

New DOE funding to accelerate ORNL advanced vehicle R&D

The Department of Energy has awarded ORNL \$1.2 million to investigate the use of ionic liquids as a new class of multi-functional (anti-wear and friction modifier) lubricant additive to allow the use of lower viscosity engine oils in order to improve engine efficiency. Project leads are Materials Science and Technology Division's Jun Qu and Energy and Transportation Science Division's Bruce Bunting.

The new funding is part of \$175 million DOE is awarding over the next three to five years to help advance research, development, and deployment of next-genera-

tion vehicle technologies. On August 10, U.S. Secretary of Energy Steven Chu announced funding for 40 projects in eight categories that focus on better fuels and lubricants, lighter weight materials, longer-lasting and cheaper electric vehicle batteries and components, and more efficient engine technologies.

In addition to leading the study of ionic liquids, ORNL is expected to receive approximately \$6 million to help support 12 additional projects.

See complete listing on page 4...

From the raceway to your driveway

The Department of Energy, Environmental Protection Agency, and Society of Automotive Engineers are helping industry win the race to cleaner fuels and more efficient technologies through Green Racing. Launched in 2006, the initiative is designed to recognize and reward automotive manufacturers that go the farthest and fastest with the smallest environmental footprint.

"Green Racing incorporates a scoring formula developed by the working group that takes into account the amount of fuel consumed during the race, number of laps completed, speed, energy efficiency, and the amount of greenhouse gases emitted during the race," said Energy and Transportation Science Division's PT Jones, who was recently named DOE's Green Racing project lead. "Technologies and fuels used by manufacturers and racing teams might range from renewable fuels and fuel blends that incorporate ethanol, biodiesel and isobutanol, to multiple propulsion systems and regenerative energy powertrains such as hybrids."

The Green Racing Protocols, SAE technical document (J2880), were published in October of 2008. That same month the American Le Mans Series (ALMS) applied the scoring formula to the racing vehicles at Petit Le Mans, where DOE and EPA awarded the first Green Racing winners. ALMS became the first racing series to formally adopt the scoring system in 2009 in a season-long Green Challenge™ championship for teams and manufacturers.

"ORNL involvement in Green Racing is relatively new

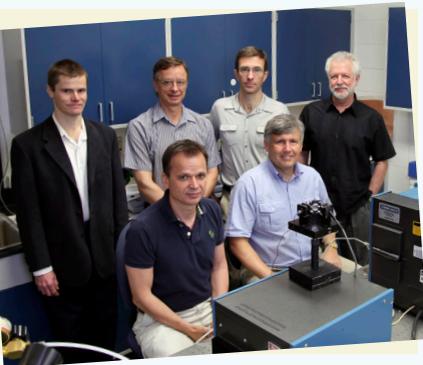
and we're excited about the opportunity to work more closely with Argonne National Laboratory (ANL), which has played a pivotal role in Green Racing since the beginning," said PT. Together, they are helping educate consumers at ALM races and other events using the Green Racing Simulator developed by ANL that incorporates scoring information that mirrors the metrics of the Green Challenge™ competition.

In Green Racing's future, PT foresees that ORNL expertise in engine/fuel efficiency testing and intelligent transportation technologies will come into play as DOE, EPA, and SAE continue to support industry efforts to accelerate the transfer of efficient automotive technologies from the raceway to the driveway.



Lyn St. James, first female Indy 500 driver and Indy Rookie of the Year-1992, experiences the Green Racing Simulator at the Clean Cities Summit held at Indy in July 2011.

Hydrogen research earns R&D 100 Award



Standing left to right, James Patton, Scott Hunter, Nickolay Lavrik, Michael Sepaniak; seated, Panos Datskos, left, and Barton Smith

An ORNL/University of Tennessee-developed sensor technology that uses nanostructured palladium layers to more efficiently detect and measure the concentration of hydrogen gas at a potentially lower cost than existing hydrogen sensors has been named a 2011 R&D 100 Award winner.

According to Measurement Science and Systems Engineering Division's (MSSSED) Barton Smith, the ORNL/UT sensor technology responds to hydrogen gas in environments with varying temperature and humidity and is not adversely affected by the gas species that interfere with the operation of most palladium-based sensors.

"The palladium layers deposited on the microcantilever mechanism in the sensor are extremely sensitive to the presence of hydrogen gas, making the Nano-Optomechanical Hydrogen Safety Sensor Based on Nanostructured Palladium Layers more sensitive when measuring levels of hydrogen within any given environment," Barton said, adding, "Its ability to detect hydrogen gas concentrations far below 1% in air, its resistance to contaminant gases, its rapid response time of less than 5 seconds, and its rapid recovery time make it ideal for monitoring industrial building activities, hydrogen fueling stations, indoor hydrogen fuel cell use, and many other of the emerging hydrogen technologies."

In addition to Barton, developers include Nickolay Lavrik of the Center for Nanophase Materials Sciences; MSSSED's Panos Datskos and Scott Hunter; and UT's Michael Sepaniak and James Patton. This work was sponsored by DOE's Fuel Cell Technologies Program and conducted in part at the Center for Nanophase Materials Sciences.

Charging forward

The Department of Energy recently celebrated the installation of twenty-five solar-assisted charging stations at

ORNL. The units are part of a larger, 125-station program that DOE – partnering with companies, like Nissan – is targeting to complete by the spring of 2012.

DOT renews commitment to CMVRTC

Trucks traveling Interstate 81 roll into the Greene County inspection station.



Members of Energy and Transportation Science Division's (ETSD) Transportation Systems Research Group hosted the quarterly meeting of the Commercial Motor Vehicle Roadside Technology (CMVRTC) Management Team on July 27. During the meeting the Federal Motor Carrier Safety Administration (FMCSA) renewed its commitment to the CMVRTC stating that the upcoming Wireless Roadside Inspection Pre-Field Operation Test would be led by ORNL and conducted with the CMVRTC. Additionally, FMCSA will fund ORNL to conduct various other commercial motor vehicle (CMV) safety related research over the next three years as well as fund the Tennessee Highway Patrol (a CMVRTC partner) to conduct real-world data collections to feed ORNL research. The CMVRTC is located on I-40 and I-81 with the Knox County and Greene County CMV inspection stations as anchor points. The charter of the CMVRTC is to increase stakeholder awareness, acceptance, and adoption of CMV safety technologies and serve as a catalyst for technology transfer. The renewed contract includes FMCSA funding of more than \$4 million dollars through 2014. Congratulations to ORNL team members including ETSD's Gary Capps, Oscar Franzese, Sheila Moore, Mary Beth Lascrain, and Adam Siekmann, all with the Center for Transportation Analysis.

DOE Vehicle Systems Program Manager Lee Slezak speaks at event.



Note from Ron Graves

As we catch up on events from the last few months, I would like to welcome Dr. Claus Daniel as the Program's new Deputy Director, and extend thanks to Keith Kahl for his excellent work in that role over the last few years. Keith will continue to collaborate with our Program staff in his new position as Group Leader for Transportation Systems Research.

We are pleased to have Sustainable Transportation among this coming year's ORNL Initiatives. We find that our thoughts on strategic directions for transportation closely match the plans for a secure energy future outlined by President Obama on March 30...alternative fuels, more efficient vehicles, electrification, and we added efficient transportation systems. ORNL has much to offer in all four areas.

A number of ORNL staff was invited to participate in the DOE Quadrennial Technology Review (QTR) led by Undersecretary Dr. Steve Koonin. They co-authored reviews of technologies such as materials, fuel cells, and engines. The QTR meeting on vehicle efficiency and electrification was held in Knoxville and was attended by about 10 ORNL members as invited guests and note takers.

The awardees were recently announced for seven of eight areas of Funding Opportunity Announcement 239 from the DOE Vehicle Technologies Program. ORNL is a member of 13 of the 40 winning teams, leading one of the teams, with a total funding value of about \$7.6 million. More details are in the body of the newsletter.

Recent distinguished visitors to ORNL include Gurpreet Singh, Ed Owens, David Howell, Lee Slezak, and Brian Cunningham from DOE. The visit by 85 technology leaders from Cummins Engine Company was covered in the EESD Newsletter last quarter. Other visiting industry firms included Bosch, Honda, and the USDRIVE Hydrogen Tech Team. From DOT Federal Highway Administration we hosted Joe Peters and Gene McHale.

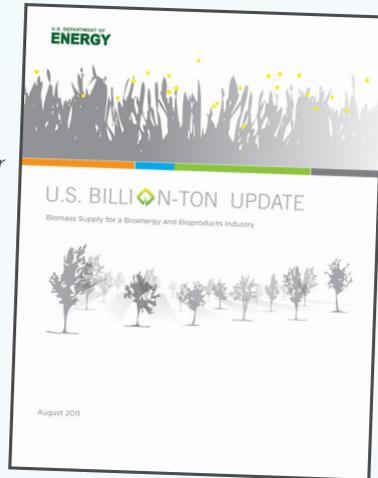
Finally, best wishes to Bill Key who retired last month after 34 years with ORNL. Bill was on assignment at HQ for the last few years and was immensely helpful to DOE, the ORNL program, and all who visited HQ.

---- Ron



Billion-Ton Study update released

In 2005, ORNL led the Department of Energy's Billion-Ton Study for the Department of Agriculture. Their first report, *Biomass as Feedstock for a Bioenergy and Bioproducts Industry: The Technical Feasibility of a Billion-Ton Annual Supply*, played a pivotal role in the development of the Energy Independence and Security Act of 2007 with findings confirming the technical feasibility of U.S. lands supplying a billion tons of biomass annually. ORNL



recently completed a second report for DOE, *U.S. Billion-Ton Update: Biomass Supply for a Bioenergy and Bioproducts Industry*. The update expands on the first report to include a spatial, county-by-county inventory of potentially available primary feedstocks, price, and available quantities (e.g., supply curves) for the individual feedstocks, and a more rigorous treatment and modeling of resource sustainability. Released in August by DOE, the Billion-Ton Update can be found online at http://eere.energy.gov/biomass/pdfs/billion_ton_update.pdf and <http://bioenergykdf.net>.

Project to address truck technology efficiency

Representatives from the Energy and Transportation Science Division (ETSD) and the Sustainable Transportation Program met with National Highway Transportation Safety Administration (NHTSA) officials in May to kickoff the Truck Technology Efficiency Assessment project. Led by ETSD's Tim LaClair, the NHTSA-funded project will study the potential fuel savings and emissions impacts of advanced efficiency technologies for Class 8 long-haul trucks, based on a comprehensive analysis of drive cycle data collected in the Heavy Truck Duty Cycle (HTDC) project. ORNL will develop characteristic drive cycles that represent the usage of the fleet measured in the HTDC project, apply a tractive energy analysis of the data to estimate fuel savings potential of advanced efficiency technologies, and develop a simple approach to quantify emissions reduction potential.

New DOE funding continued from page 1...

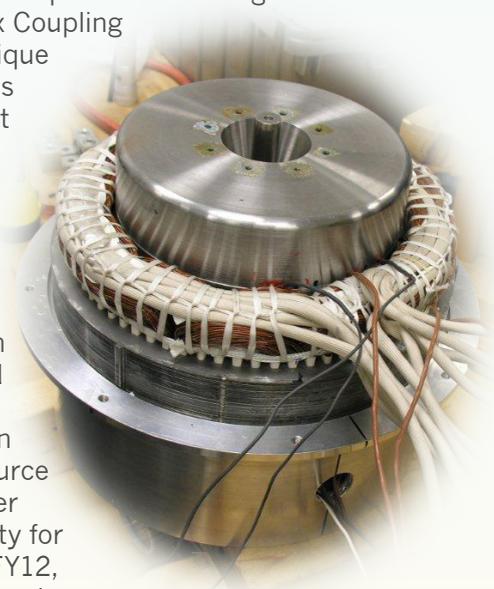
In addition to leading the study of ionic liquids, ORNL is expected to receive more than \$6 million to help support 12 additional projects described below.

- Optimize fuel-based control of novel combustion strategies in light and heavy-duty vehicles to enable diesel-like efficiencies with ultra-low engine-out emissions. Project lead is Wisconsin Engine Research Consultants, LLC.
- Evaluate and validate models for predicting the crash behavior of carbon fiber composites by building and testing subcomponent structures. Project lead is Plasan Carbon Composites.
- Develop and validate a “new passenger vehicle design architecture” that facilitates a 50% weight reduction through the extensive use of lightweight and high strength materials. Project lead is Vehma International of America, Inc.
- Develop and deliver low cost, large format cells with extremely high energy density that meet performance, life, and safety requirements of electric drive vehicles. Project lead is Dow Kokam, LLC.
- Design and assemble low cost, high volume manufacturing module for fabricating high capacity metal alloy anodes in a continuous roll-to-roll configuration. Project lead is Applied Materials, Inc.
- Develop and demonstrate ultraviolet and electron beam curing technology to reduce the cost of manufacturing lithium ion battery electrodes more than 50%. Project lead is Miltec UV International, LLC.
- Develop high performance, low cost power module and inverter switching technologies that lead to the design and fabrication of the next generation of power inverters. Project lead is General Motors, LLC.
- Develop high performance motors with non-rare earth materials by concurrently engineering advanced motor designs, materials, thermal management, and motor controls. Project lead is General Electric.

- Develop a non-rare-earth permanent magnet motor architecture that will enable the use of low energy magnet technology. Project lead is UQM Technologies, Inc.
- Develop a thermoelectric generator system to convert waste heat to electric power, with the control systems necessary to utilize that power in a vehicle. Project lead is General Motors, LLC.
- Demonstrate a robust thermoelectric exhaust waste heat recovery system that provides >5% fuel efficiency improvement for a light-duty vehicle. Project lead is GMZ Energy, Inc.
- Develop a simple and inexpensive driver feedback and powertrain management technology to reduce driver-bias on commercial fleets and improve average fleet fuel economy by at least 2%. Project lead is Eaton Corporation.

Milestone reached with non-permanent magnet motor

Congratulations to Power Electronics and Electric Machinery Research Center researchers who have met a Department of Energy Performance Management Measurement Milestone Q3 Target Objective after completing a motor component technologies evaluation of the Novel Flux Coupling (NFC) motor. The unique technology eliminates the use of permanent magnet material resulting in a significant cost reduction. Experimental data generated in May indicates that the NFC motor excitation coil can also be used to perform the function of the inductor in the ORNL-current source inverter (CSI), another promising opportunity for system savings. In FY12, researchers will be moving forward with the integration of the NFC and CSI.



Novel flux coupling motor

Crack-detecting technology could lead to healthier vehicles and emissions

A cooperative research and development agreement between ORNL and Cummins Inc. has produced a newly patented technology for diagnosing the health of a vehicle's emissions management system.

The apparatus helps detect cracks in the diesel particulate filter, a device designed to remove soot and particulates in diesel exhaust. Periodically, the filters are "cleaned" through high temperature oxidation. Cracking may occur during cleaning, start-up, shut-down, or from unforeseen transients during operation.

"The cracks typically provide a path for the gas to escape, compromising the functionality of the filter. Most often, the cracks cannot be repaired and the filter must be replaced," explained research team member Amit Shyam, Materials Science and Technology Division (MSTD). Other team members include MSTD's Edgar Lara-Curzio and Cummins' Randall Stafford and Thomas Yonushonis.

Developed using ORNL High Temperature Materials Laboratory resources and the team's propulsion materials expertise, the new technology includes sensors that consist of embedded conduction paths on the filter's exterior. The sensors measure increases in electrical resistance across conduction paths to detect the cracks and the extent of damage.

"If potential problems are identified, these can be reported during regular service intervals, enabling individual drivers to remain compliant with EPA regulations," said Stafford.

Project funding was provided by Cummins and the Department of Energy's Energy Efficiency and Renewable Energy Vehicle Technologies Program. Cummins is a global leader in the design, manufacturing, distribution, and service of engines and related technologies, including fuel systems, filtration, emission solutions, and electrical power generation systems.

Outstanding mentors named

Congratulations to Energy and Transportation Science Division's Teresa Barone, Gary Capps, Oscar Franzese, and Bill Partridge who each received the 2010 Outstanding Mentor Award. Presented by the Department of Energy Office of Science, this prestigious award is in recognition of outstanding contributions and dedication in mentoring and is based on nominations and testimonials from mentored students. Teresa and Bill are with the Fuels, Engines, and Emissions Research Center; Gary and Oscar are with the Center for Transportation Analysis. All are based at NTRC.

CFTC construction progress

Construction of the future Carbon Fiber Technology Center continues at the Horizon Center. Designed to foster collaborations with industry and academia, the 40,000-square-foot facility will operate at a pilot scale and demonstrate the scalability of technology for lowering the cost of carbon fiber and making affordable the use of carbon fiber in applications such as vehicle and wind energy technologies.



The Carbon Fiber Technology Center is projected to be operational by late 2012.



Teresa Barone



Bill Partridge



Gary Capps



Oscar Franzese

Honors & Highlights

- Claus Daniel was named Deputy Director for the Sustainable Transportation Program, effective June 1. Claus moved to this position from the Materials Science and Technology Division where he has most notably helped build and lead ORNL's battery research for vehicles and industrial technologies. Claus succeeds Keith Kahl, who now leads the Transportation Systems Research Group in the Energy and Transportation Science Division.



Claus Daniel

- U.S. Secretary of Transportation Ray LaHood has reappointed Energy and Transportation Science Division's Diane Davidson, Director of the Center for Transportation Analysis, to a two-year term on the Transit Rail Advisory Committee for Safety (TRACS). The purpose of the committee is to advise the Secretary, through the Federal Transit Administrator, on rail transit safety issues. Diane is serving as Acting Chairman.



Diane Davidson

- ORNL transportation researchers made 83 oral and poster presentations at the Annual Merit Review and peer evaluation meetings for DOE's Vehicle Technologies Program and Fuel Cell Technologies Program held in May in Washington, D.C. They also contributed to numerous other presentations on projects in which ORNL is a collaborator. Proceedings of the merit review and peer evaluation can be found at www.eere.energy.gov/vehiclesandfuels/resources/proceedings/2011_merit_review.html (Vehicle Technologies Program) and www.hydrogen.energy.gov/annual_review11_proceedings.html (Fuel Cell Technologies Program).
- Dave Warren, Sustainable Transportation Program Office, has accepted the invitation to be a plenary presenter at the Automotive Composites Conference & Exhibition in September. To be held in Detroit, this event is designed to educate

and update automotive design and production engineers, sales personnel, and management from transportation OEMs and Tier suppliers about the benefits and expanding importance of thermoset and thermoplastic composites in passenger vehicles, light trucks, and other ground transportation applications. The event draws speakers, exhibitors, and attendees from the Americas, Europe, Asia, Africa, and the Middle East.

- Energy and Transportation Science Division's Sujit Das made an invited presentation on "Transportation Challenges in Biofuels Supply Chain Logistics" at the U.S. Department of Transportation's Interagency Biofuels Infrastructure Workshop held in June in Washington, D.C. The invitation-only workshop focused on supply chain issues considering transport and distribution challenges from the point of domestic feedstock production through finished biofuel retail distribution, and each segment in between.



Sujit Das

- ORNL hosted a Power Electronics Symposium in July to help educate industry and entrepreneurs on the capabilities, expertise, technologies, and opportunities available through the Power Electronics and Electrical Power Systems Research Center to address existing problems and/or the development of new business lines. The center specializes in the advancement of inverters; converters; motor control techniques; efficient, compact electric machines; and high voltage, high speed power systems.



More than 100 participants attended the Power Electronics Symposium.



- Engineering students with the United States Naval Academy completed internships at ORNL this summer, working closely with researchers in the Fuels, Engines, and Emissions Research

Center at NTRC. While here, the Midshipmen were charged with helping set up a new lab and begin data collection on small engines to support ORNL research of unmanned aerial vehicles. Pictured here, MIDN Mark Trunzo, left, and MIDN Matt Perry.

- A meeting of the Hydrogen Storage Tech Team was held at ORNL in June. Ned Stetson and Grace Ordaz from DOE's H2 Storage Program attended and chaired the meeting. Other attendees included members of the U.S. Council for Automotive Research Hydrogen Storage Tech Team, as well as industry representatives and other national laboratories. The meeting included tours of SNS, CNMS, HTML, several carbon fiber facilities, and technical presentations. Special thanks to Andrew Payzant and David Geohegan for tours of the SNS and to HTML User Program staff members Camden Hubbard and Tom Watkins, who presented information about fuel cell user projects and related characterization expertise.
- Energy and Transportation Science Division's Zhenhong Lin and David Greene have received a 2011 DOE Vehicle Technologies Program R&D Award for developing the Market Acceptance of Advanced Automotive Technologies (MA3T) model, a market simulation model that was developed to project plug-in electric vehicle demand and its impact on energy and the environment. MA3T features 36 vehicle technologies, including conventional gasoline, diesel, hybrid electric, plug-in hybrid electric, battery electric, and fuel cell; 1,458 different market segments within the United States; multiple inputs such as fuel prices, vehicle performance, charging infrastructure, and various types of policy incentives and application flexibility. The model can provide oil displacement estimates, greenhouse gas emissions, electricity demand, the market share for each vehicle technology, and much more.

- Environmental Sciences Division's Erin Webb has been invited to join the Biomass Research and Development Initiative's Interagency Working Group for Bioenergy Logistics. This working group was established to define means of overcoming technical challenges to systems integration, scalability, and deployability for biorefinery feedstock supplies and products. The group includes representatives from DOE, national labs, USDA, DOT, and other agencies.

Oak Ridge establishes carbon fiber composites consortium

Fourteen companies have agreed to join with ORNL to establish the Oak Ridge Carbon Fiber Composites Consortium, which will work to accelerate the development, demonstration and commercial application of new low-cost carbon fiber and composites materials in many different industry sectors.

Charter members of the consortium include Dow Chemical Company, 3M Company, Faurecia, Toho Tenax America, Plasan Carbon Composites, Composite Applications Group, Umeco Composites Structural Materials, Graftech International, United Technologies Research Center, Harper International, Hills Material and Chemistry Laboratory, SSOE Group, Innovation Valley, and UT-Battelle, the managing contractor for ORNL.

Consortium members will convene twice annually for briefings on ORNL's research, development and demonstration efforts in carbon fiber composites, and to provide critical insights into market trends and opportunities. The market for carbon fiber composites is expected to grow significantly over the next several years, especially in key markets such as automotive, wind energy, oil and gas, infrastructure and various industrial applications. The consortium will host its inaugural meeting in September in Oak Ridge.

Announcement of the consortium and ORNL's carbon fiber work have received substantial media coverage recently including mentions in the following Automotive News stories:

<http://www.autonews.com/apps/pbcs.dll/article?AID=/20110801/OEM01/308019975/1298#ixzz1U0WiCoTS>

<http://www.autonews.com/apps/pbcs.dll/article?AID=/20110801/OEM01/308019969/1143#ixzz1U0XRgrOP>

Do you have news or information you would like to share?

Please submit to Kathy Graham, ORNL Sustainable Transportation Program Office
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