SPECIAL ISSUE: 21ST CENTURY AUTOMOTIVE CHALLENGE

EEVC NEWSLETTER

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email: easternev@aol.com. Web site: www.eevc.info
President: Oliver Perry, 5 Old Stagecoach Turn
Shamong, NJ 08088, (609) 268-0944

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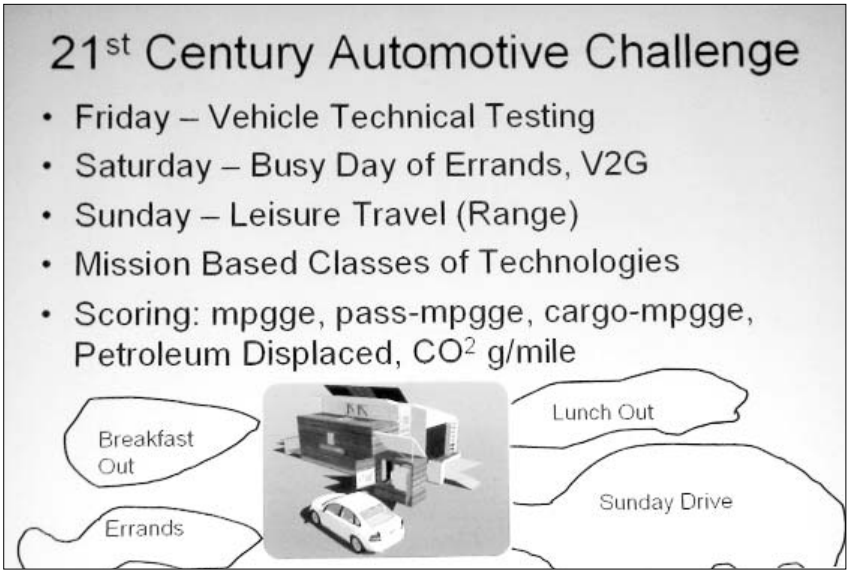
RESULTS OF THE 2009 21ST CENTURY AUTOMOTIVE CHALLENGE AT PENN STATE, APRIL 17-19 2009

Oliver H. Perry

Alan Arrison, North Haven Community, Dr. Paul Kydd, and "Team Kriebick" first place winners in their categories.



21s CAC at Penn State

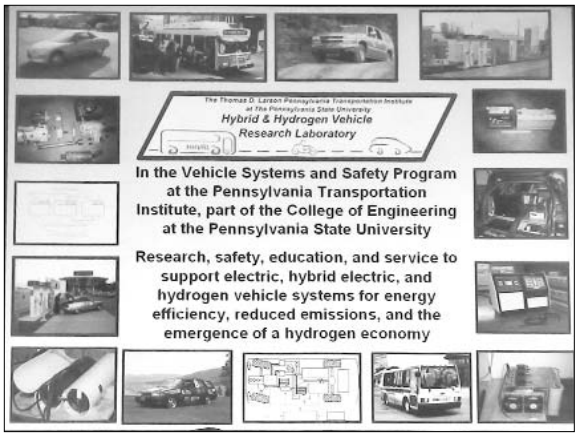
The third annual 21st Century Automotive Challenge (Spirit of the Tour de Sol) electric, hybrid, and alt-fueled vehicles championship, took place at the main Penn State Campus in State College, PA., April 17-19, 2009, under the leadership and direction of Dr. Joel Anstrom, director of the Hybrid and Hydrogen Vehicle Research Lab (HHVRL) at the Thomas D. Larson Pennsylvania Transportation Institute (LTI). Dr. Anstrom was aided by Theresa Maher, his chief engineering aide, selected members of the LTI staff, college students from Penn College of Technology, and the Penn State Schreyer Honors College This event has enabled the original NESEA American Tour de Sol electric and hybrid vehicle competition for students and individuals to continue for twenty-one successive years.

The transition of the 21st Century Automotive Challenge (21st CAC) from the Burlington County Institute of Technology (BCIT) to Penn State this year required a scaled back version of the original Tour de Sol. Dr. Anstrom and his staff consider the 2009 event a practice run for 2010. But, even as a practice run, with a limited number of vehicles, the event was first class.

Number of Entrants

Five street-legal electric battery powered vehicles entered the electric vehicle battery power division; with partial participation from a lithium ion battery powered military two seater. Three bio-diesel vehicles and one plug-in hybrid F-150 pickup rounded out the alt-fuel hybrid side of the competition, with partial participation of an experimental mini racer.

HHVRL Industry Expo and 21st CAC



HHVRL at Penn State.

Dr. Joel Anstrom welcomes everyone to the HHVRL Expo and 21st CAC Symposium

Friday, April 17th, the 2009 "HHVRL Industry Exposition Open Display, Networking, and Student Poster Display" officially began at 8:00 A.M. The location was the service bay in the test facility building located on the grounds of the Penn State LTI Test Track. The 21st CAC technical testing for vehicles followed a morning symposium, which introduced businesses to available partnerships with Penn State research facilities. After a welcome from Penn State Industrial Relations Director Tanna Pugh, Dr. Joel Anstrom's symposium made clear that there were mutual benefits for both companies and the university to join in programs that Penn State offers to the public sector. The presentation stressed that there are many opportunities for businesses to link themselves to Penn State for ventures in transportation related activities. Joel's presentation also included the objectives of the 21st CAC.

Penn State is a land grant university which attempts to attract regional businesses to form consortiums with departments within the University. They try to integrate faculty, students, and companies in mutually benefiting technological research endeavors.

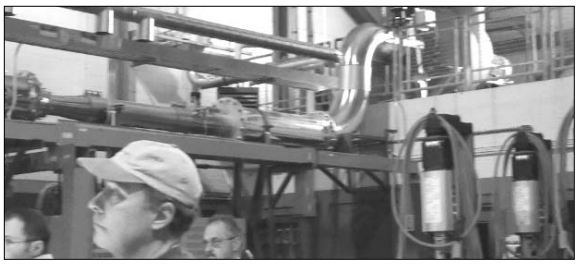
Dr. Anstrom mentioned that his department is involved in applying current technological advances to highway transportation vehicles through systems integration. He stated that they do work with fuel cell technology, battery and capacitor power, as well as hydrogen and natural gas propulsion. They major in the controls and system integration aspect. They address safety issues. They have a crash testing facility as well as a well-used track to test vehicles like the hybrid buses that run nonstop for weeks at a time. A hydraulic truck testing system is being developed for their bus testing facility, which can be utilized to test the stability of fuel cell, battery, and electronic components in the coming green transportation vehicles.

As for other departments at Penn State, Dr. Anstrom mentioned that much cutting edge research is going on in a number of transportation areas such as in battery chemistry and dielectric materials. Penn State provides a great up-to-date research facility to work in for future car engineering. But, Anstrom added, although Penn State is on the forefront of some types of transportation research, he felt that his department primarily specializes in education. What good is the research if it cannot be utilized, incorporated by students, and used to open doors for career opportunities?

The beginning of the 21st CAC overlapped a few hours with the Industry Exposition. Dr. Anstrom said that such an overlap hopefully will lead to a greater participation of industry with the 21st CAC, in terms of supplying judges and sponsors. It will also provide an opportunity for students involved with the 21st CAC to see first hand some of the existing technology opportunities in industry for their environmental transportation interests.

21st CAC, HHVRL, and Education

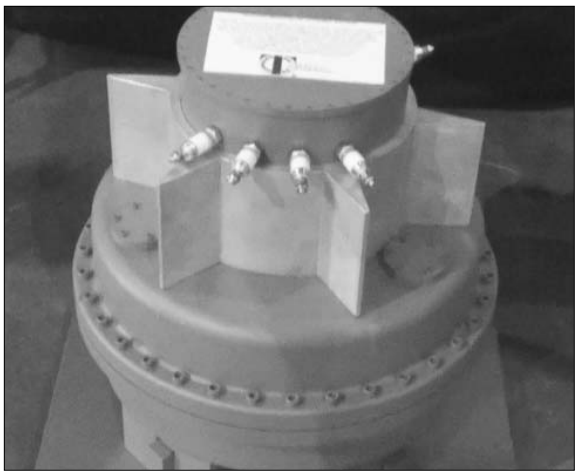
Joel then proceeded to outline the ways in which the 21st CAC competition was going to focus on the transportation challenges of our day. Joel implied that students, private individuals, and industry will all be able to attempt to solve energy and environmental issues through participation in future 21st CAC events. Dr. Anstrom illustrated how the scoring of the highway competitive events of the next few days addressed those issues. Vehicle- to- grid charging (V2G) is one of the technological advances that has been incorporated as well as the inclusion of a trip to the Penn State Solar home built for a recent Solar Decathlon competition.



Emissions Test System - LTI Test Facility

Mr. David Klinikowski spoke to those assembled about the federal program during that helps fund the test facility and reviewed some of the testing programs currently in operation. Later on a tour of the impressive new emissions testing room, Mr. Klinikowski provided us an overview of how the operation works. The facility is especially designed to test large bus sized vehicles.

Unique Flywheel



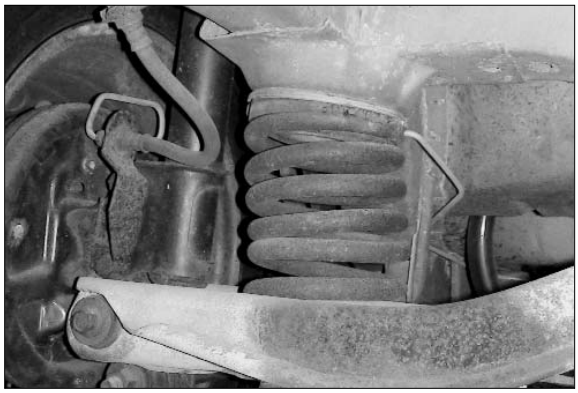
Flywheel battery model.

Of particular interest was a poster display and model of flywheel technology suitable for storing electric energy for transportation by inventor Lewis Sibley. Sibley is looking for venture capital and university support for his company Tribology Systems Incorporated (TSI). His flywheel boasts an impressive low coefficient of friction superior to magnetic bearings. His company has developed an innovative patented flywheel battery with simple mechanical bearings capable of being charged from the utility grid or other suitable power source. He told us that soon his company will be demonstrating the technology in a golf cart. He mentioned that there were applications for a flywheel that can efficiently convert braking into electrical energy in taxi vehicles as well as in elevator systems and roller coasters, all of which need to brake at the end of a run and then resume work.

George Bradford Educator's Award

Following the morning symposium a welcoming luncheon was provided for everyone. At this time introductions to the details of the 2009 21st CAC competition began. Dr. Joel Anstrom was presented the 2009 NESEA George Bradford Educators Award for his many years of commitment to the ideals of George Bradford. Joel has demonstrated Branford's zeal in the classroom, in research, and in keeping the American Tour de Sol ideals alive. Joel competed in the Tour de Sol as a student from Penn State a number of years ago and has since moved into the position of director of the Penn State laboratory that sponsored his student vehicle.

The Battery Powered Electric Competition Begins With Tech Testing



Coil Spring in Ford Escort.

At approximately 1:30 P.M. the first electric car to be approached by the six to ten certified Pennsylvania State Vehicle Inspectors was the old 1986 converted Ford Escort, The Olympian. It was hoisted in the air and inspected from below. A number of concerns were addressed, one of which was the manner in which the oversized rear coil springs had been originally adjusted to fit. Apparently the spring company that donated their services 10 years ago decided that the most economical method of quickly fitting the coils was to insert them in place and then super heat several coils until the weight of the vehicle sagged them to the proper level. As a result several windings on both coils are in contact with each other. This reduces the length of bottom end downward motion when the car hits a bump. As always, it becomes a matter of debate as to exactly how serious such a situation is.

Several other "you better fix this up a little" suggestions were made along with the comment that "It might be nice for you to have backup lights!" Otherwise the Olympian and the four other vehicles passed inspection and were considered eligible to officially engage in dynamic testing on the track. The five cars were: The converted Ford Escort, the Olympian, from BCIT, North Haven's VW bus; Methacton High School's three wheeled Lorax; EEVC member Alan Arrison's meticulously converted VW pickup; and Ken Barbour's converted yellow Geo Metro convertible.

The Olympian at the braking test.

These five cars were separately pushed up on to front and rear platform scales which weighed the respective front and rear wheel weights. Acceleration and braking tests followed. At approximately 4:00 P.M. we had a shared BBQ dinner with Expo attendees and 21st CAC participants. By late Friday afternoon the local Sports Car Club of America had set up a great low speed autocross. Then the real fun began.

The Autocross

A group of volunteers from a local autocross racing club laid out a fun course which took 45 to 75 seconds for most drivers to navigate. Instead of the typical oval shape course, this course was shaped like the outline of an onion bulb with a long green stem. The driver began his drive at the middle of the base of the onion and went around the onion bulb on the left, traveled up the stem, made a sharp U turn and came back down the course in the opposite direction, finishing by going round the right side of the bulb. A large digital sign printed out the times as each car made its three trips. The first three drivers went off course. Immediately everyone was convinced that the course, which had seemed simple to walk, took concentration to navigate when behind the wheel. Eventually each driver successfully managed the course and established good times.

Youngsters Arrison and Barbour upset the Olympian

EEVC members Ken Barbour and Al Arrison found themselves in a close personal dual for best time. Ken was first to set the record for the day. Then Alan topped it on his next run. Ken came back with an even better time. Alan was not to be beaten. He managed to better Ken's time at the end of the last and final run. Congratulations to Alan Arrison for winning the electric car division of the autocross. (The winner of the last two years was the Olympian whose drivers of the past two years were not in attendance. Ed "Cone Killer" Kriebick then made a valiant attempt to defend the title, but admitted feeling his age. To his credit he only dragged one cone off the course (which got caught in the underbelly of the car).

Day Two: Simulation of a Typical Saturday Errand's Run, Including Recharge Times

At 7:00 A.M. the 21st CAC participants met at the Test building for a drivers meeting. Everyone was provided a map and sent out on a competitive route which simulated the

course that a typical car owner might drive on a Saturday. As a navigator for EEVC member Mike Manning, who was driving the Olympian, I was not the best. I missed the first difficult designated turn. But knowing that the road we were on would reconnect us to the assigned route I stayed the course. A few others also got confused at the same turn, which added some competitive excitement to our trip. But as for winning navigator "feel good" points, I lost to better navigators.

Dr.Joel Anstrom treated us to breakfast at Wegmans

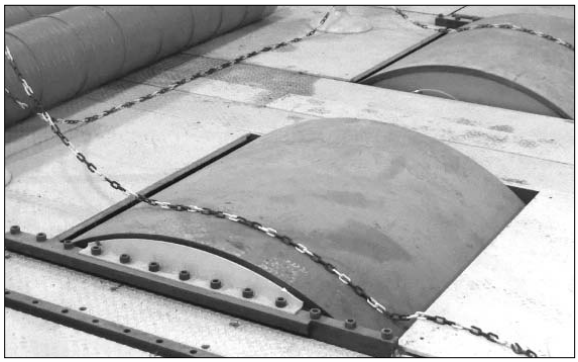
Our first stop was for a Saturday breakfast at Wegmans, 6.4 miles from the test track. Our breakfast at Wegmans was outstanding. If it becomes a tradition, Wegmans will be packed with participants in the future.

Methacton Students go over the route at Wegmans

Our goal for Saturday was to travel all of the assigned routes efficiently, on time, while maintaining sufficient charge to make the trips. We were allowed to charge any time we wanted at either, or both, of two assigned charging stations.

At the LTI Test Track facilities

After breakfast we returned to the test track, a total of 12.8 miles, our pretended home, where we were allowed to recharge our vehicle before our next errand. The assumption was made that our energy was coming from a grid that utilized home solar panels. We were billed for solar electricity accordingly which provided us with zero CO_2 points. Charging during mid-day took advantage of CO_2 free solar energy and we were encouraged by the scoring system to charge as frequently during sunlight hours as possible.



Dynamometer rollers at LTI test track

Hybrids Take the Highway Route To Penn College of Technology

The competitors who drove cars with unlimited range, like EEVC member Ed Kreibick and his son Jim, who drove a bio-diesel, took a much longer 67.2 mi one way trip to Williamsport. There, at Penn College of Technology, they were given a tour of the facilities. A short while later bio-diesels joined the electric cars for lunch at Tallyrand Park in Bellefonte Pa. EEVC member Ed Kreibick had the following comment to make concerning the facilities at Penn College.

"When we arrived we were met by the dean and a group of students. There was considerable interest in the cars. This left only time for a quick 10 minute tour of the automotive repair facility.They are expanding the school considerably, much construction of new buildings. Both Honda and Ford are big contributors to their expansion. They have a two year and four year program for mechanics and for service managers. I was impressed with the facility and the fact they already have a course specifically for hybrid automobiles. I believe the plan is that next year the tech testing will be done at this facility. They easily

have enough room to handle all the vehicles, one in each bay with a lift." — Ed K.

Next year the plan is for all technical testing to occur first at Penn State followed by a 60 mile range event to State College for highway long range vehicles. Short range electric vehicles will be towed to a range event at the LTI track.

Meanwhile the Electrics Travel Locally

Our next trip from home base involved a typical shopping excursion. The tour was around the Penn State campus. Joel and his staff provided a number of places that we were expected to stop and take a digital picture to prove we actually visited that particular place. We had both morning and afternoon to make the trip twice, selecting our stopping points on either trip. The loop was 16.3 miles. One of the stopping points was at the Thomas Larson Transportation Center where we could charge our vehicle on a state-of-the-art vehicle to grid charging facility.

Recent Penn State Graduate Jim D'Loro holds up a lithium ion cell.

A recent Penn State graduate by the name of Jim D'Loro returned for the day to assist in that particular operation. After we provided our pack voltage charging requirements Jim typed the necessary information into the computer to allow the system to charge the battery pack directly, circumventing the onboard charger. While we charged Jim provided us a tour of the Transportation Lab facilities and shops where the Penn State students work on their vehicle projects.

Part of the competition was to pack measured volume cardboard boxes into your vehicle cargo space for the cargo carrying portion of the vehicle competition. The boxes were on a loading dock at the charging site. Mike and I found a lot of space in the back of the Olympian for cargo. We packed as many boxes of varying sizes and shapes into our vehicle as possible to give us a maximum volume of cargo/ fuel mileage ratio as possible. The winner of the cargo event naturally was the electrified VW bus from North Haven, Maine, but the Olympian did the best for the two passenger vehicles.

To Lunch in Tallyrand Park in Bellefonte

Lunch site in Tallyrand Park.

The Lorax and the VW Rabbit on display in Tallyrand Park.

Ed Kreibick's biodiesel on display at Tallyrand Park.

After returning to the test track which simulated "home" in the Saturday day of shopping, participants were encouraged to head to Tallyrand Park, 5.3 miles away in the neighboring town of Bellefonte. There we placed our vehicles on display while we picked out a nearby lunch facilities for our noon meal. The weather was excellent, ideal and unexpected. All the young people were out in shorts and short sleeves. Quite a few spectators walked by the cars and asked questions.

John Dietter and His New Haven Island Crew "Out Torqued"

North Haven VW van transmission breakdown

We couldn't linger long at Tallyrand Park and still fit in the second Penn State Campus loop. It was back to the Test Center for a recharge for everyone. In the bay area of the test facility we discovered the VW bus from North Haven Community School, on an island off the coast of Maine, on the lift with its rear end mounted electric motor standing on the floor. What on earth happened?

One of the missions for all cars to accomplish on the campus tour was a drive to the top of a multi-level parking garage. On the way to the top of the parking garage, earlier in the morning, with the vehicle fully loaded with students, the transmission of the VW failed. After a few hours of cooperative discussion, mixed with mechanical work, it was verified that the transmission was destroyed and required more than a simple fix. Mike Manning, an EEVC member, who at times is a technical genius, noted that the electric motor had a torque rating greater than the original VW motor. Whether or not the high torque motor had created fatigue in the transmission over many years, or the strain of climbing the steep ramps of the parking garage with a fully loaded vehicle created a sudden overload, we could not tell. But either way, the team from New Haven was sadly out of the competition.

We salute the North Haven team, John Dietter and his crew of chaperones and students for handling the crisis with patience, acceptance, and with class. They drove from the coast of Maine all the way out to Penn State with expectations of completing the full tour and proving the worth of their vehicle. The team had to be greatly disappointed as they returned home a day early without completing the competition. North Haven intends to return next year with a Prius.

Finishing up the Campus Loops

Joe Paterno statue at the Sports Museum

After offering our help and suggestions to John Dietter, regarding New Haven's disabled VW, and after picking up some more charge for the Olympian, Mike Manning and I headed out for our second campus loop. We stopped to take a picture of Joe Paterno's statue at Beaver Stadium. His steel glasses were still attached to his head. (According to Dr. Anstrom, souvenir hunters frequently steal them.)

We also made a required stop at the Penn State operated Creamery (noted for its outstanding ice cream.) The lines were so long that it would have taken over an hour to get inside, so we snapped a picture instead of getting a receipt for ice cream, and moved on. [*Editor's note: While not everyone can get to State College to taste the ice cream at the Creamery, it's worth knowing that Ben & Jerry learned to make ice cream at Penn State, and their products are widely available*]

Only the totally focused could not help but notice the hundreds of Penn State students walking round campus in mid summer attire. We were aware that EEVC member Ken Barbour with his yellow convertible was on the campus route somewhere, most likely offering many of the attractive girls electric vehicle rides. His yellow convertible does attract attention. Since we were in competition with him we were hoping that this distraction would drain his batteries faster than normal and maybe even take him off course. However, the final scoring indicated that he must have had points to waste.

A Stop at the Penn State Solar Home

Outside the Penn State solar home.

Inside the solar home.

Dr. David Riley details the power center of the solar home.

One of the highlights of the tour competition involved a scheduled stop at the Penn State MorningStar Solar home. It was actually on the campus loop. The home is one built for solar home competition called the Solar Decathlon in Washington DC by Penn State students several years ago. We were given a tour of the building by Dr. David Riley, who went into great length and detail regarding its construction and operation. One of his statements regarding the practicalities of such a home was that electric cars may someday become an integral part of the solar homes that charge them.

***Penn State Solar Home**

*Officially the home is a part of a program called "MorningStar Pennsylvania and Hybrid Renewable Energy System (HyRES) Lab at Penn State. In 2007 the U.S. Department of Energy in Washington hosted a competition for college students to build and operate 800 square foot homes that were fully energy independent and efficient. The energy generated by the home had to power a small electric vehicle used for the transportation needs of a typical family. Penn State students placed 4th place out of twenty university teams from around the world. It contains interior movable walls to maximize minimal

space, mechanisms like water bottles to capture and hold valuable energy, and a unique combination kitchen and laundry area.

Team Meeting Review of Scoring

The view behind the podium was a little distracting

A hundred yards away from the solar home we went into an impressive auditorium and had our first scoring meeting. I was so busy looking out the humongous window behind the speaker's podium that I don't remember hearing anything unusually significant or provocative regarding the scoring. I think somebody protested Ken getting extra payload credit for all the Penn State girls he picked up on the campus loop. I pointed out that he paid for it in his four dead Wall Mart batteries that we had to help him replace later that evening.

Saturday Evening

After the scoring meeting everyone headed back to home base, the tech testing facility at the track. The amount of energy we used during the day for our shopping and touring trips would be measured that evening when we recharged. Those who had no problems quickly plugged in their cars, went out for supper, and on to bed. But those who needed some plug adjustments in order for everyone to charge in the same facility remained for an evening of cooperative charging. Joel's staff also wanted to try to utilize a computer controlled vehicle-to-grid charging station, similar to the one on the Penn State Campus. Specific Anderson connectors had been advised for including its use. Ken Barbour wanted to check out his Wal-Mart batteries, which he felt had let him down. He had added more batteries for the 21st CAC event, raised the voltage and put in a new controller, but his car's performance was not as good as expected.

We used an electronic conductive battery tester which allowed us to test each battery in place and concluded that there were about four sub par batteries. So on our way to a late Saturday evening dinner out, we stopped at Wal-Mart. Ken swapped in some new ones while Mike and I went to our motel room and got some sleep.

Sunday: Range Day

Ken Barbour lines up for the range event

Probably range day has been one of the more exciting days in the history of the Tour de Sol. Range day is significant in determining over all score. Range tests challenge the battery pack endurance and range records give bragging rights. Without achieving a good range a vehicle is not considered a viable competitor. Range is near the top of the list of criteria when judging the worthiness of electric vehicles.

A Prius was pace car for the range event

Added to the excitement of testing a car for range is the drama of doing it on a test track following a pace vehicle. With a track comes excitement, be it people, horses, or cars. And so it was, as the five or so vehicles assembled at the Penn State Larson Transportation Institute Test Track (LTI Test Track) early Sunday morning, lined up and took off after a Prius pace car. Students and

advisors alike gathered alongside the track to put their hopes to the test. Stopwatches, Blackberries, cell phones, and calculators all came out of pockets as team members became involved in achieving maximum range.

The Lorax, the Olympian and the Rabbit on the range test track.

The goal was for the pace car to establish a set speed of 35 mph around the track and for all vehicles to maintaining a set distance behind the vehicle in front. Every lap was just short of one mile, so the number of laps a vehicle made pretty much established the vehicle's range in miles.

Excitement was in the air as we watched each car whiz by with their respective drivers looking very intense. Cell phones were in operation communicating with the drivers regarding their trailing distances. Some dropped back a little, others picked up the pace. For the first fifteen minutes there was some jockeying of speed until everyone eventually settled into a 35 mph holding pattern. Then after a set time Joel had all of the vehicles come off the track for a pit stop, a chance for a driver to relieve himself and/or simply take a stretch.

An experimental military lightweight windowless lithium ion battery powered vehicle from Penn State was first to come off the track. Everyone was surprised. We thought it would win out. But Kutchera Industries said that the vehicle had not achieved a full charge the night before. In either case the windowless vehicle didn't help keep its driver warm in the cold morning air. Neither did the shorts the driver was wearing. Of the four cars remaining on the track, the Olympian was first to call it a day and head back for the charging station after completing 40 laps. Under normal driving conditions around town in the Medford, New Jersey area, with 12 well used 12 volt batteries, the vehicle was last achieving about 15 miles on a charge. A year ago it was easily getting 25 miles over the same terrain. But, as most people know, putting a vehicle on a flat track and traveling at a speed of 35 mph, with no stopping and starting, one can more than double its "normal conditions" driving range. That is why it is important to ask what the real driving conditions are for a stated vehicle's range.

A Penn State student built a little 1959 Berkeley conversion (above) with lithium ion batteries which he was anxious to experiment with. He managed to get in a few laps before returning to the shop.

Ken Barbour in his converted Geo Metro wanted to beat out the Olympian in range. Ken was next to come off the track after 42 miles. It was a great performance for his yellow electric convertible. Following Ken came the three wheeled Lorax from Methacton High School, achieving 49.6 miles.

Al Arrison won the range event.

Last to come off the track, the winner of the 2009, 21st CAC range championship, was Alan Arrison in his green WV Rabbit Pickup. Alan's vehicle totaled 66.6 miles.

Awards presented en route of the Tour de Thor

After finishing the range event at the LTI Test Track at about 11:00 A.M., the 21st

CAC competitors packed up their electric cars, or fueled up their alt-fueled vehicles, and headed out for Greenwood Furnace State Park on a route called the "Tour de Thor" by Dr. Joel Anstrom and his Penn State team. This scenic but challenging route, winding though the mountains, will be a challenge for the "ultimate" electric vehicles in the future. This year none of the electric vehicles were up to the challenge. Everyone, except Mike Manning and I, towed their electric cars to the awards ceremony, which was held on the mountainous Tour de Thor route. Those who left the test track facility on time were able to visit the Shavers Creek Environmental Center (en route) before proceeding to Greenwood Furnace State Park for the final outdoor barbeque luncheon and awards ceremony.

Awards Ceremony Introduction

Lunch before the awards.

What began as a cloudy morning turned out a few hours later to be a sun filled afternoon. The hot dog and hamburger meal, prepared at pavilion #1 in Greenwood Furnace State Park, fit the "green" atmosphere of our energy event. Dr. Joel Anstrom opened the awards ceremony by introducing Pennsylvania State Representative Mike Fleck (Huntingdon County/Blair/Mifflin) who represents the ninth largest voting district in Pennsylvania.

As Representative Fleck approached the podium Dr. Anstrom provided a description of the first annual 2009, 21st CAC, "Spirit of the Tour de Sol" at Penn State. The 21st CAC has been visualized as a "Life Style Efficiency Event" which integrates consumer choices and actions with their automobiles. The event measures the effect of these choices upon energy use and the environment. The event considers the impact of using a renewable energy sources such as sunlight collected by the Penn State Solar home and bio-fuels.

Pennsylvania Representative Mike Fleck addresses 21st CAC

Representative Fleck informed us that he was a history major in college and recognized that much of America's greatness came from the American inventor. He paid tribute to all of those who were innovating better ways of transportation through their participation in this event. Representative Fleck told us that he had recently introduced a bill in Pennsylvania to make the Neighborhood Electric Vehicle (NEV) street legal in the state. Dr. Anstrom added that he hopes to add an NEV category in next year's event but he could not this year because the vehicles could not legally access Pennsylvania roads. In addition Joel reminded us that this event is not just to focus on technology but also to find overall solutions that meet consumer demands. We are searching for practical solutions for all consumers. Whether it is a two seated commuter or a large passenger van, we want to find out what is best for every niche.

Continuing in his introduction, Dr. Anstrom diverted from the path a little to point out that his Penn State team wanted to transplant the Spirit of the American Tour de Sol into the hearts and minds of the next generation. He wants the next generation to catch the vision. He stated, "One of the rewards of hosting this event is watching the response of

the young people as they get involved in this new technology. It is good to see them recognize their enormous potential to make a difference."

Joel continued to point out that sometimes it takes a teacher to help students catch the vision. Sometimes it is the vision of the teachers themselves that is implanted in the mind of the student and transforms a mere curiosity into a life long interest.

Green Jacket Award

Ollie Perry and Dr. Paul Kydd gratefully receive the Green Jacket Award from Dr. Joel Anstrom.

Dr. Anstrom moved from that point to the point of keeping the opportunity for students to participate in such an event as the Tour de Sol alive. He suggested that his team wanted to recognize some folk who had demonstrated the tenacity to keep our menu alive and not let it falter or fade away. He expressed that special appreciation should be given to those who had carried the torch and made it possible for such an event as the 21st CAC and "Spirit of the Tour de Sol" alive. Asking the question, "What do you honor someone with who has kept things going that they would actually accept?" Joel alluded to the golfing "Green Jacket" award that goes to the few golfers who win the Master's Tournament. Those who win the Master's join a select fraternity. The jacket is a symbol of lasting respect and gratitude for those who have reached the pinnacle of their game and passed the opportunity on to others. Since we, the former Tour de Sol competitors, still play a game then we ought to have a similar "green jacket award." With that "green jacket" award comes eternal respect and no need to ever qualify or pay an entrance fee for a future event!

Dr. Paul Kydd, and yours truly Oliver Perry, were then presented with jackets. I was taken by surprise, as I am sure was Paul Kydd. What do you say at a moment like that? Both of us are truly honored.

Concerning the award itself I think everyone would agree that such an award merits the attention it receives. We look forward to having others join us in this fraternity. Not that we wish to be held in special esteem, but rather we want to see the event continued. It takes individuals worthy of the award to sustain such a worthy event. Joel, Theresa, and their staff have paved the way for this new "Green Jacket Award" to be continued. It is an innovative touch on a "Grand Old Tour."

Penn State Volunteers

Theresa Maher assisting in V-to-G charging.

Penn State Senior Scott Jacobs at work tallying scores of 21st CAC competition

As we left the podium with our jackets Dr. Kydd thanked Dr. Anstrom and his staff for taking on the Tour. In his own words, "It is a lot more fun to be a competitor in this competition than directing it!" Dr. Anstrom proceeded to recognize members of his team; Theresa Maher (engineering aide LTI staff), Robin Tallon (LTI staff), Allen Holman (LTI staff), Dave Klinikowski (LTI faculty), Dean Sauerivine (Honda volunteer), Duane Hobbs (LTI faculty) Dr. Zoltan Rado (LTI faculty) and his son Richard, Bryan Markovich (grad student), James D'Luro (Moog Inc. and Penn State graduate), Scott Jacobs (Penn State senior) who worked hard and long into the night on scoring, and LTI Test Track manager, Roger Dunlap.

Scoring Results and Placement

See the last page for specific details

It is nearly impossible to have everything exactly tabulated in time to present awards immediately after an event with a complex scoring system. But Joel and his scoring team managed to provide an up-to-date standing with appropriate titles for recognition on paper at the award ceremony. Actual awards were promised for later.

In what has been traditionally referred to as the battery powered electric car division and now categorized as the Independent Light Duty Local: Category (Two or Less Seater) they are as follows.

Abbreviations: mpgge - miles per gallon gasoline equivalent (energy); PD - petroleum displaced; DNF - did not finish; Best Overall - 1st place in all divisions combined.

Note: petroleum displacement (PD) is based upon the assumption that the average vehicle uses 500 gallons of petroleum per year. Cargo miles per gallon equivalent is cu ft/mile. Scores are out of 1000 possible points.

Electric Cars, Independent Light Duty Local (two or fewer seats)

Out of 1000 possible points.

1st place, 866.2 pts, Al Arrison, EEVC member, VW Rabbit Pickup Conversion: Fuel Eff. (1st) 124.8 mpgge. Seating (1st) 249.7 seat-mi/gge. Cargo (2nd) 992.5 cargo miles/gge. PD 161.6 gge/year. Range (1st) 66.8 miles. Greenhouse Emissions (3rd) 101.7 g of CO_2 per mile. Autocross (1st) 59.1 s.

2nd place, 735 pts, Burlington County Electechs, 86 Ford Escort Conversion "The Olympian," Team members EEVC member Michael Manning, BCIT electric car advisor Oliver Perry: Fuel Eff. (4th) 102.3 mpgge. Seating (4th) 204.6 seat-mi/gge. Cargo (1st) 1655.7 cargo-miles/gge. PD 161.6 gge/year. Range (4th) 40.1 miles. Greenhouse Emissions (4th) 61.5 g of CO_2 per mile. Autocross (3rd) 65.8 s.

Methacton High School students receive their award.

3rd place, 698 pts, Methacton High School, Lorax three wheeled sports car, Advisor Steve Savitz: Fuel Eff. (2nd) 119.3 mpgge. Seating (2nd) 238.5 seat-mi/gge. Cargo (4th) 428.2 cargo miles/gge. PD 161.6 gge/year. Range (2nd) 48.6 miles. Greenhouse Emissions (1st) 111.9 g of CO_2 per mile. Autocross (4th) 77.6 s.

4th place, 604 pts, Ken Barbour, EEVC member, Geo Metro Convertible Conversion: Fuel Eff. (3rd) 104.8 mpgge. Seating (3rd) 209.7 seat-mi/gge. Cargo (3rd) 760.1 cargo-miles/gge. PD 161.6 gge/year. Range (3rd) 42.0 miles. Greenhouse Emissions (2nd) 108.5 g of CO2 per mile. Autocross (2nd) 62.8 s.

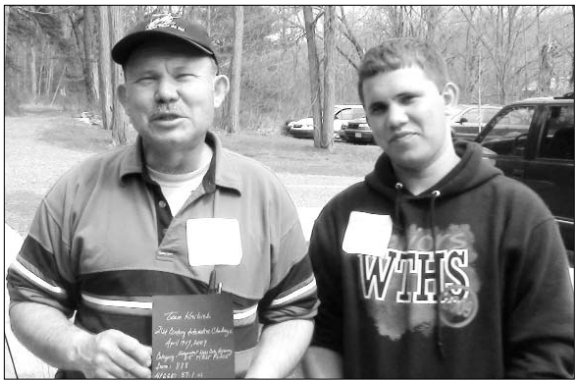
Independent Light Duty Local (6 or more seats) division

1st place, 985 pts, North Haven Community School, Advisor: John Dietter; the team that traveled the farthest to attend; VW bus Conversion (transmission failure): Fuel Eff. 70.5 mpgge. Seating (Best Overall) 493.5 seat-mi/gge. Cargo (Best Overall) 4948.6 cargo-miles/gge. PD 500.0 gge/year. Range DNF. Greenhouse Emissions 204.2 g of CO_2 per mile. Autocross 78.8 s.

Plug Hybrid, Independent Light Duty Local 3-5 seats

1st Place, 900 pts, Dr. Paul Kydd, EEVC member, Partnership Inc Ford, 150 pickup hybridized: Fuel Eff. 28.1 mpgge. Seating 87.6 seat-mi/gge. Cargo 1173.4 cargo miles/gge. PD 77.5 gge/year. Range DNF. Greenhouse Emissions 391.6 g of CO_2 per mile. Autocross DNF.

Bio Diesel, Independent Light Duty Highway 3-5 seats



Ed and Jim Kreibick, winners of the bio diesel highway division.

1st place, 900 pts, Ed and Jim Kreibick, EEVC members, 1976 Mercedes Benz biodiesel: Fuel Eff. (1st) 57.4 mpgge. Seating (1st) 286.8 seat-mi/gge. Cargo (1st) 806.0 cargo-mi/gge. PD (1st) 210.3 gge/year. Greenhouse Emissions (2nd) 56.2 g of CO_2 per mile. Autocross (1st) 65.2 s.

Dr. Jerry Clever, second-place winner.

2nd place, 498 pts, Jerry Clever, Freedom Energy LLC, Mercedes Benz Modified bio-diesel, vegetable oil: Fuel Eff. (2nd) 36.9 mpgge. Seating (2nd) 184.5 seat-mi/gge. Cargo (2nd) 295.9 cargo-miles/gge. PD (2nd) 102.9 gge/year. Greenhouse Emissions (1st) 5.5 g of CO_2 per mile. Autocross (2nd) 66.3 s.

Back at the Test Track

Those towing their electric vehicles to the Awards Ceremony left the Tour de Thor route after lunch to return to their respective homes the shortest way possible. However, Mike and I, who had wisely chosen not to tow the Olympian to the award ceremony, headed out to finish the Tour de Thor route in my van. The tow vehicle, my 92 Dodge Caravan, would have aged greatly on the Tour de Thor. Back at the test track facility we were able to watch the three bio-diesel competitors measure the amount of fuel each used to run the first annual Tour de Thor. And, having driven the route with my Dodge Caravan, I agreed that the Tour de Thor will be an excellent benchmark test for any 21st CAC vehicle of the future.

When Mike and I drove into the parking lot of the LTC Test Track we found three vehicles that had driven the whole Tour de Thor refilling their fuel tanks. There were some serious discussions going on over the accuracy of amount of fuel being replaced. A simple incremented quart pouring cup was not the problem. Using conversions between metric and English units of volumetric measure the drivers were able to estimate reasonable amounts of fuel that they felt they should have used on the route. Some felt that there was a discrepancy between the estimated reasonable amounts and their measured amounts. When Mike and I left we overheard discussion going on about possible air bubbles in the tanks that could have resulted in miscalculated amounts of fuel.

Final Results of "The Tour de Thor"

On display at Greenwood Furnace State Park.

Three alt-fueled vehicles managed to take on the Tour de Thor challenge. The drivers filled their fuel tanks to the brim at the LTI Test Track fueling center and headed out. Their competition was half way completed when they reached the awards luncheon stopover. After the lunch and awards ceremony they proceeded to finish the 79.4 mile trip which routed them back to the starting point at the LTI Test Track facility. Back at the starting point their fuel tanks were accurately refilled to determine exactly how much fuel each vehicle used on the rugged "Tour de Thor."

Number one in the Tour de Thor was Kyoto Chimera driving a VW Passat driven by Jonathan Bartlett. After eliminating an air bubble in his tank his winning results were finalized at 68 mpg.

Number two, Ed Kreibick and his son Jim, in their 76 Mercedes bio-diesel, with a 64.1 mpg rating. This was actually better than their 57.1 mpg mileage on the flat tour Saturday. Dr. Joel Anstrom pointed out that a diesel engine actually runs more efficiently under load than on cruise. His theory is that the engine will actually get better mileage climbing hills than cruising on the flat.

Third place went to Jerry Clever in his 1995 300 Mercedes Diesel, which achieved 50 mpg running on nearly 100% vegetable oil. Jerry's comments:

"Hard to say what my mileage was in the Tour de Thou. Joel agreed next year to have a gallon beaker available in addition to the quart measuring cup, since essentially with that we were forced to making reasonable estimates. In that I had two tanks (one for 100% biodiesel and a second veggie oil tank) we again made estimates which they assumed resulted in something over 40 mpg. If one is only considering the bio-diesel I used less than a gallon. (In the Saturday run to Williamsport and back it was estimated as only a cup.)"

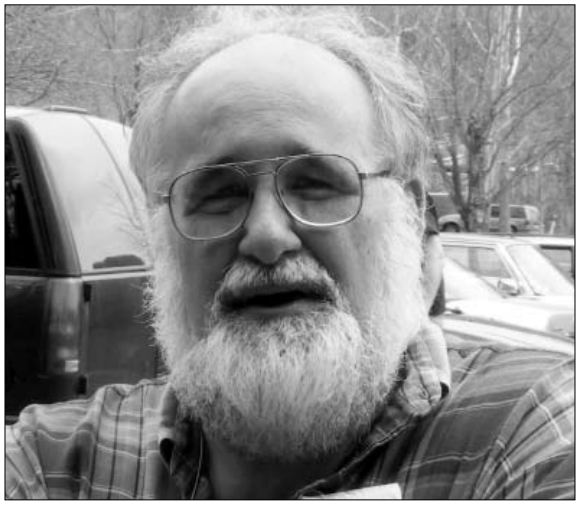
"When one considers that virgin vegetable oil is a renewable (though it does not have a carbon footprint for planting, nurturing, harvesting, pressing, and delivery et al) it is a fair fuel to test and to compete with. The question is how do you comparatively score a vehicle that burns two types of fuel, with a vehicle that uses just one, or vehicles that each use different fuels, in a competitive event like the Tour de Thor? Veggie oil gets about 10% lower fuel economy and loss of 2% horsepower than pure bio-diesel. (Most people would not do a conversion of a recent model vehicle, like the 2008 Passat in the Tour de Thor which has the benefit of a six gear automatic transmission and higher capacity for fuel economy, to a vehicle like mine which can use veggie oil.) As a novice to this event, I was not aware the Tour de Thor was a competition that measured mpg alone. I was pleased that my entry of a later model Mercedes Benz placed first in lowering CO_2 emissions. That is my goal as well as lower dependence on fossil fuel (decarbonization). As such, I was pleased overall and hope to join everyone again next year."

Brief Notes on Scoring and Strategies for the Lifestyle Efficiency Competition
By Joel Anstrom

The Electric and PHEV vehicles demonstrated the highest fuel efficiency values per gallon of gasoline equivalent (gge) of energy received because the onboard energy conversion for batteries and electric motors is more efficient than for internal combustion engines. Fuel efficiency tends to decrease as vehicle passenger seating and cargo capacity increase since vehicle weight and frontal area increase with them. Electric vehicles in the independent light-duty local division with seating of two or fewer passengers demonstrated the highest fuel efficiencies between 100-125 mpgge with the two lowest mpgge cars affected by weak battery problems during the competition. Carbon emission was lowest for the Freedom Energy Diesel running on mostly vegetable oil with a little biodiesel to start. EVs and PHEVs were assessed considerable carbon emissions for charging at night when available grid electricity is generated with significant amounts of fossil fuel, mainly coal. A winning strategy might be to charge with as much solar electricity as possible during the day and avoid charging at night or use of petroleum based fuels. This can be accomplished by starting the day at a low state of charge — with the use of a kWh meter — followed by

traveling during the low solar production hours of the early morning and late afternoon and aggressive solar charging during the peak solar production hours around noon. It may then be possible to discharge excess solar energy above initial state of charge back to the grid in the late afternoon to displace additional carbon emissions from fossil fuel generated electricity.

CLOSING THOUGHTS
By Mike Bianchi, Tour de Sol Historian and Archive Volunteer
In His Own Words



I think we have just possibly witnessed the sustainable rebirth of the American Tour de Sol, a viable demonstration of technology needed for transportation and environmental protection. Joel and company have picked up on what the founders of the Tour de Sol perceived as the real value of this sort of event. Competition, public outreach, and publishing the results of the research lead to improvements and advancements for us all. People who are motivated to make a difference can do that through this event. Over the years I have seen a lot. One reason I do not compete is that I do not feel that I have the mind set required to strategize, to do that sort of thing. I am quite happy to sit back and watch. If I see a good idea I often think to myself I will pursue it. My motivation for coming is to see the technology, to learn about new things, and to hear the stories of teams and individuals. I wasn't sure that I was going to show up this year because of the conflicts on my schedule. But when I found out about this year's event and started to chase it down I said to myself, this is worth my time. This is worth coming to. Joel is the perfect person to head a competition like this up. He is surrounded by great facilities and many great people (such as Dr. Riley of the Penn State Solar Home …editor's addition). Great things can happen in this environment.

Save the Date - May 21-23, 2010
For the next 21st Century Automotive Competition at Penn State

		Class A: Local								Class B: Highway			
Team Name		The Burlington County Electechs	North Haven Community School	Ken Barbour Jr. EEVC Geo Metro Convertible	Green Rabbit	Methacton Electric Car Club	Kuchera Engineering	Berkley	Partnership 1, Inc	Team Kreibick	Freedom Energy LLC	Partnerships 1, Inc.	Pruis
Fuel Type		EV	EV	EV	EV	EV	EV	0	Gasoline	Bio Diesel	Bio Diesel	Gasoline	Gasoline
Class		ILL	ILL	ILL	ILL	ILL	ILL	ILL	ILL	ILH	ILH	ILH	ILH
Scoring Category	Total/ Cat	1	2	3	4	5	6	7	8	11	12	13	14
articipation	40	40	40	40	40	40	26.66667	26.66667	40	40	40	40	0
isplay	30	30	15	30	30	30	0	0	30	30	30	30	0
ıspection and Technical Testing	30	30	30	30	30	30	30	30	30	30	30	30	35
ynamic Handling	30	30	30	30	30	30	30	35	0	30	30	0	35
utocross	70	55.483	70	62.03211	70	30	53.1507	0	0	70	30	0	#DIV/0!
uel Efficiency	200	50	200	66.74015	200	162.9346	-625.083	#DIV/0!	200	200	50	-6.35199	#DIV/0!
uel Efficiency per Passenger Mile	150	50	150	61.1601	150	125.2897	-404.497	#DIV/0!	150	150	50	-44.6334	#DIV/0!
uel Efficiency per Cargo Mile	150	150	150	77.03827	95.97205	50	15.11382	#DIV/0!	150	150	50	222.0351	#DIV/0!
etroleum Displacement	150	150	150	150	150	150	#DIV/0!	#DIV/0!	150	150	50	-19.5444	#DIV/0!
arbon Footprint	150	150	150	56.71814	70.27948	50	#DIV/0!	#DIV/0!	150	50	150	160.7638	#DIV/0!
enalties		0	0	0	0	0	0	0	0	0	0	0	0
otal	1000	735.48	985	603.6888	866.2515	698.2244	#DIV/0!	#DIV/0!	900	900	510	412.2691	#DIV/0!