only writing, but (unintelligible).

A: (Mr. Krumholz) Well, this is District 5 again, and I think that, in my public-information role, where I attend, you know, numerous meetings and get a

chance to see our staff from the highest level right on down, is that communication skills are very important. It is one thing to have the technical background, or the engineering background, but you'd be surprised how many times people with those backgrounds are in a position of making public presentations, going before a local government agency. So I certainly would suggest to the students that maybe taking some college courses in public speaking would be helpful.

Ms. Johnson: Is there anyone else who'd like to join in on that? What skills do you think people should have, to go into transportation?

A: (Mr. Pinheiro) This is James Pinheiro in Orange County, District 12.

Ms. Johnson: Yes.

A: (Mr. Pinheiro) Probably just thinking through the process that, first of all, the listening skill is incredibly important. To listen to others and to be able to comprehend material, whether it's something you're reading and comprehending, or whether it's listening to someone and comprehending what they're saying, and then being able to digest that information and then communicate it back, whether that be to speak clearly back to someone, or to write clearly back to someone, and really give them an answer that reflects the service that they need, or the answer they need, or the problem that you're trying to solve, and I just wanted to kind of emphasize those skills. Thank you.

Ms. Johnson: I find it interesting that no one's mentioned computer skills. I guess that's just a given these days. Everyone's going to work on a computer. Okay.

I'm going to move now to the last group at Leonardtown High School number two. What's your question?

Q: (male voice) Yes. We would like to know what fuel sources are most viable in the future?

Ms. Johnson: Most viable fuel sources for the future. Okay. Who wants to weigh in? Larry? What does Caltrans look at for the fuel of the future?

A: (Mr. Orcutt) I think that's a really tough question. One of the schools talked about hydrogen, and the governor does have an initiative here in California to pursue hydrogen highways, so putting out fueling stations for hydrogen. But that's a huge question, because I think most people would agree that we're not going to be able to rely on fossil fuels for very much longer, so we do need an alternative fuel source, and I think most people are putting their research and energy into hydrogen right now, but there's other alternative fuels that are being considered. One of the other schools talked about ethanol. That's another option.

But I think a lot of it really depends on how can you convert that energy source into something that we can use for vehicles, and do it in a manner where it's environmentally friendly, because one of the big issues is greenhouse gases. So I think, from an environmental perspective, it's really going to depend on what comes out of the research and technology industries to come up with a fuel that basically replaces what we have, but does it in a way [that] it's environmentally friendly.

A: (Ms. Johnson) I would say, since I'm the research director at the Mineta Transportation Institute, we don't do the technical research in our institute, but I certainly watch what other institutes are focusing on, and there are a number of universities whose programs are looking very deeply into alternative fuels.

The University of California at Davis, for example, is one of those with a strong program in alternative fuels. And they're one of many universities around the country that are doing the research. As Larry said, we don't know yet, and so we're in that exploratory phase, discovery.

One that wasn't mentioned in today's program, and Larry didn't mention it, is biodiesel, converting biological wastes, and using them in diesel engines, and that's another potential source that is actually being used in some engines today, and may have a future, as well. In a way, bio-fuels includes the ethanol, and so on, because it's from a biological source, but something more like coffee grounds, things like burning old fats, and things of that sort, can be biodiesels, as well. So there are lots of options, and I don't think anybody can say there's one that we know now that will be *the* fuel of the future yet. So maybe --

A: (Mr. Orcutt) Trixie, there was one thing I wanted to add on that. We do have a couple of hydrogen cars here that we've worked with Daimler Chrysler to test, because there's other institutional issues when it comes to using an alternative fuel. But just to give you an idea, these are relatively small cars. They're about the size of a Ford Focus, but they run a million dollars apiece, so right now, it would be pretty expensive to buy a hydrogen car.

Ms. Johnson: Yes! We said "future." (laughter) Yeah, very true. But that certainly is a huge area for exploration, and I am sure, even though you may be, you know, seventh- to ninth-grade students, the questions will *not* be answered before you're doing your college work. There is plenty of work for you to do, if that's what you're interested in working on.

A: (Mr. Diridon) This is Rod Diridon at the Oakland site. Don't discard the very attractive and relatively easily-available access to electric power, though. Electric power can be generated now by the sun through photovoltaic technology, and

it's becoming much more economical and efficient to do that, and as battery technology is improved, so that you can carry more and more energy with you in your batteries, and the new nickel-metal-hydride batteries take a great step in that direction, electric energy becomes more and more attractive, because it can be created completely sustainably, but from the sun. So please keep an eye on that opportunity. It may be that we won't get there immediately. It may be that the battery technology will take years to create; but keep an eye on that very clean, sustainable technology as *you* begin to develop the energy sources in the future, as you complete your education and get into the field directly.

Ms. Johnson: We have a question here.

Q: (male voice) Do any of you use solar power and fuel hydrogen fuel cells?

A: (Mr. Diridon) The question was, again, can you use solar power -- that would be electric power -- to create hydrogen fuel? And, indeed, you can. You can use the electric current from a photovoltaic, either directly from the photovoltaic cells, or from the battery that would store the electric energy from the photovoltaic cells, and that electric power, then, can be used to do what's called "reducing" the water into hydrogen and oxygen, and then you'd use the hydrogen for creating power for your car, burning in your car. That is a little more complicated. It does require the storage of the energy through the batteries, and it adds an extra step in the process. If you can go directly to electrically-powered cars, it's more efficient. And then again, it may be that hydrogen-powered automobiles, for a period of time, until we get to purely-electric-powered cars, would be a better way of going.

Male voice: Agreed.

Ms. Johnson: Okay. I think we have made our round of questions. We've had a lot of interesting ones, and I hope they're just the beginnings of questions that you have, as you think about the careers that you're looking for in the future, and the kinds of classes you might want to take, the kinds of places you might want to work, and the people you might want to work *with* for the rest of your lives, and maybe trying them out a little bit with internships, as you go, and volunteer situations -- always a good thing to do.

We really appreciate all the work the students have done, and a big, special "thank you" to the teachers who worked with you.

And we're going to be judging your projects, and all of the materials that the teachers will be sending in will be part of that, as well. If you've created any materials for us, we judge those. So the judging is going to take us about a week or so. Then we'll be notifying everyone of how the competition turned out. We're very excited that you've presented us with some interesting and challenging concepts, and it's not going to be an easy choice, I might add.

I have just a word for the teachers before we leave. You have also been invited to be part of the judging circle. We're asking you to submit your top two choices. Yes, you can name your own school, if you want; but we're interested in who you thought was your best competition, and maybe we'll discount your choice, but look at who you thought was your best competition.

But, in any event, we would like the teachers to rank the projects that they saw, their top two. You have an evaluation form that you need to fill out, and it needs to be at MTI by April 12th. So I guess we won't make our total decision in the next week until all of those materials are in and available to us for the judging.

I want to thank also all of the sponsors at the various sites, both of you, all of those of you who joined us here on the teleconference, and those who couldn't be here today, and they were a few, as well. It takes a lot of energy for your sponsors to go out and find the schools, recruit the teachers, and get the materials together, and help it all happen. And also getting engaged with the students as you did today. That's a big help. Role models make a big difference.

So, to all of you, the students, the teachers, the sponsors, we thank you very much for helping us make the seventh Garrett Morgan National Video Conference possible.

And I have one last very big "thank you." He hasn't been shown on the screen here, but there's an MTI staffer who pulls all of this together and coordinates the whole thing. His name is Jim Swofford. He knows all the technical stuff. He's standing back in the corner. ... (applause) And I can say with great confidence, none of this would happen if Jim weren't there at the top, making it all work, and pulling it all together. So it's been a big exercise. We thank you for being part of it. We hope you enjoyed yourselves, and we hope you really think about transportation for your future careers. Thank you.

Male voice: Thank you all, and that concludes the Seventh Annual Garrett Morgan Sustainable Transportation Symposium for High School and Junior High School Youth. We'll look forward to being with you all again next March, when we'll have another competition, and that concludes our day. Good-bye!

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