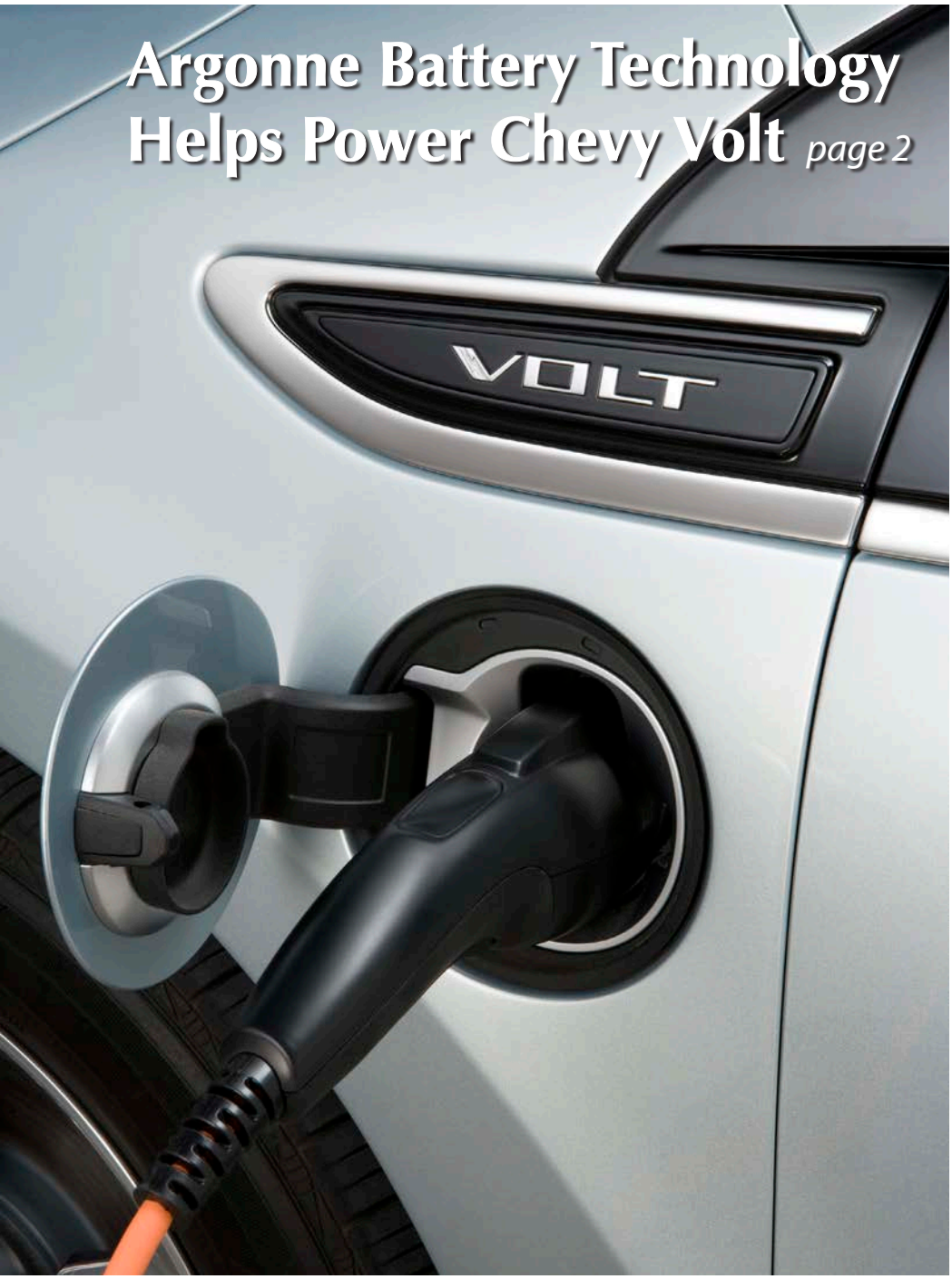
Argonne NATIONAL LABORATORY
Transportation Technology R&D Center

TransForum

News From Argonne's Transportation Technology R&D Center
www.transportation.anl.gov

New in this Issue!

Beginning with this issue of TransForum, you may now navigate to individual articles from the contents page. You can also move forward one article, back one article or return to the contents page from each article. Navigation is located at the bottom of each page.



Argonne Battery Technology Helps Power Chevy Volt *page 2*

Volume 11, No. 1 — Spring 2011

Argonne Battery Technology Helps Power Chevy Volt

When General Motors recently introduced the Chevy Volt as the first mass-produced, plug-in hybrid electric car, it was widely viewed as a technological marvel.

In addition to the car's unique engineering, it has a battery that lasts longer, runs more safely and performs better than other batteries currently on the market. This novel battery chemistry is based in part on a revolutionary breakthrough pioneered by scientists at Argonne National Laboratory.

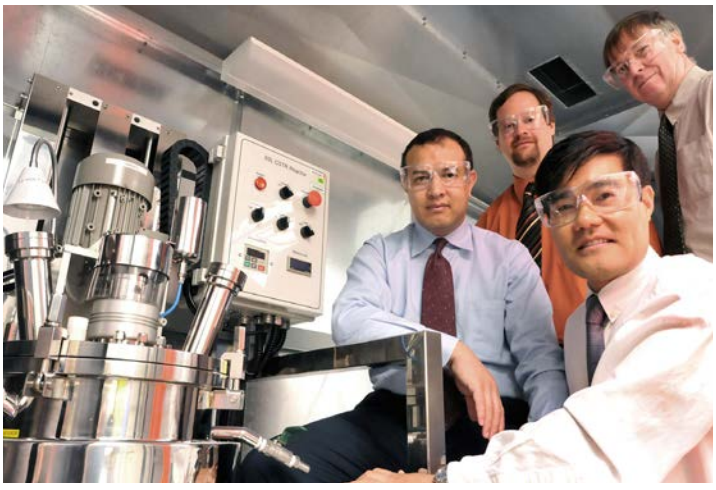
"Existing materials weren't good enough for a long-range vehicle," explained Michael Thackeray, an Argonne Distinguished Fellow who is one of the holders of the original patent. "The Argonne materials take a big step forward in extending the range of an electric vehicle."

The Argonne-developed technology offers the longest-lasting energy available in the smallest, lightest package: a 50–100 percent increase in energy storage capacity over conventional cathode materials. Further, its unique lithium- and manganese-rich mixed-metal oxide combination extends the operating time between charges, lengthens the calendar life and improves the inherent safety of lithium-ion cells.

A Decade of Research

But this potential game-changing technology is not brand new; it's the culmination of nearly a decade of research. The story begins in the late 1990s, when the U.S. Department of Energy's Office of Basic Energy Sciences funded an intensive study of lithium-ion batteries.

In order to improve the design, scientists had to know how batteries worked at the atomic level.



Argonne battery researchers (from left) Khalil Amine, Chris Johnson, Sun-Ho Kang and Mike Thackeray are co-inventors of the revolutionary cathode material used in the battery that powers GM's 2011 Chevrolet Volt. Jaekook Kim (not pictured) is also a co-holder of the original patent.

"What we really needed to do was understand the molecular structure of the material," said Argonne chemist Chris Johnson.

The Argonne research team wanted to improve the battery's cathode, the positively charged material. They began by using incredibly intense X-rays from Argonne's Advanced Photon Source synchrotron to watch chemical reactions while they were occurring in the lithium battery. Once these reactions were understood, they set out to modify and optimize the cathode materials. Using new synthesis methods, they created lithium- and manganese-rich materials that proved remarkably more stable than those found in existing designs.

Because these cathodes are more stable than those used in today's batteries, the new batteries are safer and less likely to overheat. Manganese is cheap, so the battery will cost less to manufacture. The researchers also increased the upper charging voltage limit to 4.6 volts—higher than the usual operating voltage—and saw a tremendous jump in the battery's energy capacity.

The Argonne battery design became, in a radical leap forward, cheaper, safer, and longer-lasting.

"To me, that's exceptional," said Jeff Chamberlain, who heads Argonne's battery research and development. "New advances often sacrifice cost or safety for performance; it's a rare breakthrough that improves all three."

The Next Generation

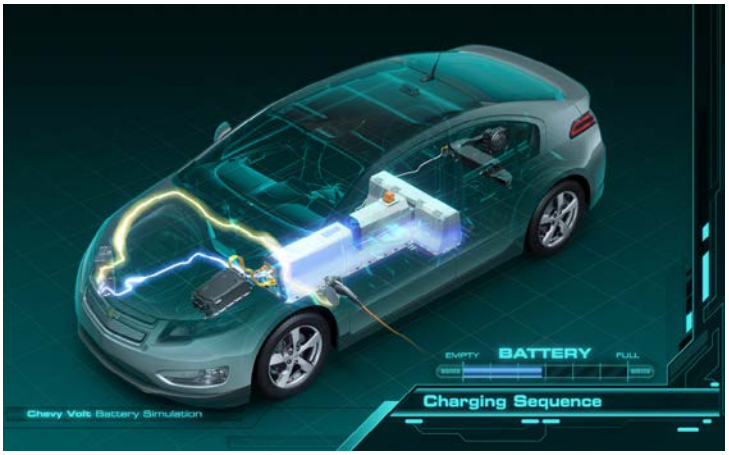
Batteries for electric and plug-in hybrid cars are much larger—and thus far more expensive—than laptop batteries, and they make up a large percentage of the car's price. Lowering the cost of the battery will lower the cost of all-electric and hybrid cars, according to Khalil Amine, an Argonne senior materials scientist, and subsequent improvements will improve battery performance even further.

"Based on our data, the next generation of batteries will last twice as long as current models," Amine said.

Furthermore, Chamberlain said that the new battery technology pioneered by Argonne can boost American manufacturing and create new jobs.

"Batteries are a large, heavy component of electric and hybrid cars, and so it's best to manufacture them near the factory where the cars are assembled," Chamberlain explained. "This means cars assembled in U.S. factories will also need battery factories nearby—creating more American jobs."

A total of $1.5 billion in stimulus grants went to several companies last year—including A123 Systems, Johnson



The 2011 Chevy Volt's 16 kWh battery can be recharged using a 120V or 240V outlet. Image courtesy of General Motors.

Controls and Compact Power, an LG-Chem subsidiary—to build battery plants in the United States.

Chamberlain, who worked in private industry for 13 years before joining Argonne in 2006, says the national laboratories play a crucial role in developing these kinds of breakthrough technologies. "The labs perform basic research," he said. "In the U.S., businesses tend to invest in research that will pay off in the short term; in this field of research, the national laboratories are filling a gap by conducting the essential research that will change the game ten to 20 years down the road."

When companies show interest in the technology, he said, the labs collaborate with them to help adopt the method for large-scale production.

LG Chem licensed the technology from Argonne and used the materials to create the battery supplied for the 2011 Volt. GM has also licensed the technology for its own tests.

"Seeing this play out is absolutely gratifying," Chamberlain said. "We're developing technology that I'm highly confident will help make plug-in hybrid cars more economical. The work at Argonne ends up in the hands of taxpayers who paid for research. This is a fulcrum, a key component to moving away from fossil fuels."

Funding for this work was provided by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy, Vehicle Technologies Program and the Office of Basic Energy Sciences.

For more information, contact
Jeff Chamberlain
jchamberlain@anl.gov

Battery Tech Licensed to Several Companies

Argonne has now licensed its groundbreaking battery technology to five companies. In addition to GM and LG Chem, the following companies are working with the Argonne-developed cathode material:

- **Envia** – In January 2011, this California start-up signed a license with Argonne. The lab's cathode material will contribute complementary technology to Envia's development of industry-leading lithium-ion battery solutions. This deal builds on an existing Argonne-Envia collaboration that garnered an R&D 100 award from *R&D Magazine* in 2009 for the joint development of an innovative composite electrode material technology.
- **BASF** – In June 2009, the world's largest chemical company signed a worldwide licensing agreement to mass produce and market Argonne's patented composite cathode materials to manufacturers of advanced lithium-ion batteries.
- **Toda Kogyo** – In March 2008, this Japanese company reached a worldwide licensing agreement for the commercial production and sales of Argonne's battery materials for lithium-ion batteries.

The technology remains available for licensing.

For more information, contact
Argonne's Office of Technology Development and Commercialization
www.anl.gov/techtransfer/

New Battery Facility Allows Argonne to Create Prototype Battery Cells

With Argonne's new Cell Fabrication Facility, researchers have the ability to create their own full-size prototype battery cells by using promising laboratory-developed materials and without having to rely on battery manufacturers to make the larger cells.

The climate-controlled fabrication facility allows Argonne scientists to manufacture, for their own use, both pouch cells and 18650 cells.Pouch cells are contained in flexible, heat-sealable foils that allow them to be tailored to specific shapes and sizes; 18650 cells are contained in solid, cylindrical metal shells (18 mm in diameter, 65 mm in height). The new facility will also make battery electrodes.

> "This will greatly reduce the time to get battery improvements into production."

Previously, Argonne researchers were only able to fabricate very small coin cells using laboratory glove boxes (sealed units that allow researchers to manipulate materials in a contained environment). When Argonne wanted to create larger prototypes for more detailed testing, the laboratory was forced to go to battery manufacturers for the production of pouch and 18650 cells. However, for the fabrication process to be worthwhile, manufacturers would require large quantities of the prototype cells to be produced, which was not cost-effective or convenient for Argonne.

"Having [the capability to make prototypes] allows us to evaluate the novel battery chemistries we create in our R&D laboratories in a more practical and timely manner," said chemical engineer Andy Jansen. "If we like what we see, we will scale it up in the fabrication facility."

After fabrication, the prototype cells are then evaluated for performance, battery life and safety in Argonne's state-of-the-art battery testing facilities.

Unique U.S. Facility

Outfitted with pilot-scale production equipment and cutting-edge dry room technology, Argonne's Cell Fabrication Facility is one of a few of its kind in the country.

Because moisture is detrimental to batteries, the facility was constructed as a climate-controlled dry room. A controller constantly monitors the humidity of the room and guarantees a dew point (the temperature at which dew forms) below -42°C with up to six people working inside.

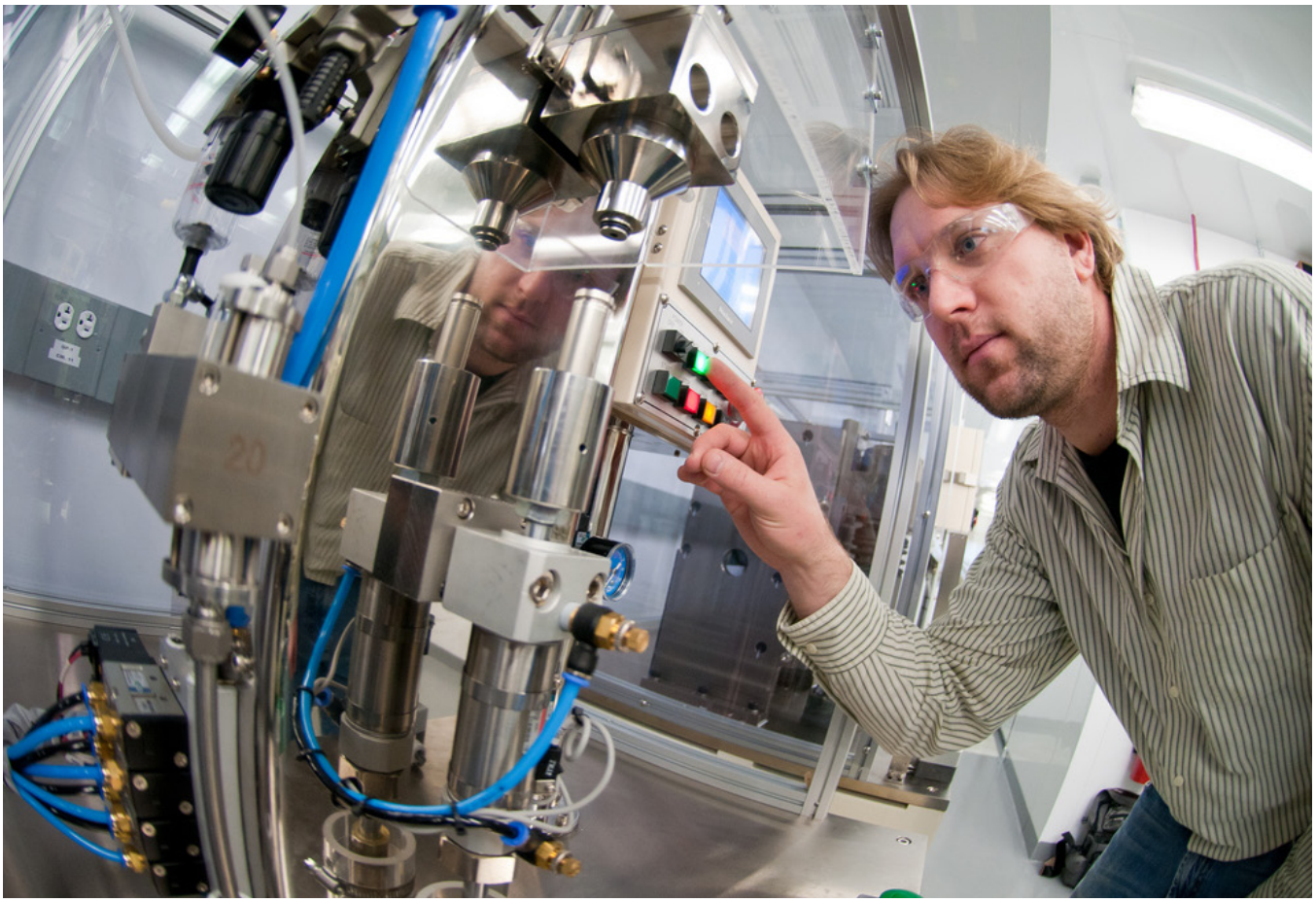
"Moisture can cause an electrolyte to become acidic, which can destroy the battery," Jansen said. "To ensure quality, fabrication needs to be done in a controlled environment like this."

One-Stop Shop for Battery R&D

With the addition of the fabrication lab, along with plans for a new Materials Engineering Facility (MEF) and a Post-Test Analysis Facility, Argonne's already world-renowned battery research program will take a significant leap forward. The MEF will help develop manufacturing processes for producing advanced battery materials in sufficient quantity for industrial-scale testing. The post-test facility will help researchers understand the changes that occur in materials as a battery ages from use or testing.

From basic battery materials research and fabrication to scale up and performance testing, Argonne is expanding its capabilities so that nearly every aspect of battery R&D can be done on-site.

"These facilities will create a direct pipeline between materials researchers and battery developers," said Dennis Dees, an electrochemical engineer at Argonne who will help oversee the Cell Fabrication Facility. "This will greatly reduce the time to get battery improvements into production."



Argonne process engineer Bryant Polzin fills an 18650 lithium-ion battery cell with electrolyte using semi-automated equipment at Argonne's Cell Fabrication Facility.

The laboratory's energy storage research focuses on battery materials and batteries for hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs) and all other electric vehicles (EVs).

"What's holding EVs and PHEVs back is the lack of high-energy density batteries that are safe and affordable," Jansen said. "Our research revolves around making materials with higher energy densities and improved safety while staying within the targeted cost criteria."

Funding for the new facility was provided by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy, Vehicle Technologies Program under the direction of David Howell and Peter Faguy.

For more information, contact
Andy Jansen
jansen@anl.gov

Argonne Investigates Lithium Supply and Battery Recycling

The superior energy density of lithium-ion batteries is making it the battery chemistry of choice for a new wave of advanced vehicles such as the Chevy Volt and Nissan Leaf, replacing the nickel-metal hydride batteries typically found in hybrid vehicles.

But with this expanding market for automotive lithium-ion batteries, some questions emerge:

- Will there be enough lithium to meet the added demand?
- What will happpen to these car batteries when they reach the end of their useful life?

Researchers at Argonne's Transportation Technology Research & Development Center have been investigating these issues by examining the material demand and recycling issues related to lithium-ion batteries.

Volt battery pack (left). With advanced vehicles like the Chevy Volt now using lithium-ion batteries, it is important to consider how we will deal with these new battery packs at the end of their useful automotive life. Photo courtesy of General Motors.

"It's important to consider potential material supply constraints before moving ahead with an ambitious program of development for any new technology," said Linda Gaines, Argonne transportation systems analyst.

Lithium Supply

With optimistic electric vehicle market penetration scenarios mapped out to 2050, Gaines and her colleagues found that the lithium supply should not be an issue any time soon.

"In the case of materials for lithium-ion batteries, it appears that electric-drive vehicles can be supported for decades with known supplies of lithium, even at an aggressive rate of growth," Gaines said.

The recovery of lithium and other materials through battery recycling would help lessen the production demand for virgin materials.

Recycling Processes

As part of the Argonne research effort, Gaines and her colleagues are analyzing the available battery recycling processes and how they compare in terms of materials recovery, energy efficiency and emissions production.

To gain insights into existing battery recycling operations, Gaines has visited and researched facilities in the U.S., Canada and Europe. She found a wide variety of recycling practices, with most facilities concentrating on the recovery of valuable metals like cobalt and nickel.

At one extreme, there are smelting processes that recover basic elements or salts. Smelting takes place at high temperature, and organics are burned as fuel or reductant. Valuable metals are recovered and sent to refining so that the product is suitable for any use. Other materials, including lithium, are contained in the slag, which is used as an additive in concrete. Smelting facilities are operational now on a large scale and can take just about any input.

At the other extreme, battery-grade materials can be recovered directly. This type of process requires the battery feed to be as uniform as possible because impurities jeopardize product quality. A variety of physical and chemical processes separate the components, and all active materials and metals can be recovered. Some components may need to be purified or reactivated to make them suitable for reuse in new batteries. Only the separator is unlikely to be usable. This low-temperature process requires minimal energy.

"The recovery of battery-grade materials would help avoid the energy requirements and emissions from production of raw materials," Gaines said. "Recovered materials would also be less expensive than virgin materials, but we need to make sure the quality is good enough."

Recovering Lithium

Recovering lithium from battery recycling is currently not a common practice. This is because lithium is relatively cheap and most batteries contain only small amounts of lithium, presenting little economic need or incentive for such a process.

"Right now it hardly pays to recycle lithium," Gaines said. "That could change as demand increases and larger supplies of materials are used."

In a first step toward building a domestic infrastructure for lithium battery recycling, the U.S. Department of Energy awarded a $9.5 million grant to Toxco in 2009 to build and operate an advanced lithium battery recycling facility at its existing site in Lancaster, Ohio. The plant was previously dedicated to recovering materials from lead acid and nickel -metal hydride batteries. Toxco also operates the only lithium battery recycling plant in North America in Trail, British Columbia.

Gaines and her fellow researchers are conducting further studies to identify the greenest, most economical recycling processes. Research includes investigating recycling practices to determine how much of which materials could be recovered with current or improved methods, and quantifying the environmental impacts of both battery production and recycling processes through life cycle analyses. The Argonne research team is also considering the possibility of reusing old batteries for utility storage before recycling.

Thus far, research has shown that recycling lithium-ion batteries would reduce environmental burdens and extend material supplies. However, achieving the aim of recycling is not without difficulties, Gaines said. Recycling processes have their own costs and impacts, and recovered materials may have such low value that recycling does not pay. This reality leads to questions such as:

- Will battery manufacturers be willing to purchase recovered materials?
- Will materials from today's batteries be compatible with materials in use 10 or 15 years from now?

"Different processes recover material at different stages, and the best route will depend on numerous factors," Gaines said. "We continue to investigate these issues."

Funding for this research is being provided by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy, Vehicle Technologies Program under the direction of David Howell.

For more information, contact
Linda Gaines
lgaines@anl.gov

TRACC Simulates the Transport of Saltwater Sprays onto Steel Bridge Understructures

By Ronald F. Kulak, Senior Structural Mechanics Leader and Cezary Bojanowski, Computational Structural Mechanics Engineer, Argonne National Laboratory

Researchers at the U.S. Department of Transportation's Federal Highway Administration's Turner-Fairbank Highway Research Center (TFHRC) recently enlisted help from Argonne's Transportation Research and Analysis Computing Center (TRACC) to solve a problem affecting some of the nation's steel bridges. Weathering steel was developed to intentionally form a hard thin coat of rust that did not peel off, thus stopping the rusting process, which eliminated the need for costly painting. Unfortunately, in the 1980s, accelerated corrosion of some weathering steel bridges was reported (Figure 1).

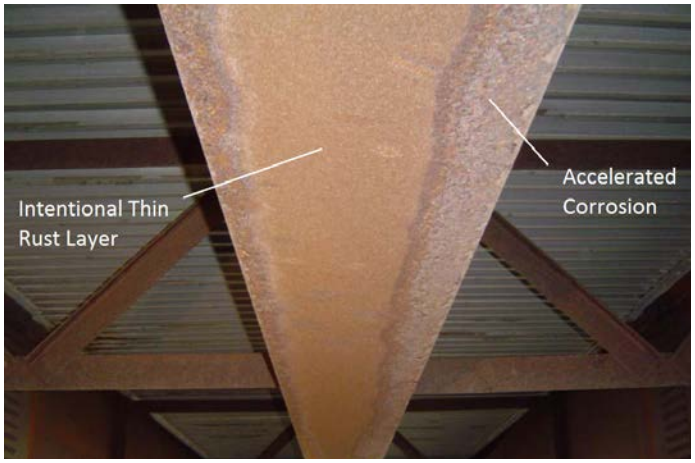


Figure 1. "Road level" view of accelerated corrosion on the surface of a bridge support beam made from weathering steel

Speculation indicated that the geometry and aerodynamics of some bridge/tunnel systems were conducive to transporting the de-icing salt spray dispersed by vehicles driving over salted, wet roads up to the overhead steel beams. With higher-than-expected concentrations of salt depositions and continuous moist conditions, the weathering steel continued to rust. In 1989, the Federal Highway Administration issued Technical Advisory 5140.221 to warn bridge owners of situations where weathering steel should not be used.

Modeling Salt Sprays

TFHRC teamed up with TRACC for the purpose of applying high-performance computing (HPC), state-of-the-art modeling and simulation techniques to study the physics of this problem. The modeling of the transport of saltwater mixtures from the pavement surface to the underside of steel bridges involved understanding three phases:

- Lifting of the mixture from the road surface by the tires and ejecting the mixture into the swirling air around the wheels;
- Ejection of the mixture from the wheel region to the outside and undercarriage of the vehicle, with eventual ejection from the rear of the vehicle; and
- Formation of vortex wakes by exiting mixtures, which are propelled to the underside of the steel beams of the bridge.

To study the problem, a modeling approach using the multiphysics capability of LS-DYNA®/MPP2 software was used. LS-DYNA's multi-material Arbitrary Lagrangian Eulerian formulation allowed cars and trucks modeled with traditional finite element structural models to pass through a computational aerodynamic domain that contains the salt spray mixture.

The challenge was to develop accurate models of the vehicle, bridge and salt spray, and to simulate the resulting fluid-structure interaction. The vehicle chosen for the simulation was a Mack CH 613 tractor with a sleeper and dry freight van-type trailer. TFHRC gave TRACC detailed drawings of a steel bridge that was experiencing high corrosion due to salt spray. Figure 2 shows a snapshot from the resulting computational simulation of a Mack tractor trailer traveling at 60 mph at a position partly under the bridge. The fluid-structure interaction computations revealed the movement of selected points of the saltwater spray and their impingement onto the bridge's steel support girders.

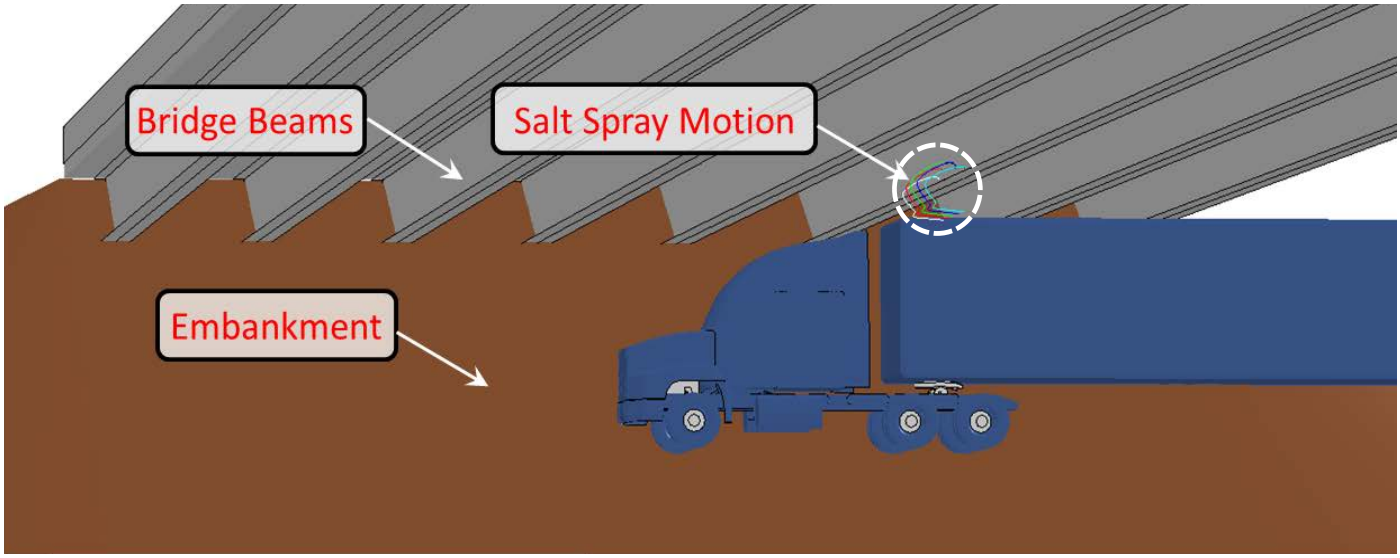


Figure 2. Computational snapshot of a semi-trailer truck traveling at 60 mph propelling salt spray onto the underside of bridge support beams

TRACC researchers were able to demonstrate that it was possible to evaluate salt spray transport for a single bridge using multiphysics simulations. Work has now started to evaluate the effects of roadway/bridge geometrics and vehicle speed on salt spray motion.

Computational structural-multiphysics mechanics is one of three focus areas within TRACC that uses HPC resources to solve current problems of interest for the U.S. Department of Transportation (USDOT). The combination of HPC with modern modeling and simulation multiphysics capabilities available in commercial software—such as LS-DYNA®/MPP—provides the tool set used by TRACC's structural-multiphysics simulation experts.

This work was funded by the U.S. DOT's Federal Highway Administration's Turner-Fairbank Research Center.

References

1. Technical Advisory: Uncoated Weathering Steel in Structures (www.fhwa.dot.gov/bridge/t514022.cfm)
2. LS-DYNA (www.lstc.com/lsdyna.htm)

For more information, contact
Ronald Kulak
kulak@anl.gov

TRACC Website: www.anl.gov/TRACC

Argonne Leads the Charge with On-Site Electric Charging Stations

The EV Charging Pilot Program makes use of solar panels on a tracking array mount that allows the panels to tilt toward the sun. Electric vehicle charging stations are shown in front of the solar array.

As part of Argonne's continuing efforts to reduce its carbon footprint, several electric vehicle (EV) charging stations will soon be installed around the laboratory campus as part of Argonne's EV Charging Pilot Program. The first charger went live on April 21, 2011 during Argonne's Earth Day celebration.

In addition to displacing petroleum through the use of EVs and plug-in hybrids, the program will include the installation of a solar power array and wind turbine to provide clean, renewable electricity for charging.

Not only will the program offer a means for recharging both employee-owned and laboratory fleet EVs and plug-in hybrids, it also gives transportation researchers a real-world test bed to gather data and validate smart charging technologies.

"There is good synergy between Argonne's EV Charging Pilot Program and our ongoing smart charging and smart grid technology development projects," said Ted Bohn, principal electrical engineer in Argonne's Transportation Technology Research & Development Center (TTRDC). See the sidebar on page 11 for more on these projects.

On Earth Day, Argonne gave employees a preview of the new charging infrastructure with various activities promoting the laboratory's most recent efforts to go greener.

Renewable Energy Sources

The solar energy will come from twelve 3.8 kW Sunpower panels with a DC/AC inverter and a tracking array mount that allows the mounted panels to tilt toward the sun, guaranteeing an optimal angle for power generation. The solar array will also feature a monitor to track how much electricity is being generated by sunlight.

A 60-foot, free-standing Skystream 3.7 wind turbine will supply wind power.

The deployment of charging stations will begin this year with 20 parking spots strategically located around the lab's 1,500-acre campus. The eventual goal is to have enough charging stations to accommodate five percent of Argonne employees, which equates to 160 parking spaces.

Electrifying Argonne's Fleet

Although commercial EVs and plug-ins are just starting to hit the consumer market, the laboratory already has five all-electric vehicles in its fleet, with plans to add more in the future. Its small, Hummer-like EVs from E-Ride Industries get up to 55 miles on one charge and cost less than $5 to charge, making the cost savings significant.

"They are the perfect solution for the stop-and-go deliveries made around the Argonne campus," said John Surdey, manager of Argonne's vehicle fleet. "The vehicles require little maintenance—we just need to add some distilled water once a month."

As a member of the Grid Interaction Tech Team, Bohn is excited about the prospect of having a small-scale, functioning EV charging infrastructure on site.

"As a laboratory focused on energy R&D, this is the right thing to do," Bohn said. "But it's also a great research tool for us as we pursue the development and validation of smart charging and smart grid technologies. We can use this on-site charging infrastructure for data collection and for field tests on our new prototype technologies, such as software-defined radios and compact metrology units."

The installation of the charging stations, solar array and wind turbine will be completed sometime in 2011.

Funding for this work is being provided by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy, Vehicle Technologies Program under the direction of Lee Slezak and Argonne National Laboratory's Greenhouse Gas Energy Conservation Account, Facilities General, under the direction of Mike Dunn.

Argonne recently added five new electric cars to its fleet. These vehicles from E-Ride Industries are ideal for stop-and-go trips made around the laboratory.

For more information, contact
Ted Bohn (EV Charging Pilot Program)
tbohn@anl.gov

John Surdey (EV Fleet)
jsurdey@anl.gov

Get Smart: Argonne Research Enables Smart Grid

Codes and Standards Development: Argonne researchers are helping create codes and standards that will enable widespread adoption of electric-drive transportation with smart grid interoperability. For example, the Society of Automotive Engineers' (SAE) J1772 connection standard will enable manufacturers to build compatible connector plugs and vehicle sockets that support both charging and two-way communication with utility companies. Another standard, SAE J2847, will specify the communications systems between electric vehicles and utility companies. Engineers are also actively pursuing the development of standards related to plug-in vehicles and methods to test them.

Smart Grid Metrology: Smart grid metrology systems are end-use measurement devices (EUMDs) that measure and communicate energy usage information to ensure accurate consumption readings and fair billing. Argonne researchers have made a major breakthrough with the development of a compact metrology system that is a fraction of the size and cost of existing systems. The groundbreaking technology is garnering international attention because of its low price of less than $30 per unit and its compact size (smaller than a business card). This technology would also be an alternative to installing a secondary charging meter specifically for charging an electric vehicle.

Software-Defined Radio: This wireless technology, which allows one radio to use different frequencies depending on needs at the time, will provide more bandwidth for electric utilities to communicate with consumer vehicles. Argonne researchers have developed a software-defined radio technology in a low-cost field programmable gate array (FPGA) device that would enable electric vehicle-to-grid interoperability for a wide variety of infrastructure resources. This promising technology offers a less expensive and more efficient option for smart grid communications.

Reducing Greenhouse Gas Emissions from U.S. Transportation

Transportation is the number one cause of U.S. oil dependency and is responsible for a quarter of U.S. greenhouse gas emissions (GHGs). In a January 2011 report created for the Pew Center on Global Climate Change, Argonne researcher Steve Plotkin and his co-author, David Greene of the Howard H. Baker, Jr., Center for Public Policy, examined what it would take to substantially reduce GHG emissions examined what it would take to substaintially reduce vehicular GHG emissions in the next 40 years. Through a combination of policy and technology initiatives, the report, "Reducing Greenhouse Gas Emissions from U.S. Transportation," states that GHGs can be lowered substantially from "Business as Usual" levels, even to levels well below today's, despite continued population and economic growth.

The report presented three plausible scenarios for reducing GHGs. Each scenario outlined different degrees of intensity in public policy implementation (such as performance standards, gas pricing), technological innovation (vehicle design, alternative fuels) and consumer commitment to lowering GHGs. All three scenarios include a price on carbon, either as a tax or indirectly from a cap-and-trade system.

Scenarios for Mitigation

The first scenario, called "Low Mitigation," calls for post-2016 GHG emissions standards for light-duty vehicles requiring reductions of two percent per year. The scenario includes a highway user fee indexed to energy efficiency, modest improvements in energy efficiency in non-highway modes, and little alternative fuel use. The low mitigation case sees a 6.5 percent reduction in GHGs from 2010 levels by 2035 and a reduction of 17 percent by 2050, compared to an expected *increase* of 28 percent by 2050 in the Business as Usual case.

The "Mid-Mitigation" scenario envisions a greater consumer commitment to reducing GHGs, more rapid technological progress, and innovative carbon pricing policies. Emission standards are tougher. There is a move to enact public policy to promote the use of GHG-lowering technologies, fuels and land use. The mid-mitigation case sees a 29.8 percent reduction of GHGs below 2010 levels by 2035 as a result of these combined strategies, reaching a 40.1 percent reduction in 2050.

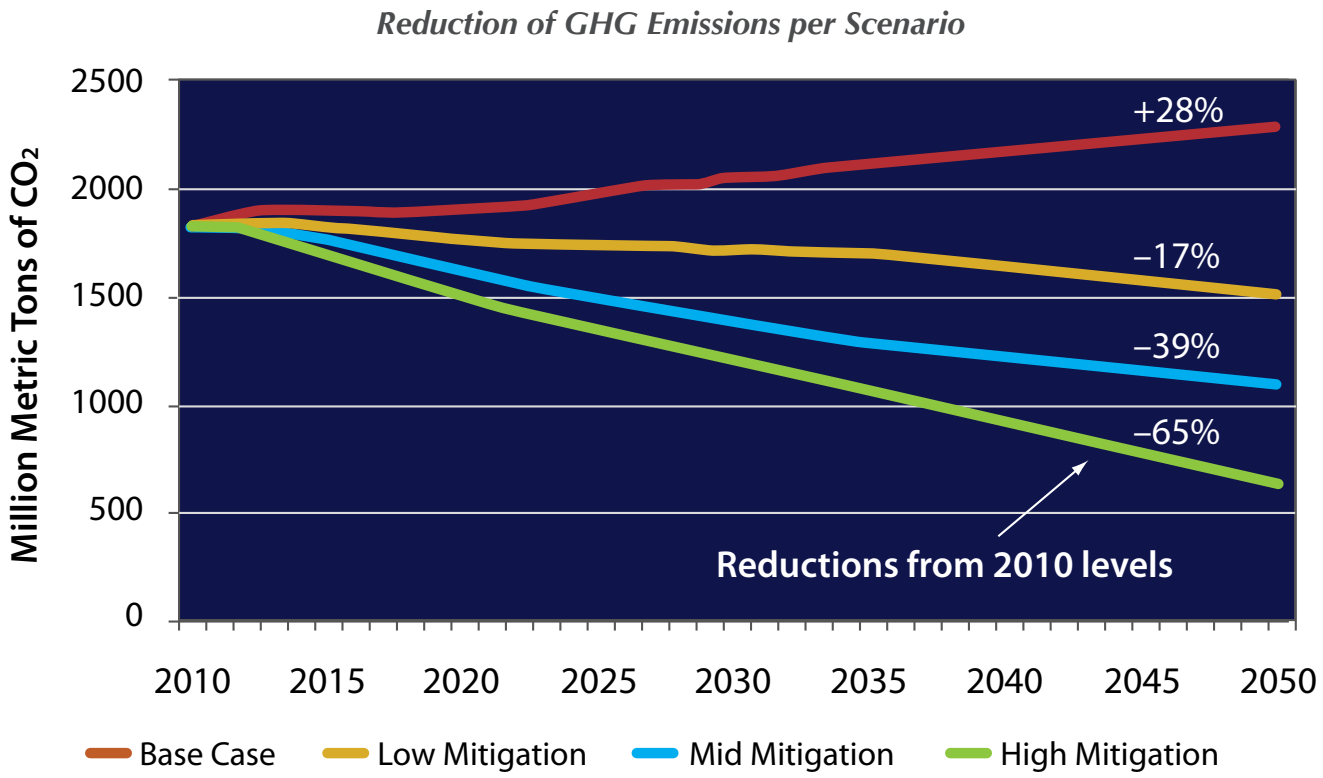
Finally, a "High-Mitigation" scenario assumes rapid technological progress and aggressive emissions standards, as well as greater effectiveness in public policies such as eco-driving, land use, acceptance of congestion pricing and more. A transition to electric and/or hydrogen vehicles and automated highways on major routes is also included in this scenario. With the high-mitigation case, GHGs are lowered by 41.5 percent in 2035 and by 65.9 percent in 2050 compared to 2010 levels.

Lowering GHGs is Possible

Overall, Plotkin said any of the report's three scenarios was possible, since most of the policies "can be implemented now and sustained over time to deliver" benefits to drivers. However, the level of uncertainty ascribed to the scenarios increases significantly from the low- to the high-mitigation scenarios, since the high scenario assumes very substantial technological progress and consumer acceptance of some significant changes in the transport system—both of which cannot be assured.

The report claims, however, that over time, things can improve substantially even if only incremental changes are made. For example, the average efficiency of cars and trucks is improving with technology, and by 2035, on-road fuel economy could be 34 to 41 mpg, rising to 45 to 59 mpg in 2050. Similar expectations are held for trucks, buses, air and rail transport methods. Improving highway system efficiency and shifting some traffic to more energy efficient modes (for example, sending products by rail and ships instead of by truck), and encouraging consumers to take shorter trips and to go by foot, bike or public transit will also help.

"Many of the technologies for lowering CO_2 emissions are already available from the same manufacturers that once declared them to be impractical. Turbocharged four-cylinder engines, for example, are able to replace six-cylinder power plants; they reduce emissions but do not cause a decline in performance. And lithium-ion cathode technology licensed from Argonne is being used to improve the performance and increase the safety of the batteries being manufactured by South Korea's LG Chem for the Chevrolet Volt," said Plotkin.



Per the PEW report, all three scenarios illustrate a large potential for transportation GHG mitigation.

Policies and Consumers Are Key Components

Policy makers can promote the lowering of GHG levels by setting standards for fuel economy and emissions and the use of renewable fuels. At present, the federal Renewable Fuels Standard requires that 12 percent of gasoline consumption of renewable fuels be sold for highway use by 2022, of which 21 billion must be cellulosic biofuel with 50- and 60-percent lower life cycle GHG emissions than gas. Different pricing schemes on carbon fuels (such as taxation, rebates to lower GHG-producing vehicles, and pay-as-you-drive insurance) can increase energy efficiency, promote low carbon fuels, encourage environmentally friendly travel choices, and motivate innovation.

Finally, the report recognizes that consumer behavior is crucial to attaining large reductions in GHG emissions. Consumers must be committed to lowering GHGs and cooperate with policy makers and technology innovation, taking personal steps in their own lives to adopt greener ways of using transportation.

The report is an update to the Pew Center's 2003 report of the same name. The report has been disseminated to government, transportation policy makers and other interested parties. Presentations on the report have been given at the Transportation Research Board Annual Meeting, Georgetown University Law Center, and via Webcast to the National Petroleum Council and the American Association of State Highway and Transportation Officials. Report findings will be presented at the 2011 Energy Information Administration (EIA) Energy Conference.

For more information, contact
Steve Plotkin
splotkin@anl.gov

Download the report:
www.pewclimate.org/docUploads/Reducing_GHG_from_transportation.pdf

Simulator Makes Green Racing Real

Ever want to drive a race car? Now you can, with Argonne's Green Racing Simulator. Working with the American LeMans Series (ALMS), and developed by transportation researchers Danny Bocci and Forrest Jehlik, the simulator allows a person to have a racetrack experience with a difference—the simulated race car uses green transportation technologies.

How the Simulator Works

Sit in the seat and start the engine! The racing simulator uses a gaming system and a computer to display Green Racing in action. The simulator, created by Danny Bocci, is based upon the recently released game Gran Tourismo 5 for the Playstation 3, with additional computers wrapping around every aspect of the game to provide the true green technology experience to the driver. While driving, the computer also monitors the racer's every move to measure how green and how fast they really are.

"This simulation is a great way to teach folks about sustainable racing in a way they'll remember. Hopefully, this experience will be a takeaway that will influence their transportation decisions in the future," said Bocci.

The simulator has graphics to display the race car's speed, indicators of when the hybrid system is using regenerative braking and boost, a "Hybrid Energy" gauge to show the amount of energy stored and available, and additional gauges to display the amount of nonrenewable petroleum that is being consumed.

The simulator also imitates the way hybrid powertrains use regenerative braking, which stores some of the energy from braking to be used later. "As the racer applies the brakes, kinetic energy is stored and reused when the driver presses a button on the steering wheel to increase the race car's acceleration until all of the energy is depleted," said Forrest Jehlik.

Using real race engine data, the simulator also calculates the amount of petroleum fuel consumed for both E85 and race fuel, and uses the MICHELIN® GREEN X® Challenge criteria to calculate the "green" scores for driving based on how much petroleum the driver saves using the hybrid system. The score is flashed on the final screen after the race is complete, the lowest score being the winner.

Artist's mockup of future Green Racing Simulator Trailer

The simulator consists of gaming equipment to give a virtual racing experience.

Coming Soon: Green Racing Simulator Trailer Exhibit

The Green Racing Simulator will soon come to a racetrack near you in an exciting trailer exhibit. Experience the simulator, learn about green racing, and receive a customized lanyard of your experience imprinted with your name and best race time. To learn where the trailer will be, visit www.transportation.anl.gov/green_racing/. The trailer is supported by both the U.S. Department of Energy and the U.S. Environmental Protection Agency.

The Green Racing Simulator and Green Racing Simulator Trailer Exhibit are part of Argonne's educational outreach effort to consumers, teaching about green vehicle technologies and aiming to promote the reduction of petroleum use in the U.S.

Funding for simulator work is being provided by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy, Vehicle Technologies Program under the direction of Lee Slezak.

For more information, contact
Forrest Jehlik
fjehlik@anl.gov

Learn more about Argonne's Green Racing Efforts:
www.transportation.anl.gov/green_racing/

EcoCAR Tackles Dynamometer Testing at the Year Three Spring Workshop

By Dana Bubonovich, Assistant Communications Specialist, EcoCAR, Argonne National Laboratory

Participants from the sixteen EcoCAR teams at the 2011 Spring Workshop.

In March, sixteen EcoCAR teams from various universities traveled to Ann Arbor, Mich., to attend the two-week Spring Workshop hosted by the U.S. Environmental Protection Agency (EPA) at its National Vehicle and Fuel Emissions Laboratory (NVFEL).

During this time, each EcoCAR team tested its vehicle on a chassis dynamometer. Prior to the start of the workshop, each team put together a test plan describing the drive cycles on which its vehicle would be tested. Possible drive cycles included EPA certification-type cycles, such as cold-start and hot-start Urban Dynamometer Driving Schedule (UDDS) and highway driving cycles.

Before dyno testing, each team underwent a rigorous 300-point safety technical inspection performed by staff from Argonne National Laboratory, General Motors and the U.S. Department of Energy (DOE).

Upon passing inspection, teams then completed two four-hour testing sessions that evaluated their emissions and fuel energy consumption. The first session evaluated the team's powertrain according to its test plan. The second included a cold test Federal Test Procedure followed by two highway drive cycles.

"The opportunity that EPA has provided us in testing EcoCAR vehicles at their facility offers the students invaluable hands-on experience and further exemplifies the importance of partnership between government, industry and academia," said Kristen De La Rosa, Argonne's EcoCAR director.

At end of the workshop, ten EcoCAR teams completed the dyno testing. Most of these teams performed engine tuning optimizations, baseline testing and testing of various exhaust after-treatment systems that reduce emissions. Some teams like Penn State, Mississippi State and Virginia Tech completed Full-Charge Test sets of repeating UDDS cycles for plug-in hybrid electric vehicles to generate research data for EPA and the DOE. The University of Ontario Institute of Technology's vehicle, a full-function electric vehicle, was able to achieve 223 miles on a single charge during a battery depletion test.

During the workshop, teams also toured the General Motors Proving Ground and A123 Systems laboratory and manufacturing facilities, attended presentations on the upcoming Year Three Final Competition and gave presentations on their outreach programs to competition judges.

For more information, contact
Kristen De La Rosa
kdelarosa@anl.gov

Engineer Honored with EPA's Outstanding Research Award

In March 2011, Argonne engineer Henning Lohse-Busch was awarded the Outstanding Researcher Award by the U.S. Environmental Protection Agency (EPA) at the Year Three EcoCAR Spring Workshop hosted at EPA's National Vehicle and Fuel Emissions Laboratory (NVFEL) in Ann Arbor, Mich. He received the award to acknowledge his efforts and the collaboration between Argonne and EPA at the Workshop. This intergovernmental agency recognition was to acknowledge fuel economy and emissions chassis dynamometer testing guidance of advanced automotive technology vehicles.

> "Their partnership in explaining the technical depth of testing was well received and the students learned so much from their time testing in the lab."

Lohse-Busch, a principal mechanical engineer at Argonne National Laboratory, and Tom Schrodt, a senior project engineer at NVFEL, were recognized for their contributions to the success of the EcoCAR Spring Workshop.

"Their partnership in explaining the technical depth of testing was well received and the students learned so much from their time testing in the lab," said Maria Peralta, manager of the Compliance and Development Testing Group at NVFEL. "They both bring their areas of expertise to the table for a great pairing between energy and power and emissions that really address the goals of EcoCAR."

Lohse-Busch and Schrodt were able to work with students on their dynamometer testing plans prior to the workshop and then implement those plans. Test drivers followed a series of cold- and hot-start urban and highway drive cycles, which EPA established to emulate real-world drive patterns. This was the first opportunity for many of the students to participate in controlled, dynamometer testing, which provided an assessment of vehicle performance and fuel consumption for future vehicle and controls refinement.

"The energy, talent and enthusiasm the students bring to the program is inspirational," said Schrodt. "I've also learned a lot about the complexities and possibilities of emerging vehicle technology from the students. This knowledge will continue to benefit me as I move forward with my own career."

Dyno testing at the Spring Workshop could have not been possible without Lohse-Busch, Schrodt, and others at General Motors, the U.S. Department of Energy, Argonne, and NVFEL.

From left to right: Henning Lohse-Busch (Argonne), Maria Peralta (NFVEL), Tom Schrodt (NFVEL).

"The award is an amazing recognition of our efforts to impact, guide, and develop the next generation of highly skilled engineers," said Lohse-Busch. "These new engineers will solve the challenges facing the automotive ecosystem, which stands at the beginning of a true and fundamental powertrain revolution."

For more information, contact
Henning Lohse-Busch
hlb@anl.gov

In the News

Here's a taste of Argonne's transportation news stories as published across the nation. See more stories at http://www.transportation.anl.gov/media_center/press_coverage.html.

MARCH 2011

Don Hillebrand was featured on PBS's *Nightly Business Report* in a segment called "EV's Impact on the Power Grid." Watch the video and read the transcript at http://www.pbs.org/nbr/site/onair/transcripts/ev_impact_on_power_grid_110330/.

Jeff Chamberlain

Jeff Chamberlain is quoted in the article, "Building Better Batteries for Electric Cars," in the *New York Times*. Read the article at http://www.nytimes.com/2011/03/31/business/energy-environment/31BATTERIES.html?_r=3&src=busln.

Forrest Jehlik writes to Chicago in the article, "Dear Chicago: Green the Fleet" on the *WBEZ 91.5* website. Read his letter at http://www.wbez.org/story/election-2011/dear-chicago/dear-chicago-green-fleet-84251#.

Michael Thackeray talks to the University of Chicago about Argonne's battery technology licensing efforts with GM and LGChem. Read the article at http://magazine.uchicago.edu/1104/chicago_journal/battery-power.shtml.

Argonne's lithium-ion battery technology is referenced by U.S. Department of Energy (DOE) Secretary Chu in the article, "How National Security Depends on Better Lithium Batteries," in *Scientific American*. View the complete article at http://www.scientificamerican.com/article.cfm?id=how-national-security-depends-on-better-batteries.

DOE Secretary Chu mentions **Argonne's GM licensing** in the *CNET* article, "Chu Calls for Comeback in U.S. Energy Tech," viewable at http://news.cnet.com/8301-11128_3-20037666-54.html.

FEBRUARY 2011

Jeff Chamberlain was interviewed on the U.S. DOE's *ENERGYBLOG* about "Argonne Lab's Breakthrough Cathode Technology Powers Electric Vehicles of Today." See the complete interview at http://blog.energy.gov/blog/2011/02/14/argonne-lab%E2%80%99s-breakthrough-cathode-technology-powers-electric-vehicles-today.

Don Hillebrand discussed transportation technology on *The Promise of Tomorrow* radio show. Listen to the show at http://www.promiseoftomorrow.biz/bizradio/021411/021411.htm.

JANUARY 2011

Ted Bohn was interviewed by the *National Fire Protection Association (NFPA) Journal* for the article, "Taking Charge." The story discusses training emergency responders and preparing the nation's electrical infrastructure for the emergence of more electric vehicles on U.S. roadways. Read the article at http://www.nfpa.org/publicJournalDetail.asp?categoryID=2123&itemID=50002.

Ted Bohn

Linda Gaines was quoted in the article, "5 Concerns about Electric-Car Batteries," in *MSN TreeHugger* at http://editorial.autos.msn.com/article.aspx?ucsort=1&cp-documentid=1176838.

Ann Schlenker co-authored the article "Plug into the Future" for *IEEE Magazine*. Read the article at http://www.promiseoftomorrow.biz/bizradio/021411/021411.htm.

Forrest Jehlik was interviewed by *Ethanol Producer Magazine* on "Green Flags for E85." Read the interview at http://www.ethanolproducer.com/articles/7396/green-flags-for-e85.

Continues on page 18 ▸▸

Steve Plotkin talked to *Physics Today* about reducing carbon dioxide emissions. Read the article at http://blogs.physicstoday.org/politics/2011/01/cutting-co2-transportation-emi.html.

Argonne Laboratory Director **Eric Isaacs** authored the *Huffington Post* op-ed titled, "Putting the Power of Science Into the Electric Car." Read it at http://www.huffingtonpost.com/eric-d-isaacs/putting-the-power-of-scie_b_807129.html.

Eric Isaacs

Ted Bohn was quoted in an article in *Technology Review* about the battery-ultracapacitor hybrid vehicle. Read the article at http://www.technologyreview.com/energy/27045/?p1=A1&a=f.

Mike Duoba is interviewed in the *Bloomberg* article, "Toyota Readying Motors That Don't Use Rare Earths." Read it at http://www.bloomberg.com/news/2011-01-14/toyota-readying-electric-motors-that-don-t-use-rare-earths.html.

DECEMBER 2010

Pat Davis of the U.S. DOE's Vehicle Technologies Program was interviewed on the facts of electric vehicles on the DOE *ENERGYBLOG*. Read the interview at http://blog.energy.gov/blog/2010/12/22/facts-electric-vehicles-interview-pat-davis.

On *WIRED's Autopia* blog, **Aymeric Rousseau** talks about Autonomie. Read the blog post at http://www.wired.com/autopia/2010/12/automakers-plug-and-play-with-autonomie/.

Will Elias is quoted on Argonne's battery research in the *R&D Mag* article, "New Economy, New Playbook." Read the article here: http://www.rdmag.com/Featured-Articles/2010/12/Policy-And-Industry-Government-Funding-New-Economy-New-Playbook-Part-6/.

OCTOBER 2010

Forrest Jehlik blogs about his work with green racing on *WIRED's Autopia*. Read the blog post at http://www.wired.com/autopia/2010/10/argonne-national-laboratory-project-green/.

Forrest Jehlik

Ted Bohn is quoted in the *CNN* article, "The New Fear:Electric Car Range Anxiety." Read the article at http://www.cnn.com/2010/US/10/18/ev.charging.stations/index.html.

Jeff Chamberlain is quoted in the *Foreign Policy* article, "The Great Battery Race," about U.S. progress versus that of China. Read the article at http://www.foreignpolicy.com/articles/2010/10/11/the_great_battery_race?page=full.

George Fenske is quoted on fighting friction in the *C&EN* cover story. The story can be viewed at http://pubs.acs.org/cen/coverstory/88/8841cover.html.

Steve Ciatti is interviewed on diesel technology by *Sports Car Illustrated*. Watch the interview at http://www.youtube.com/watch?v=Z1-agmOzfIU.

Steve Ciatti

FASTRAX

APRIL 2011

Resin wafer electrodeionization technology developed by **Seth Snyder** and his group was licensed to Nalco Company, Naperville, Ill. The technology will help significantly reduce the cost of producing clean energy and of the chemicals and water used in industry. The separations technology can process biomass-based feedstocks into biofuels and chemicals.

Seth Snyder

Essam M. El-Hannouny acted as an organizer for the Fuel Injection and Sprays technical session at the Society of Automotive Engineers (SAE) World Congress, Detroit, Mich. This session is devoted to experimental and computational work in the area of diesel fuel injection systems and sprays. View the complete session schedule at http://www.sae.org/servlets/techSession?EVT_NAME=PFL210&GROUP_CD=TSESS&SCHED_NUM=190259&tab=sessionDetails&REQUEST_TYPE=SESSION_DETAILS.

Thomas Wallner received the Lloyd L. Withrow Distinguished Speaker Award at the 2011 SAE World Congress in Detroit, Mich. This honor is conferred upon those speakers at SAE meetings who have received the Oral Presentation Award more than twice over the past years.

MARCH 2011

The Argonne transportation research team of **Michael Duoba**, **Glenn Keller**, **Henning Lohse-Busch**, **Danny Bocci**, **Michael Kern**, **Dave Bell**, **Geoff Amann**, **Eric Rask** and **Dave Shimcoski** received an Argonne Pacesetter Award for going "above and beyond" in the planning, organization, research, engagement and execution of validation testing of high fuel-efficient vehicles for the U.S. Department of Energy (DOE) in support of the Progressive Insurance Automotive X Prize $10M competition. The expertise contributed to this endeavor allowed seamless testing of nontraditional vehicles (2-wheeled, 3-wheeled and 4-wheeled) with accurate and consistent results.

Researchers receive Argonne Pacesetter Award. Back row, left to right: Larry Johnson (award presenter); Dave Bell, Dave Shimcoski, Henning Lohse-Busch, Eric Rask (recipients); Pam Sydelko, Ann Schlenker (presenters). Front row, left to right: Danny Bocci, Geoff Amann, Mike Kern, Mike Duoba (recipients).

Renee Nault, **Jim Collins** and **Else Tennessen** received an Award of Excellence for the news magazine TransForum from the Society for Technical Communication (STC). An award of excellence reflects a major achievement in writing, editing and design. The award was presented at the STC's March banquet in Chicago, Ill.

Linda Gaines presented her talk, "How Green is Battery Recycling?" at the 28th International Battery Seminar and Exhibit in Fort Lauderdale, Fla.

John Sullivan presented his paper, "Role of Recycling in the Life Cycle of Batteries," at the TMS (The Minerals, Metals and Materials Society) Annual Meeting held in San Diego, Calif., on March 2.

Ted Bohn participated in an interactive seminar titled, "Towards a Secure, Wireless-Based, Home Area Network for Metering in Smart Grids." This March 1 seminar was hosted by the Power Systems Engineering Research Center (PSERC), was comprised of 13 university and 40 industry members, and focused on engineering the future electric energy system.

Continues on page 20 ▸▸

Argonne Vehicle Testing and Analysis Section staff members provided technical support to the EcoCAR Challenge Workshop held at the U.S. Environmental Protection Agency's National Vehicle and Fuel Emission Laboratory (EPA NVFEL) test facilities in Ann Arbor, Mich., March 7-17.

Mike Duoba participated in the ISO HEV Testing Procedures and Standards Committee meeting in Paris, France and the IEA Vehicle Systems Annex meeting in Geneva, Switzerland. In both forums, discussion centered on the need for harmonized test procedures and standards to assist in promoting the adoption and global marketability of electrified vehicles.

Mike Duoba

FEBRUARY 2011

Linda Gaines gave a seminar titled "How Can We Supply Personal Transportation with Minimal Impacts?" at the Rochester Institute of Technology, Rochester, N.Y., on February 16.

Seth Snyder was elected president of the Council for Chemical Research (CCR). Snyder has been active within CCR since 1996. He was voted onto the Governing Board in 2006 and served as second vice chair and chair in 2008 and 2010, respectively. As president, Snyder will communicate the CCR mission, engage CCR members to support their participation, and grow and expand the organization to achieve a stronger voice, thereby promoting CCR's mission and advancing the chemical enterprise.

Forrest Jehlik represented Argonne at the U.S. DOE-Canada Clean Energy Dialogue meetings in Washington, D.C., to discuss collaboration synergies between the two countries. Collaborations include hybrid and electric systems, materials technology, fuels and combustion, and fuel cells.

At Argonne's Introduce a Girl to Engineering Day, **Center for Transportation research staff** explained the role of the Advanced Powertrain Research Facility in the development of advanced powertrain technologies that will contribute to petroleum displacement and sustainable transportation.

Eric Rask and **Mike Duoba** participated in the SAE 2011 Hybrid Vehicle Technologies Symposium held in Anaheim, Calif. Duoba presented his talk, "Beyond MPG: Characterizing and Conveying the Efficiency of Advanced Plug-In Vehicles," and Rask spoke on "Codes and Standards: Global Harmonization."

Eric Isaacs, director of Argonne National Laboratory, gave a keynote address at the Feb. 8 Energy Security Initiative at the Brookings Institution, Washington, D.C. The Initiative examined vehicle battery technology, specifically the status of technology development, the major challenges in moving the various designs to the marketplace, and what policies and incentives are needed to commercialize the technologies and expand electrification of vehicle transportation.

Oyelayo O. Ajayi was made a Fellow of the Society of Tribologists and Lubrication Engineers (STLE). The STLE states that "Fellow members shall be persons of outstanding personal achievement in the field of lubrication, shall have 20 years of active practice in the science and/or engineering profession, and shall have been a member of the society for 10 years. Recognized outstanding contributions in either management, education, research or technological areas in the tribology field constitute outstanding personal achievement."

Oyelayo O. Ajayi

Argonne hosted representatives from Normal, Ill., on February 22 who discussed their plans to introduce 1,000 electric vehicles over the next three years to the twin cities of Bloomington/Normal in mid-state Illinois. Discussions included vehicle acquisition plans for commercial and private owners, charging infrastructure issues, consumer education, and potential incentives.

JANUARY 2011

Jules Routbort was an invited session chair and speaker at the 35th International Conference on Advanced Ceramics and Composites in Daytona Beach, Fl. He chaired the session, "Power Required to Pump Ceramic-Based Nanofluids." He co-authored papers with **Elena Timofeeva** on "Engineering the Heat Transfer of Nanofluids: The Efficiency Approach," and **Dieter Gruen**, "Optimization of Electronic Entropy and Energy Transport: A Novel Approach to High ZT Materials."

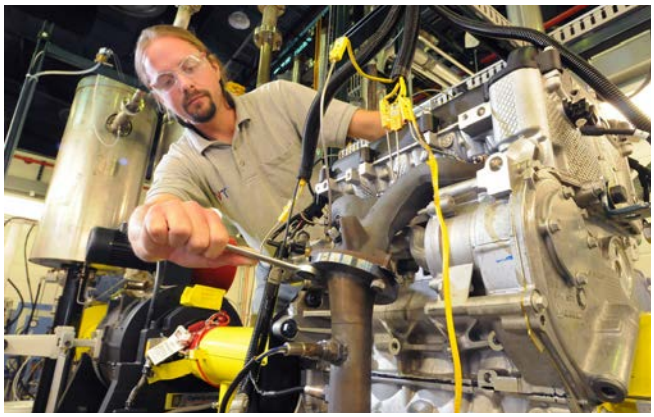
Linda Gaines gave a poster presentation, "Life Cycle Analysis for Lithium-Ion Battery Production and Recycling," at the Transportation Research Board Annual Meeting in Washington, D.C. A paper based on this poster has been selected for publication in *Transportation Research Review*.

Kristen Pappacena presented her paper, "Processing and Tribological Properties of MoN/Cu Coatings," co-authored with **Dileep Singh**, **Oyelayo Ajayi**, **Jules Routbort** and **Osman Eryilmaz**, at the Advanced Ceramics and Composites Conference in Daytona Beach, Fla., on January 23-28.

Aymeric Rousseau

Aymeric Rousseau, developer of Autonomie, released the Autonomie Demonstration Tool (www.autonomie.net/demo.html) and the Heavy Duty Labeling Tool developed in collaboration with the European Automobile Manufacturers' Association (www.autonomie.net/labeling_tool.html)

Thomas Wallner presented his paper, "Efficiency and Emissions Potential of Hydrogen Internal Combustion Engine Vehicles" at the Symposium on International Automotive Technology 2011 Conference in Pune, India.



Thomas Wallner

Don Hillebrand, director of the Center for Transportation Research, served as a panelist on the Green Car Summit at this year's Washington Auto Show held in Washington, D.C., Jan. 28 – Feb. 6.

DECEMBER 2010

Mike Duoba, a principal mechanical engineer at Argonne, was awarded the 2010 Henry Souther Standards Award for his work on advanced transportation technologies standards, such as Society of Automotive Engineers (SAE) J1711.

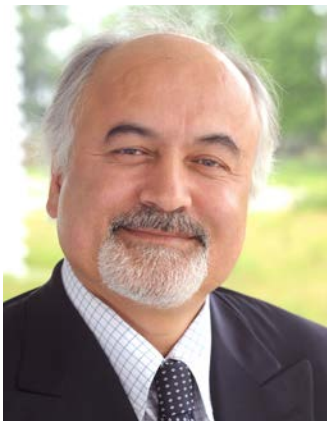
NOVEMBER 2010

Jules Routbort was an invited speaker at The Ohio State University's Chemistry Department. His talk was titled, "Nano-ceramics (Al_2O_3 and SiC) as Additives for Heat Transfer Fluids."

Linda Gaines gave her invited talk, "Life Cycle Analysis for Lithium-Ion Battery Production and Recycling," at the Metal Kokkola 2010 conference in Kokkola, Finland.

Continues on page 22 ▸▸

Ali Erdemir was inaugurated as a Fellow in the American Vacuum Society (AVS). The AVS is a not-for-profit organization that promotes communication, education, networking, recommended practices, research, and the dissemination of knowledge on an international scale, in the application of vacuum and other controlled environments to understand and develop interfaces, new materials, processes and devices through the interaction of science and technology.



Ali Erdemir

Jules Roubort participated in the 3rd International Congress on Ceramics held in Osaka, Japan. He served as a session chair and was invited to present his work, "Nano-ceramics (Al_2O_3 and SiC) as Additives for Heat Transfer Fluids." He also presented "Optimization of an LSAM Electroceramic for Use in Oxygen and NO_x Sensors," co-authored with **Kristen Pappacena** and **Dileep Singh,** and "Residual Stresses and Adhesion Energy Measurements in Thin Tribological Coatings," co-authored with **Kristen Pappacena** and **Osman Eryilmaz**.

Jeff Chamberlain testified before Congress on grid technology on November 15. He participated in the House Committee on Science and Technology Field Hearing on options and opportunities for on-site renewable energy integration. Read the transcript at http://www.anl.gov/Media_Center/News/2010/ChamberlainHouseTestimony.html.

TransForum Wins STC Award

Argonne National Laboratory is proud to announce that *TransForum* won an award of Excellence in the 2010 Society for Technical Communication (STC) Chicago Chapter's publications competition.

One judge commented, "I was drawn to the articles because of the graphics and simple format for the complex content…I learned more than I expected. This is a significant endeavor to inform the public on how tax money is being spent."

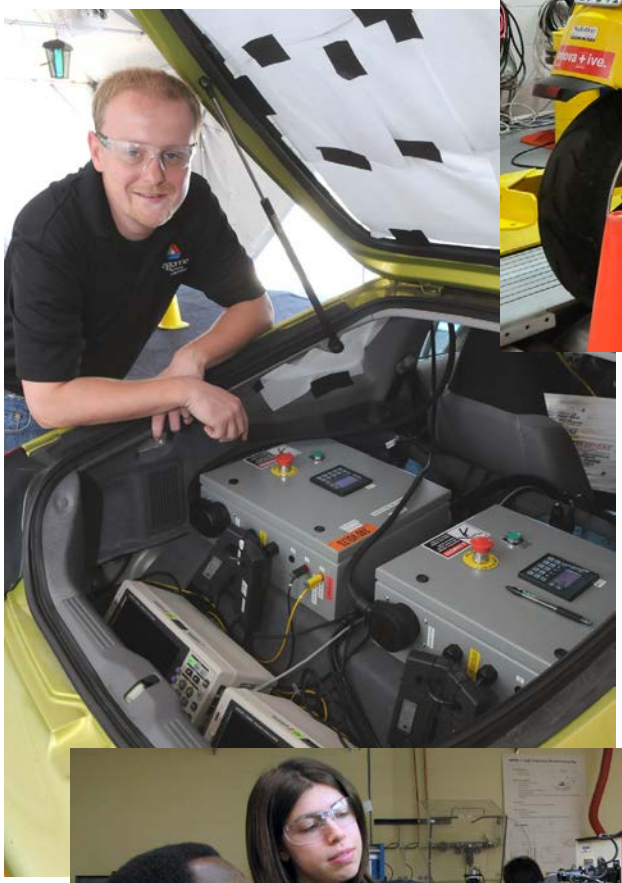
TransForum was developed to highlight the latest in Argonne's transportation research. It debuted in the winter of 1998 as an eight-page, two-color printed newsletter.

Society for Technical Communication

This is the second time that *TransForum* has received an STC award. In 2000, it received an award of Merit. View all issues of *TransForum* here: http://www.transportation.anl.gov/publications/transforum/index.html

PARTING SHOTS

Below, Argonne researcher Henning Lohse-Busch monitors high-precision charging equipment for result accuracy, redundancy and safety during Automotive X Prize validation testing at the laboratory's Advanced Powertrain Research Facility (APRF).



Above, Argonne researcher Geoffrey Amann prepares the E-Tracer 79 for testing at the laboratory's APRF. In August 2010, APRF researchers provided validation testing for the finalists in Progressive Insurance's Automotive X Prize Competition to determine they met the competition's goals for performance and efficiency targets.

Above, Argonne researcher Bob Larsen explains the Green Racing Simulator to budding young drivers. Photo courtesy of American LeMans Series.

Above, Argonne tribology scientist Oyelayo Ajayi (left) and research aide Ashley Masoner use a block-on-ring test machine to study a type of engine and drivetrain failure, known as scuffing or galling, which occurs under severe contact at high loads and speeds.

Argonne NATIONAL LABORATORY
9700 South Cass Avenue
Argonne, IL 60439

Non-Profit Organization
U.S. Postage Paid
Lemont, IL
Permit No. 87

PUTTING ARGONNE'S RESOURCES TO WORK FOR YOU

Industrial technology development is an important way for the national laboratories to transfer the benefits of publicly funded research to industry to help strengthen the nation's technology base. The stories highlighted in this issue of TransForum represent some of the ways Argonne works with the transportation industry to improve processes, create products and markets, and lead the way to cost-effective transportation solutions, which in turn lead to a healthier economic future.

By working with Argonne through various types of cost-sharing arrangements, companies can jump-start their efforts to develop the next generation of transportation technologies without shouldering the often prohibitive cost of initial R&D alone. Argonne has participated in dozens of these partnerships and has even been involved in helping to launch start-up companies based on the products and technologies developed here.

If working with world-class scientists and engineers, having access to state-of-the-art user facilities and resources, and leveraging your company's own capabilities sound like good business opportunities to you, please contact our Technology Development and Commercialization Division and see how we can put our resources to work for you.

Technology Development and Commercialization
Argonne National Laboratory, Bldg. 201
9700 South Cass Avenue, Argonne, IL 60439
800.627.2596
partners@anl.gov
www.anl.gov/techtransfer

www.transportation.anl.gov

Scan with any barcode scanner on your smartphone.

TransForum » Volume 11, No. 1, Spring 2011
ISSN 2156-3594 (print)
ISSN 2156-373X (online)

Editor: Else Tennessen
Associate Editor: Jim Collins
Designer: Cindi Andersen
Contributors: Dana Bubonovich, Angela Hardin, Ron Kulak, Louise Lerner and Steven Plotkin.

TransForum is published by the Transportation Technology R&D Center, Argonne National Laboratory. Publishing support services are provided by Argonne's Technical Services Division.

Else M. Tennessen
TransForum
Argonne National Laboratory
9700 South Cass Avenue, Bldg. 362
Argonne, IL 60439-4815
630.252.8170
etennessen@anl.gov

U.S. DEPARTMENT OF ENERGY

Argonne National Laboratory is a U.S. Department of Energy laboratory managed by UChicago Argonne, LLC.