

TransForum

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RESEARCH REVIEWS

- 2 China's Minister of Science and Technology Visits Argonne
- 3 Argonne Researchers Recharge Plug-in Vehicle Standards
- 4 Different Energy Mixes Will Fuel Plug-in Hybrid Cars
- 6 Green Car of the Year Tour™ Visits Argonne
- 7 Transportation Gets "Wired"
- 8 Argonne Provides Technical Support for Auto X Prize Competition
- 10 Plug and Play with Autonomie
- 11 Facility Spotlight: Battery-in-the-Loop
- 12 TRACC Keeps Transportation Analysis "On Track"
- 14 Argonne Achieves Dramatic Improvement in Low-Temperature Engine Combustion
- 15 Could a Diesel Engine Run on Gasoline?
- 16 The Green Racing Paradox
- 19 **IN THE NEWS**
- 22 **FASTRAX**
- 24 **PUTTING ARGONNE'S RESOURCES TO WORK FOR YOU**



Autonomie Launches page 10

China's Minister of Science and Technology Visits Argonne

Wan Gang, Minister of Science and Technology of the People's Republic of China, visited Argonne on July 21 to learn about the laboratory's transportation research program. Wan Gang was accompanied by David Sandalow, Assistant Secretary for Policy and International Affairs, U.S. Department of Energy (DOE).



Wan Gang, Minister of Science and Technology, discusses China's New Energy Vehicle Program with David Sandalow, Assistant Secretary for Policy and International Affairs, U.S. Department of Energy.

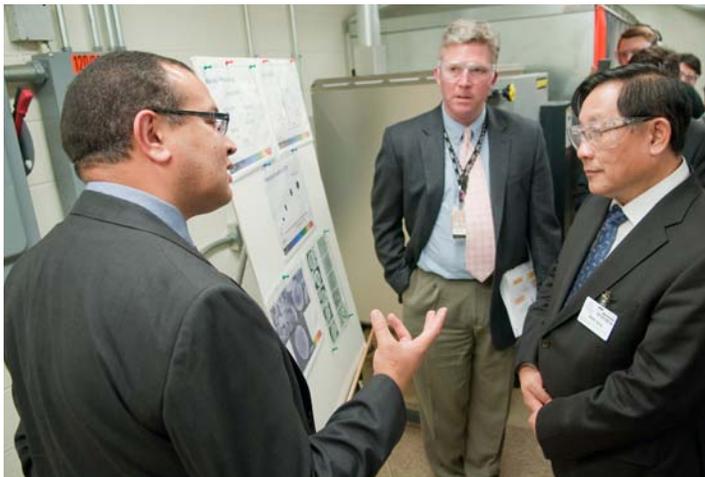
The visit consisted of an overview of Argonne by Al Sattelberger, associate laboratory director for Energy Engineering and Systems Analysis, a tour of Argonne's advanced battery research facilities, a visit to the vehicle and engine dynamometer labs, and a stop at the Advanced Photon Source for X-ray and transportation research highlights.

Wan is an expert on automobiles, and was the president of Tongji University. He was appointed the Minister of Science and Technology of the People's Republic of China on April 27, 2007.

Speaking through a translator, Wan said, "The development of clean and electric vehicles is a national strategic emerging industry...we will devote every effort to promote this industry."

Wan continued, "China is devoted to cutting emissions and saving energy...to realize these goals and commitments, we have to develop clean and electric vehicles. China and the United States both have these national priorities and will work together closely on their common goals."

Representatives from DOE, Argonne and the Chinese Ministry of Science and Technology met again in late August.



Argonne materials scientist Khalil Amine (left) explains Argonne's battery research program to Wan Gang (right) while Argonne's Jeff Chamberlain, Lead, Energy Storage Initiative, looks on.



Mechanical engineer Thomas Wallner (left) describes Argonne's engine work to Wan Gang (center) and David Sandalow of DOE.

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Argonne Researchers Recharge Plug-in Vehicle Standards

After years of work, Argonne transportation researchers have successfully led the revision of test procedures that will help to better evaluate hybrid and plug-in hybrid electric vehicle (PHEV) technologies.

For the past three years, Mike Duoba, a principal mechanical engineer in Argonne's Transportation Technology R&D Center, chaired the SAE International (Society of Automotive Engineers) task force charged with updating SAE J1711, the revised recommended practice for figuring out the fuel economy and exhaust emissions test procedures of hybrids and PHEVs. This summer, SAE members approved the update during a two-phase voting process.

This important accomplishment will encourage and support the nation's move to electrified vehicles for petroleum savings.

"Until now, the fuel economy claims for plug-in hybrids were not calculated according to similar procedures, making car-to-car comparisons virtually impossible," Duoba said. "What makes this procedure—and other SAE-developed recommended practices—significant is that EPA typically considers them as the basis for the automotive regulations it promulgates." Ultimately, the consumer benefits with valuable vehicle information that can help guide a purchase.

The U.S. Environmental Protection Agency has recently issued proposed rulemaking for reporting the fuel economy of advanced vehicles that references SAE J1711 on many of the technical procedures required for PHEV testing. The use of "utility factors" to derive final results was also taken from the Argonne-led SAE committee work.

Argonne's experienced automotive research staff conducted several hundred tests on PHEVs in the lab's state-of-the-art Advanced Powertrain Research Facility (APRF) during the development of this recommended practice. (The APRF is DOE's principal facility for assessing advanced vehicle technologies.)



Engineer Mike Duoba tests an all-electric Tesla at Argonne's Advanced Powertrain Research Facility. Argonne's work with the Tesla continues its support in revising the Society of Automotive Engineers (SAE) J1634 standard on electric vehicle testing.

With the completion of SAE J1711, Duoba and his colleagues are now focused on supporting the revision of testing standards for all-electric vehicles, known as SAE J1634. The development of this standard may be finished by year's end, with voting by SAE members to take place shortly thereafter, Duoba said.

To help in that task, Argonne automotive researchers are in the process of testing many electric vehicles to generate a test procedure that is unbiased from the technology in the vehicle. As a neutrally positioned research organization, Argonne's technical leadership in this and other SAE recommended practices provide assurance to stakeholders—including the automotive industry, suppliers and EPA with other regulators—that a standard's development was handled in an unbiased manner.

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

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Different Energy Mixes Will Fuel Plug-in Hybrid Vehicles

Few drivers know exactly which well in which country their gasoline comes from, and from an environmental standpoint, it doesn't matter. Burning petroleum from anywhere in the world releases large amounts of harmful greenhouse gases into the atmosphere.

However, the development of market-ready plug-in hybrid electric vehicles (PHEVs) will change this calculation. Unlike petroleum, which comes almost uniformly from drilled wells, the electricity that PHEVs will consume comes from a variety of natural resources: wind and solar energy, nuclear power, coal and natural gas.

The production and distribution processes for each of these different sources of electricity results in different quantities of greenhouse gas emissions, and therefore each has a markedly different impact on the environment. Scientists at Argonne National Laboratory have begun to examine the precise effect of this portfolio of PHEV fuel sources on our world.

Led by engineers Michael Wang and Amgad Elgowainy, an Argonne team expanded and used the laboratory's Greenhouse Gases, Regulated Emissions and Energy Use in Transportation (GREET) model to assess which types of power plants are likely to satisfy the additional electrical demand that PHEVs will present in different parts of the U.S. Although hybrids emit fewer greenhouse gases, and are therefore more environmentally friendly, the Argonne model shows a remarkable result for electrified vehicles.

Although the increased demand for electricity by PHEVs is small relative to the quantity of electricity we already consume, this increased demand could produce very different greenhouse gas effects in each region of the country. Meeting the new demand of PHEVs in Illinois would likely require an increase in the generation of coal-generated power, while in the Northeast or California the same demand would be met by plants that burn cleaner natural gas. In the absence of new construction, nuclear power plants would be unlikely to meet much of the additional demand represented by PHEVs because current facilities already generally operate close to their capacity, according to Elgowainy.

"The development and production of more plug-in hybrid vehicles will definitely help ease America's dependence on foreign oil and improve our national security," said Elgowainy. "It's important that we also address how they will change the amount of greenhouse gas emissions coming from the transportation sector."

The Argonne researchers also looked at how different patterns of behavior for charging these hybrids would impact the total demand on the electric grid. They assumed that PHEV owners would likely charge their vehicles overnight, when they won't be driving and energy is cheapest. Under this paradigm, more and more fossil-based power plants would be brought online to handle the additional demand represented by vehicle charging. For regions with a large share of coal-power generation, the additional electricity generated to recharge PHEVs could result in increased greenhouse gas emissions, in amounts comparable to conventional gasoline-powered vehicles.

However, the researchers also considered a different case—one in which many drivers chose to charge their batteries in the middle of the day. In this scenario, the additional electrical demand would likely be met by different power plants such as natural gas plants—which would result in less greenhouse gas emissions, comparable to grid-independent hybrid vehicles, which generate electricity from the act of braking.

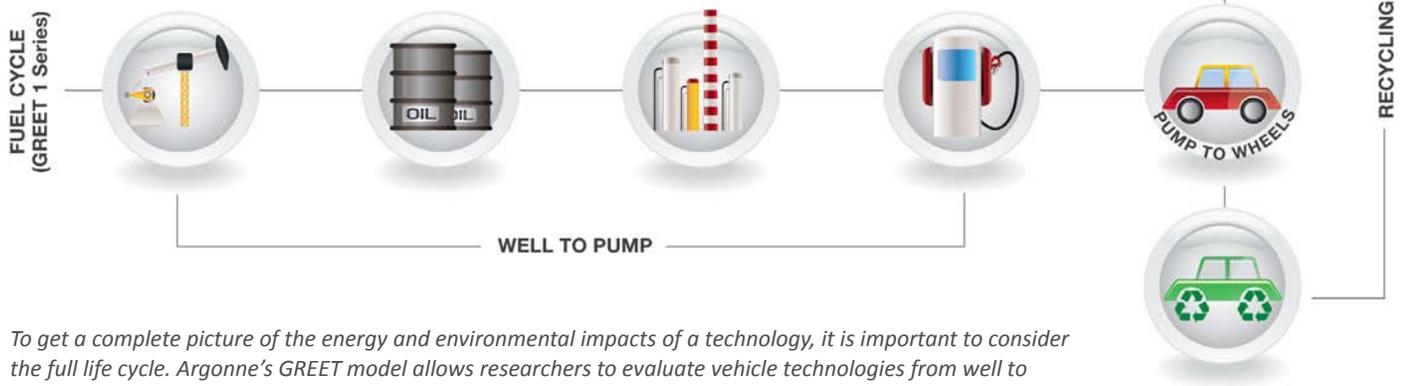
"The decision to plug in a hybrid at a different time of the day could change the energy resource used to power it," Wang said. "Ultimately, this could alter the economic and environmental effects of owning a plug-in hybrid."

As the United States transforms its energy portfolio from one based on fossil fuels to one that relies on renewable power sources, PHEVs will, in turn, become more environmentally friendly. "As we electrify America's transportation infrastructure, we must also strive to find cleaner sources of energy to supply the increased demand," Wang said.

Funding and support for this research is provided by the Vehicle Technologies Program, the Fuel Cell Technologies Program, and the Biomass Program of the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy.



Researcher Michael Wang works on Argonne’s GREET model. The auto industry and governmental agencies maintain that GREET has become the “gold standard” for well-to-wheel analyses of vehicle and fuel systems.



To get a complete picture of the energy and environmental impacts of a technology, it is important to consider the full life cycle. Argonne’s GREET model allows researchers to evaluate vehicle technologies from well to wheels for fuels and from raw material mining to vehicle disposal for automobiles. GREET has over 14,000 registered users. To download a copy, go to <http://greet.es.anl.gov>.

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www.transportation.anl.gov/pdfs/TA/629.PDF

Green Car of the Year™ Tour Visits Argonne

Green Car Journal's first-ever Green Car of the Year Tour™ made a stop at Argonne National Laboratory on August 20 for a media event that included tours and presentations on the laboratory's transportation research program.

Researchers from Argonne's Transportation Technology R&D Center shared information about their clean diesel technology and fuels work plus other research on advanced and efficient powertrains. Visitors drove Tour cars, attended presentations by Argonne researchers and took tours of the lab's advanced vehicle technologies facilities.

This initial Green Car of the Year Tour™ stop offered media the chance to drive this year's winner, the Audi A3 TDI, as well as some of the other most celebrated diesel models in the U.S. market. Audi, Volkswagen, and Bosch participated in the Green Car of the Year Tour™ activities at Argonne.



Argonne's Deputy Division Director Don Hillebrand (left) talks with Ron Cogan, editor and publisher of Green Car Journal, at the Green Car of the Year media event. This year's winning car, the Audi A3 TDI, was showcased at the Argonne event.

The Audi A3 TDI achieves an EPA-estimated 42 mpg highway fuel economy, resulting in reduced petroleum use and significantly lower CO₂ greenhouse gas emissions.

"The growing importance of clean diesel vehicles in the U.S. is clear," said Ron Cogan, editor and publisher of *Green Car Journal* and editor of GreenCar.com. "In an era where exotic and expensive technologies are often discussed as exclusive answers to our transportation challenges, today's modern diesel technology can bring an average 25 percent reduction in CO₂ emissions and 30 percent better fuel efficiency now, at reasonable cost and proven durability."

The Green Car of the Year Tour™ is sponsored by Robert Bosch LLC.



The Green Car of the Year winner, the Audi A3 TDI, was showcased at the Argonne event.



Argonne mechanical engineer Thomas Wallner leads a tour of the laboratory's transportation research facilities.

Argonne's transportation research is supported by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy, Vehicle Technologies Program.

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Green Car of the Year Tour™ website: www.greencar.com

Video: www.voanews.com/english/news/environment/Chicago-Lab-Promotes-Advances-in-Green-Diesel-Technology-104890389.html

Transportation Gets “Wired”

To help get the word out about some of the exciting things happening in Argonne’s Transportation Technology R&D Center, lab researchers have started contributing to AUTOPIA, *Wired’s* transportation news blog. Here are a few snippets from Argonne’s first two contributions.

Dyno-Testing the Automotive X Prize Finalists by Mike Duoba (Sept. 9, 2010)

I’m a mechanical engineer at Argonne National Laboratory, home to the Department of Energy’s principal vehicle testing facility. We have a whole set of facilities designed to evaluate how well cars work. How many miles per gallon a car gets, its emissions, how its engine performs on different kinds of fuels—it’s all tested here. We’ve even developed new procedures and machines to evaluate new technologies, like plug-in hybrids and battery electric vehicles.

The Department of Energy is a major sponsor of the Progressive Automotive X-Prize, so we were selected to test these advanced technology vehicles during the contest’s validation stage, the final tests before a winner is named.

All of the cars are unique and exciting. Working with them really gives you the sense that you’re seeing the future.



Mike Duoba

Dynamometer testing them proved to be a bit of a challenge, as we had to adapt the hardware and find creative ways of restraining the cars on the dynamometer. Some of them have three wheels, which is a bit unusual to say the least.

To see Duoba’s complete blog post, visit www.wired.com/autopia/2010/09/dyno-testing-the-automotive-x-prize-finalists/

Making Diesel Engines Burn Gasoline by Steve Ciatti (Sept. 27, 2010)

One of the cool things about working at Argonne National Laboratory is exploring new ideas. I’ve worked on a lot of combustion technologies, including hydrogen, but right now I’m doing something really unusual—burning gasoline in a diesel engine.

The first question you’re probably asking is, “Why in the world do you want to do that?” Well, I got the idea after talking to some colleagues who have been working on similar concepts.

We’re working on a combustion system that’s not traditional diesel combustion but not spark-ignition combustion either.

Why, you ask, would we explore this when traditional diesel and spark ignition have served us well for more than a century? Because traditional diesel combustion spews a lot of particulate matter and oxides of nitrogen (NO_x). And spark-ignition gasoline combustion has a significant efficiency problem due to the throttle, which is needed to control power output. Because of the nature of these two systems, there’s really no significant improvement that can be achieved with either one.

We decided to look for something that was a cross between the two.

This new system is more like traditional diesel combustion than spark ignition but uses a fuel and combustion approach that minimizes the emissions problems associated with diesels. It cuts NO_x more than particulate matter but has advantages for both.

To see Ciatti’s complete blog post, visit www.wired.com/autopia/2010/09/making-diesel-engines-burn-gasoline/



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Wired’s Transportation Blog: www.wired.com/autopia/

Argonne Provides Technical Support for Auto X Prize Competition

*By Glenn Keller, Principal Project Engineer
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Argonne National Laboratory was the last stop for competitors in Progressive Insurance's Automotive X Prize Competition. In August, researchers at Argonne evaluated the finalists' vehicles to see if they met the competition's goals for performance and efficiency targets. The goal of the competition was to empower teams from all over the world to construct innovative vehicles that would be able to achieve over 100 miles per gallon (MPG) equivalent. Entrants competed head-to-head for a \$10 million prize.



The Aptera 2e

Argonne transportation researchers provided their expertise in the development of competition events and performed the contest's energy efficiency validation stage at the lab's Advanced Powertrain Research Facility (APRF). Argonne's team was challenged early on to devise a test procedure for evaluating the energy efficiency of a diverse group of vehicles that included hybrid electric, plug-in hybrid electric, battery electric and gasoline-powered vehicles. Moreover, the test protocol had to be accurate and repeatable, and not favor one powertrain choice over another.

Prior to validation at Argonne, X Prize teams participated in qualifying events at the Michigan International Speedway (MIS). The race was designed with input from Argonne so that the vehicles were operated in a manner consistent with real-world driving and matched up with portions of the APRF chassis dynamometer tests. Argonne also advised on the instrumentation used for monitoring the operational parameters of each vehicle and providing real-time telemetry during the track events. The data was shared live on the web to track competitor performance.

Getting Ready for the Validation Round

To run the validation tests for the competition, Argonne

- ▶ Invented a way to safely tie-down unique vehicles onto the dynamometer (some vehicles were 2- and 3-wheelers),
- ▶ Came up with safe battery charging procedures for early prototype vehicles,
- ▶ Worked with critical deadlines, and
- ▶ Provided the utmost in accuracy for every competitor tested.

Many of the needed preparations were accomplished in advance of the event and emphasized flexibility and contingency management in the event of an unforeseen equipment failure. The results were robust procedures and redundant instrumentation that ensured no data could be lost, minimizing the potential for rework.



The TW4XP



Electric cars at smart grid charging stations outside Argonne's APRF

Seven vehicles were tested at the APRF. Testing went smoothly and encompassed a full three weeks in August. The results of the energy efficiency testing were delivered to the contest organizers for their final averaging with the on-road events run the previous month at MIS. The winners were announced in Washington, D.C. in September. The Edison2 took home \$5 million; Li-ion Motors and X-Tracer each received \$2.5 million.

Valuable Knowledge Gained

During the X Prize validation round, Argonne learned:

- ▶ How battery charger efficiency can offer significant advantages in the overall energy savings profile of electric vehicles,
- ▶ How to acquire coast down matching data with electric motors that had presented a challenge to industry, and
- ▶ How drivers influence electric vehicle regeneration strategies.

In addition, a large amount of hard data was collected on the “full” charge state of the vehicle battery. Repeatability of the “full” charge state could be used to validate assumptions about charging events in the development of SAE's J1634 Battery Electric Vehicle Test Procedures.

The results of the X Prize competition comprise a gold mine of technical data that define this moment in the evolution of transportation technologies and allow comparisons between them. It is a snapshot of the capabilities of many of the latest electrification and charging technologies, lightweight materials, vehicle design and powertrain integration practices of this decade. Due to the rigor of both the on-track testing and the dynamometer-based validation testing, a large amount of unbiased data on the very latest automotive technologies will be made available to the public.

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Argonne's APRF:
www.transportation.anl.gov/facilities/aprf.html

Auto X Prize website: www.progressiveautoxprize.org/

Plug and Play with Autonomie

Argonne National Laboratory recently unveiled Autonomie, a new “plug and play” software modeling tool that complements the automotive industry’s interest in reducing costs by accelerating the development and introduction of advanced automotive technologies. Autonomie allows the virtual simulation of vehicle powertrains and components and their operation without the expense of building a real-time system.

“To reduce cost and time to production while properly evaluating and developing advanced technologies, OEMs are turning to model-based design,” said manager Aymeric Rousseau, who led Autonomie’s development. To facilitate this goal, a standard plug-and-play model architecture and framework for interfaces of hardware and controls models is required to integrate and manage models of varying degrees of fidelity and complexity. Autonomie gives us just that.”



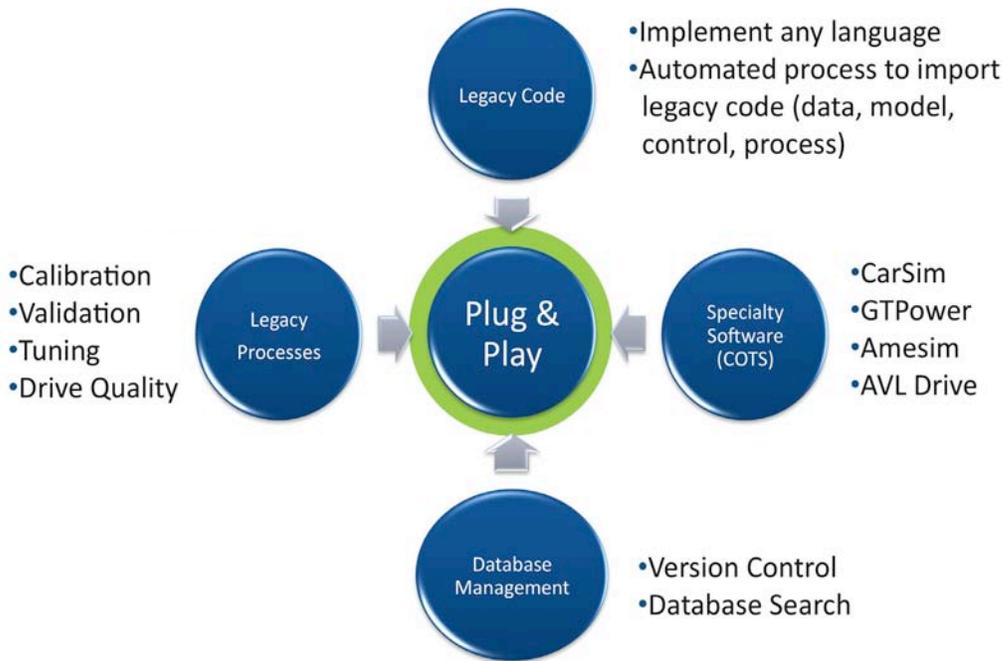
Autonomie allows users to integrate legacy models, controls, data and processes into a single environment that can be used throughout the different steps of the vehicle development process—from model-in-the-loop, software-in-the-loop, hardware-in-the-loop, to rapid control prototyping and production. Reusing models with varying degrees of fidelity and languages will allow engineers to quickly evaluate the benefits of new technologies in a total system context.

Autonomie will also make it easier and more economical for suppliers and auto makers to work together. “Every company currently has modeling tools that use different nomenclature,” Rousseau said. “So when an automaker buys a component from a supplier, the supplier must create a custom simulation

model of the component to that particular client’s requirements, which slows down the manufacturer’s development process by several months. And, of course, the parts supplier passes the software development costs on to the vehicle manufacturer. With Autonomie, the original equipment manufacturer can easily integrate the supplier’s component model into the manufacturer’s library of models and processes for immediate use.”

Autonomie replaces and greatly expands on the capabilities of Argonne’s Powertrain System Analysis Toolkit (PSAT), which will be phased out. The more than 750 licensed PSAT users will automatically receive Autonomie. Non-PSAT users will need to acquire a license for Autonomie.

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



Autonomie’s plug and play features allow the building of advanced vehicle simulation models. No other tool currently on the market builds models automatically.

On the cover: Argonne’s Aymeric Rousseau leads the Autonomie development team.

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Facility Spotlight: Battery-in-the-Loop

Engineers at Argonne's Transportation Technology R&D Center have developed a battery-in-the-loop system to evaluate and benchmark advanced prototype batteries for electric drive vehicles. Researchers use the battery-in-the-loop set-up to gain insight into the performance, life and cost of advanced energy storage systems.

In the battery-in-the-loop system, energy storage devices (like batteries) are connected to a bidirectional power supply that acts as a power source or sink. Researchers control this power supply so the battery behaves as if it were in a vehicle. Using the Argonne-developed Autonomie simulation tool, batteries can be evaluated in a closed-loop, real battery-virtual vehicle scenario.

Using battery-in-the-loop, researchers are analyzing and evaluating:

- ▶ Impact of battery parameters on vehicle performance and fuel economy;
- ▶ Impact of vehicle parameters on battery use in a vehicle, and its relationship to battery life and performance;
- ▶ Potential of hybrid energy storage devices (such as an active combination of batteries and ultracapacitors) to overcome the current shortcomings of lithium-ion battery packs in a cost-effective manner; and
- ▶ Performance of coolant loops under extreme battery use scenarios.

This research helps reduce the development time of battery packs for hybrid electric, plug-in hybrid electric and battery electric vehicles, and solves critical battery and vehicle integration issues.

Battery-in-the-loop has been used in vehicle systems studies to understand the impact of battery thermal behavior on PHEVs, and to understand the impact of PHEV energy management on battery utilization (battery life). Battery-in-the-loop tests were used for development of the SAE EV (electric vehicle) test procedure (J1634), along with chassis dynamometer testing of EVs. It is also being used to evaluate battery management systems and performance of battery thermal management systems for hybrid and plug-in hybrid applications.

Funding and support for this research is provided by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy, Vehicle Technologies Program under Lee Slezak.

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Engineer Neeraj Shidore prepares a PHEV battery for testing in Argonne's battery-in-the-loop system.

TRACC Keeps Transportation Analysis “On Track”

By David Weber, Senior Nuclear Engineer
Argonne National Laboratory

The Transportation Research and Analysis Computing Center (TRACC), established in 2007 at Argonne National Laboratory, provides high-performance computing (HPC) resources and training to researchers in the transportation industry and performs research on critical issues of interest to the U.S. Department of Transportation (USDOT).

High Performance Computing Resources

Researchers use TRACC’s high-fidelity modeling and simulation, state-of-the-art engineering analysis software, and high-performance, massively parallel computers. The TRACC cluster is a Linux cluster, expanded in 2010 to 1,024 cores on its 128 compute nodes. Supported software includes the USDOT-developed TRANSIMS, commercial computational fluid dynamics software, structural analysis codes, codes for mesh generation and other packages for use on parallel systems.

TRACC staff supports external users in the use of these resources, including implementation and optimization of user-developed software, and the use of USDOT and commercially available analysis software on its massively parallel systems.

Research Projects

TRACC HPC resources are currently being used in 30 projects by over 100 researchers in areas such as

- ▶ Bridge hydraulics,
- ▶ Wind loading on highway structures,
- ▶ Roadside safety structures,
- ▶ Accident reconstruction,
- ▶ Brain response to automobile crashes,
- ▶ Rollover crash analysis,
- ▶ Bridge response to wind and traffic,
- ▶ Bridge structural stability,
- ▶ Crash simulation of paratransit buses,
- ▶ Urban area transportation system modeling/analysis, and
- ▶ Evacuation planning.

In addition to Argonne’s work, researchers come from USDOT organizations and universities. TRACC’s formal university partners include the University of Illinois at Urbana-Champaign and Northern Illinois University.

TRANSIMS

TRACC staff also conducts research in key areas requested by USDOT. One of these is the development and deployment of the traffic modeling system TRANSIMS. TRANSIMS models the movement and behavior of individuals and vehicles (including autos, trucks, buses, subways and trains) in a metropolitan area on a second-by-second basis for an entire metropolitan region, and it can model detailed traffic flow over very large areas. Research has focused on the Chicago metropolitan area, working with local metropolitan planning agencies and county and state departments of transportation. TRANSIMS can analyze congestion, evaluate the effects of roadway changes on traffic patterns, examine proposed new capacity in selected areas (such as airports) and evacuation planning. Figure 1 shows a detailed model of downtown Chicago during rush hour, taken from the more comprehensive TRANSIMS model of the entire Chicago region.

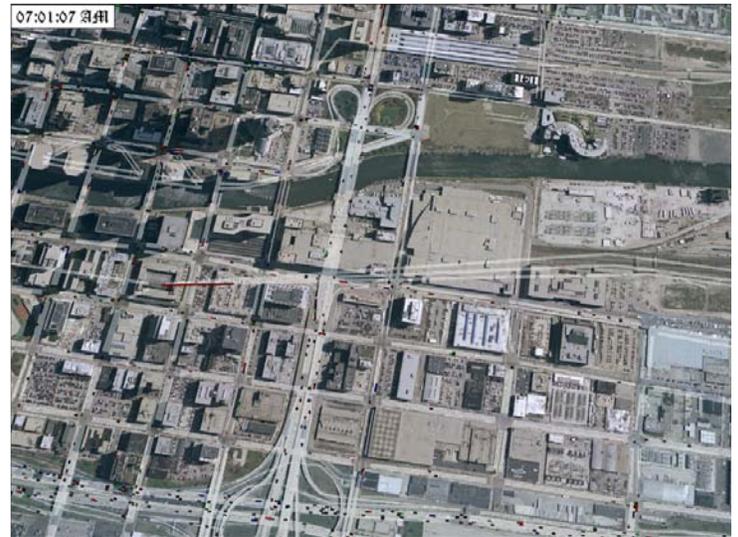


Figure 1. “Helicopter” view of predicted traffic patterns in Chicago

Computational Fluid Dynamics

TRACC research also focuses on predicting bridge response to flooding by using tools such as computational fluid dynamics (CFD). Since the majority of bridge failures are caused by riverbed erosion (scour), understanding the sediment transport process and evaluating mitigation strategies is important to transportation agencies. TRACC researchers are evaluating alternative approaches to using STAR-CD and STAR-CCM+ CFD software for predicting scour at bridges during major flood events.

TRACC is working with the Federal Highway Administration Turner Fairbank Highway Research Center to correlate CFD analyses against controlled experiments being performed at the research center. Figure 2 shows a close-up of the experimental scour facility at Turner Fairbank used in the evaluation and Figure 3 shows a comparison of the predicted scour patterns using CFD and experimental observations.

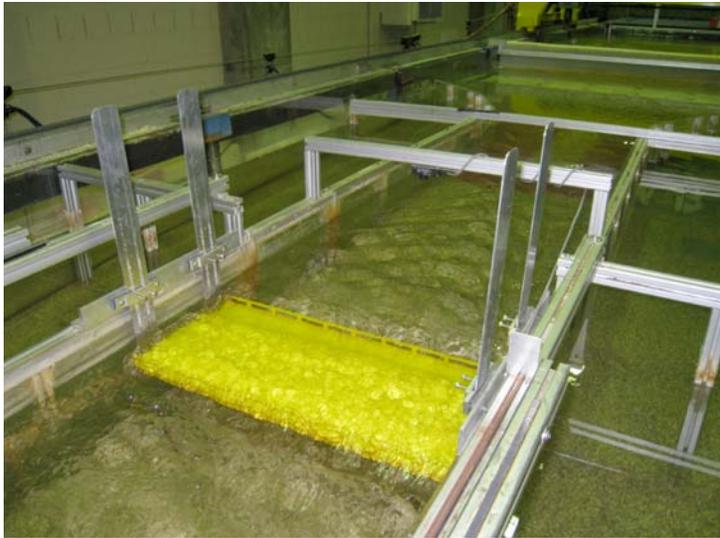


Figure 2. Turner Fairbank Highway Research Center test section for flooded deck experiments

Computational Structural Mechanics

Several areas in computational structural mechanics are also being investigated at TRACC. The structural stability of bridges with piers embedded in scour holes is being studied using newer mesh-free methods available in the LS-DYNA® code. In another area, detailed analyses of bridge dynamic response to wind/traffic loadings and crash analysis are performed using traditional finite element methods. Finally, in a collaborative project with Florida Agricultural and Mechanical University-Florida State University College of Engineering (FAMU-FSU), paratransit buses are being assessed to determine their crashworthiness and to develop best practice design guidelines for the paratransit bus industry. Figure 4 shows a predicted maximum deformation from a rollover event for use in comparison and validation against experimental information provided by FAMU-FSU.

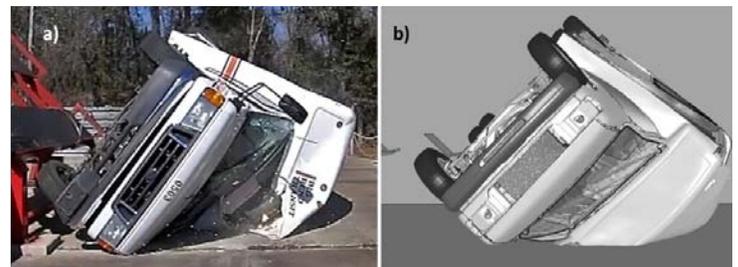


Figure 4. Comparison of bus deformation in FAMU-FSU rollover test (a) experiment and (b) Finite Element simulation

TRACC Training

Multi-day training classes are held at the TRACC Collaboratory at Argonne National Laboratory, external locations and over the Internet. Classes include traffic modeling with TRANSIMS, computational fluid dynamics, and computational structural mechanics.

Funding

TRACC is funded by the U.S. Department of Transportation and managed by the USDOT Research and Innovative Technology Administration.

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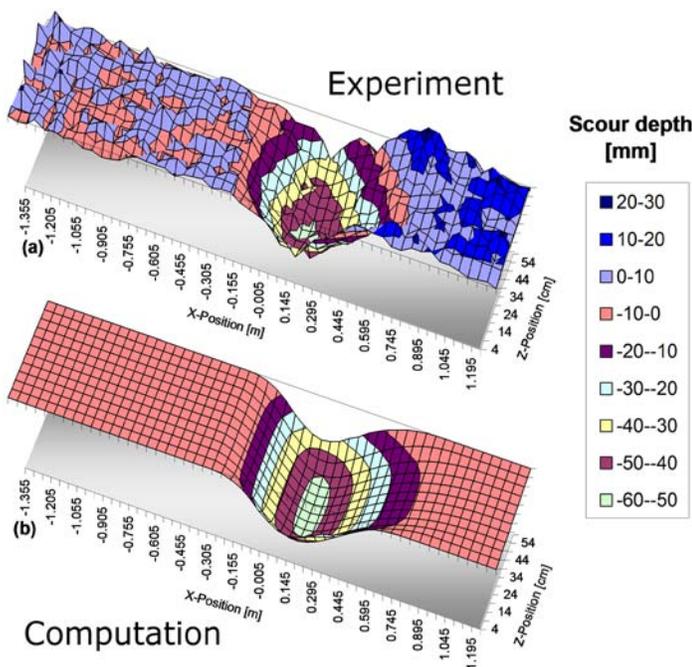


Figure 3. A comparison of the predicted scour patterns using CFD and experimental observations

Argonne Achieves Dramatic Improvement in Low-Temperature Engine Combustion for Vehicles

Argonne engineers in the Transportation Technology R&D Center (TTRDC) are developing an advanced combustion system that achieves diesel-like high efficiency and current level power density while producing ultra-low emissions.

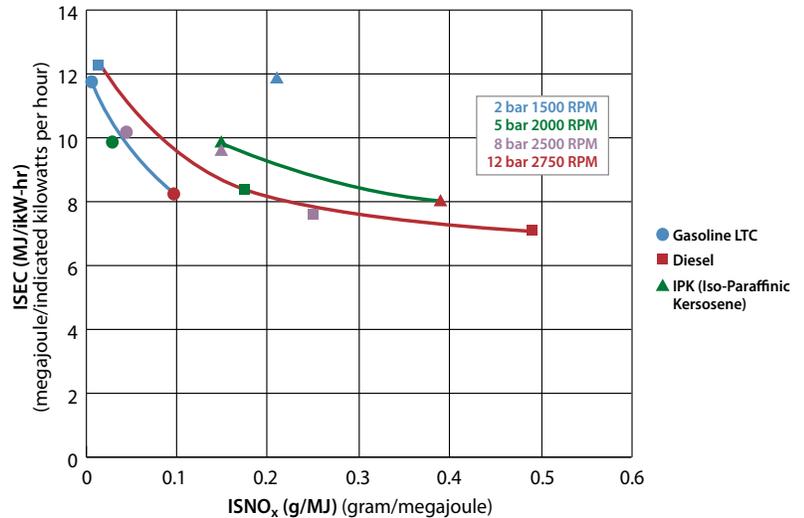
This advanced combustion system uses low cetane fuels (derived gasoline and naphtha blends) that are easier for the energy companies to produce than pump gasoline or diesel. The benefit of this system is the retention of very high efficiency while drastically reducing or eliminating the exhaust after-treatment demand of current diesel engine systems.

The challenge is to make this combustion system robust enough for vehicular applications. To achieve this, scientists need detailed knowledge of fundamental mechanisms, including fuel spray and mixture preparation, ignition chemistry mechanisms, and concurrent numerical approaches to turbulence modeling and simultaneous reaction chemistry modeling.

TTRDC engineers have teamed with scientists at Argonne's Advanced Photon Source on a fuel-spray project, and with the Chemical Sciences and Engineering Division on combustion chemistry. They are also collaborating with researchers in the Argonne's Leadership Computing Facility to optimize this combustion approach for practical engines.

Achievements so far include:

- ▶ Robust engine operation up to 3,000 RPM at 16 bar BMEP (brake mean effective pressure) load (approx. 100 hp). Previous work by others has only shown benefits at low loads of 5-6 bar BMEP. Our goal is 18-20 bar BMEP.
- ▶ Ultra-low emissions under driving cycle conditions (mid-speed and load) that are below 0.2 g/hp-hr (gram/horsepower hour) for NO_x .



Gasoline low-temperature combustion (LTC) shows diesel-like fuel efficiency with very low NO_x , especially at the higher speeds and loads.

- ▶ Efficiencies between 30 percent and 40 percent over the range of conditions encountered in the driving cycle.
- ▶ As seen in the figure, gasoline low temperature-combustion (LTC) shows diesel-like fuel efficiency with very low NO_x , especially at the higher speeds and loads.

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Could a Diesel Engine Run on Gasoline?

Yes. Running a vehicle on a diesel engine has definite advantages: diesel engines have a longer lifespan, and are power-dense and more efficient than regular spark ignition gasoline engines, but they have high NO_x emissions.

Argonne is investigating what it would take to run a regular diesel engine on gasoline without generating high diesel emissions. Using residue fuels (crude gasolines with low cetane numbers), Argonne is mixing and measuring fuel chemistry and fluid dynamics to determine the ideal fuel/air injection and mixture strategies for diesel engine use.

Work to date has shown significant reductions in NO_x emissions. Engine efficiencies have also remained high—close to diesel efficiency—and roughly double that of spark-ignited (regular combustion engine) gasoline at low speeds and loads.

Equipping cars with diesel engines that run on regular gasoline would not only make a more efficient vehicle with a longer lifespan, but also reduce emissions and contribute to a greener environment.

This project is funded by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy, Vehicle Technologies Program under Gurpreet Singh.



Steve Ciatti tests a diesel engine running on gasoline.

For more information, contact

Steve Ciatti
sciatti@anl.gov

AUTOPIA blog post by Ciatti:
www.wired.com/autopia/2010/09/making-diesel-engines-burn-gasoline

The Green Racing Paradox

*By Forrest Jehlik, Principal Mechanical Engineer
Argonne National Laboratory*

Let's talk about stereotypes.

When you think about automotive racing and environmentalism, it presents a potential battle royale of stereotypes. On the green side, picture a stereotypical environmentalist: a Birkenstock-wearing hippy armed with a polished rant about polar bears and melting ice caps. On the racing side, the clichéd race fan: a blue-collar gearhead who wrenches on a hot rod and thinks the Daytona 500 is a national holiday.

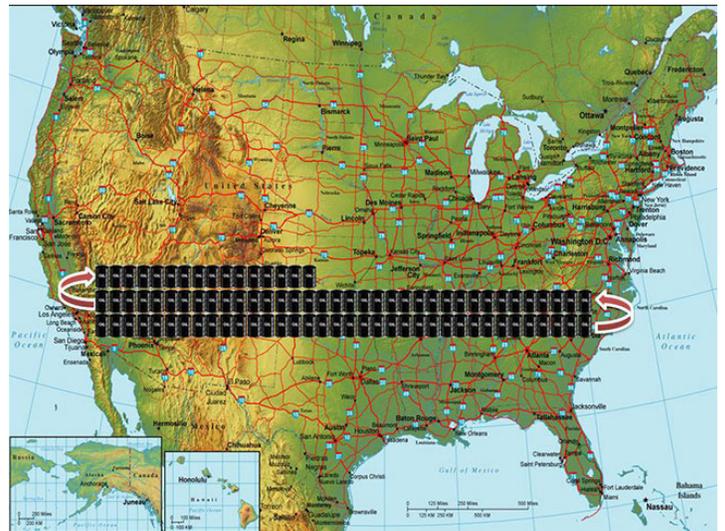
Now imagine introducing these two stereotypes as business partners.

On the surface, the intermingling of these two personalities and philosophies are as probable as a Paris Hilton alibi. But guess what? They *can* co-exist, and I'm here to prove it. Yet before I try convincing you that green racing is an unlikely hero in our fight to reduce our dependence on oil (and just maybe save the polar bears), I'd like to give you some background on the issue.



Argonne researcher Forrest Jehlik (second from right) with the Dalton Zehr Racing crew. Left to right: chief crew mechanic Mark Jones, team owner Marty Zehr, driver Dalton Zehr, Circle Track magazine editor Robert Fisher, Jehlik and Argonne electrical engineer Danny Bocci.

As a transportation research engineer at Argonne National Laboratory, I'm working toward solutions that achieve petroleum displacement. (Actually, it's not just my job; it's something I'm passionate about.) The United States currently consumes 20 million barrels of oil per day, 365 days a year.¹ How much is 20 million barrels per day? Being an engineer, I like things I can rationalize and wrap my mind around, so I did some calculations. This is what 20 million barrels looks like:²



Barrels stacked side by side from one day of U.S. consumption would stretch from California to the east coast, back to the west coast, and then back to somewhere in Nebraska. This is one quarter of the world's consumption of just over 85 million barrels per day. Because we import approximately 65 percent of our oil at a cost of \$77 a barrel (the cost when I wrote this), that's a billion dollars per day going somewhere else to pay for our energy needs.

Now, if you happen to venture to the U.S. Energy Information Administration website, you can also find that the world's current proved petroleum reserves stand between 1.1 and 1.35 trillion barrels.³ That might sound like a lot, but if you divide that number by our current rate of consumption,

that puts us at around 37 years of known reserves. Now, I understand there is much debate over this number and of course there are some other means of getting petroleum and other unfound sources. But one day, perhaps sooner than later, this resource is going to become awfully scarce and the need for alternatives will be paramount.

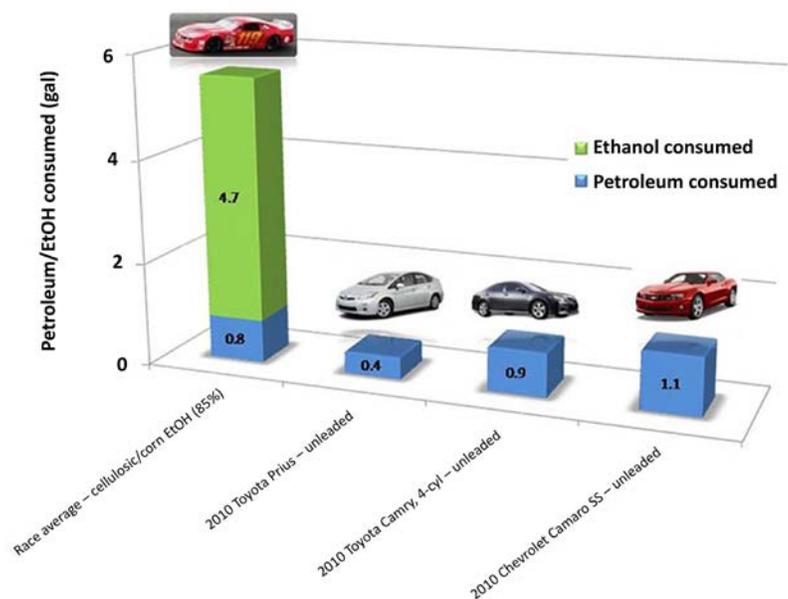
The second major issue with petroleum centers around the issue of global climate change. Petroleum is pumped out of the ground and combusted, releasing that trapped hydrocarbon into the atmosphere as (mostly) carbon dioxide (CO₂) and water vapor. This increases the concentration of atmospheric CO₂, a global warming gas. China recently passed the U.S. in CO₂ emissions, but our country still accounts for 20 percent of the global carbon emissions—and our transportation system is responsible for a third of our carbon emissions from fossil fuels. Automobiles are the single biggest contributor, therefore technologies that could address the problem could have a huge impact. Maybe even what upper management calls a “win-win.”

So now that I’ve framed the issue surrounding national energy security as it relates to petroleum consumption and global climate concerns, I’ll tell you how the future of racing could play a role in our country’s independent energy future.

I’m working with *Circle Track Magazine’s* Project GREEN to prove the viability of green racing. I view this as a grassroots movement that can educate the public about cleaner and more efficient automotive technologies and inspire them to support these innovations.⁴ Can almost half a million circle track racers and fans be wrong?

Race tracks are among the few venues where you’ll still find carburetors. A lot of these race cars also run on expensive emissions-spewing racing fuels that often contain lead. Our research team has shown that a fuel-injected racing car fueled by E85 can outperform the same engine with a carburetor and leaded racing fuel. Doubt my word? I’ll prove it.

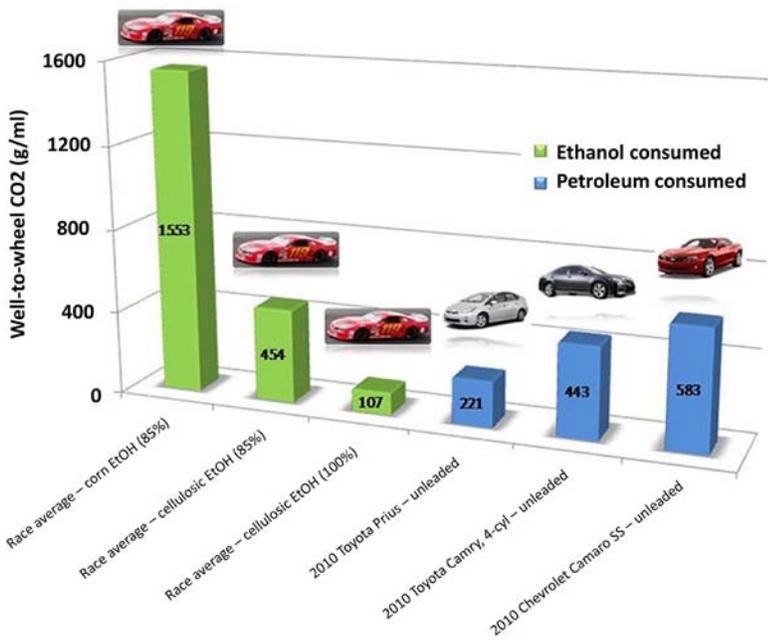
Using readily-available corn-based ethanol in an E85 mixture (85% ethanol and 15% gasoline) and a customized data acquisition system, we entered one of our project cars in the annual Oktoberfest race at the La Crosse Speedway in Wisconsin. In a 33-lap race (approximately 20 miles), our Project GREEN Camaro race car used less gasoline than a typical small, 4-cylinder sedan would in everyday city-highway driving—and our race car was going at speeds of up to 115 mph!



Continued on page 18 ▶

Green Racing Paradox continued from page 17

Using Argonne National Laboratory’s Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation Model (GREET) to calculate well-to-wheel greenhouse gas emissions, we found that using cellulosic E85, the Project GREEN Camaro running flat-out would generate less well-to-wheel greenhouse gases, per mile, than a small 4-cylinder sedan using petroleum driving mixed city/highway cycles. If we chose to run near 100 percent ethanol, the race car would have generated less well-to-wheel CO₂ emissions than a vehicle that got 110 miles per gallon. Now imagine the reduction if that renewable fuel was used in everyday vehicles. That’s good stuff!



Our hope is that if we prove race cars can run faster, more efficiently and cheaper with fuel-injected engines burning domestically produced biofuels, these green technologies will catch on with race car drivers—and eventually be used in the cars of the 20 million racing fans across America.

We’re proving that the environmentalist and the gearhead can work together to hasten the adoption of clean transportation technologies. So grab your Birkenstocks and your wrenches and let’s go green racing!

This work is funded by the U.S. Department of Energy’s Office of Energy Efficiency and Renewable Energy, Vehicle Technologies Program under Lee Slezak.

References

1. http://www.eia.doe.gov/energyexplained/index.cfm?page=oil_home#tab2
2. http://www.eia.doe.gov/energyexplained/index.cfm?page=oil_home#tab2
3. <http://www.eia.doe.gov/emeu/international/reserves.html>
4. <http://www.circletrack.com> and search “Project GREEN”

For more information, contact
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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.

OCTOBER 2010

An Argonne partner, BASF of Elyria, Oh., broke ground on a new facility to produce advanced cathode materials for automotive lithium-ion batteries. BASF is one of only two licensed suppliers of Argonne's patented nickel-cobalt-manganese cathode materials, which employ a combination of lithium and manganese-rich mixed metal oxides. The plant will open in 2012. Read more at

<http://www.favstocks.com/basf-breaks-ground-on-north-american-li-ion-cathode-plant/2727132/>

SEPTEMBER 2010

As reported in the *Bradenton Herald*, **Argonne** and BASF are being awarded a 2010 Deals of Distinction award for a worldwide licensing agreement for the mass production and marketing of Argonne's patented lithium-stabilized NCM (nickel-cobalt-manganese oxides) cathode materials, which are used to manufacture advanced lithium-ion batteries. Read more about the award at

<http://www.bradenton.com/2010/09/29/2614912/licensing-executives-society-usa.html>

An overview of **Argonne's** transportation research is described in the article, "A Look at What's Cooking at Argonne National Laboratory," featured on the *Green Car Reports* website. View the article at

http://www.greencarreports.com/blog/1049019_a-look-at-whats-cooking-at-argonne-national-laboratory

AUGUST 2010

Researchers **Michael Wang** and **Amgad Elgowainy** are featured in an article about GREET on the *Autoblog Green* website called "Well-to-Wheel Emissions of Plug-in Hybrids Will Be All Over the Map." Read the article at

<http://green.autoblog.com/2010/08/24/well-to-wheel-emissions-of-plug-in-hybrids-will-be-all-over-the/>

A profile on **Glenn Keller's** engineering career story is featured at AnnArbor.com in the article, "For University of Michigan grad, running Argonne National Lab's auto test facility is 'cutting-edge' experience." Read it at

<http://www.annarbor.com/business-review/for-u-m-grad-running-argonne-national-labs-auto-test-facility-is-cutting-edge-experience/>

At PlugInCars.com, **Mike Duoba** is quoted in the article, "Expert: Don't Dumb Down Window Stickers for Plug-in Cars," about the new standard J1711. Read his remarks at

<http://www.pluginCars.com/expert-dont-dumb-down-window-stickers-plug-cars-52510.html>



Don Hillebrand

Don Hillebrand talks about his green car picks in the article "All About Green Cars—and Not Just Expensive Ones" on the *Daily Herald* website. Read what he picked at <http://saxo.dailyherald.com/article/20100801/News/308019959/>

Seth Snyder is quoted in the article, "Hard Work Has Made Biodiesel a 'Drop-in' Fuel," on the *Biodiesel Magazine* website. Read the article at

http://www.biodieselmagazine.com/article.jsp?article_id=4278

JULY 2010

Forrest Jehlik was interviewed by the *Daytona Beach News Journal* in the article "Green Car Passes Test at NSS." Jehlik and his team raced a fuel-injected, E85-fueled car at New Smyrna Speedway and the results showed that the car was faster than its carbureted benchmark. Read the article at

<http://www.news-journalonline.com/racing/local-racing/2010/07/28/green-car-passes-test-at-nss.html>

Autoblog Green's article, "Study: Argonne Makes the Case for a Propane-powered Automotive Future," features **Argonne** research on the usefulness of liquefied petroleum gas as an alternative fuel. Read the article at <http://green.autoblog.com/2010/07/26/study-argonne-makes-the-case-for-a-propane-powered-automotive-f/>

The **Argonne** report, "U.S. Well-to-Wheels Analysis of Landfill Gas-based Pathways" is featured on the *NGV Global News* website. See the report at <http://www.ngvglobal.com/us-well-to-wheels-analysis-of-landfill-gas-based-pathways-0719>

Researcher **Forrest Jehlik** discusses the technology he implemented at the Green Racing Project in "Go Green Goal," an article in the *Daytona Beach News-Journal*. Read it at <http://www.news-journalonline.com/racing/local-racing/2010/07/15/go-green-goal.html>



Mike Duoba

Mike Duoba is interviewed in the *R&D Magazine* article, "Argonne Researchers Recharge Plug-in Vehicle Standards," about the passage of SAE standard J1711 governing measurement of PHEV emissions and fuel economy. Read the complete article at <http://www.rdmag.com/News/2010/06/Energy-Transportation-Argonne-Researchers-Recharge-Plug-In-Vehicle-Standards/>

Argonne's **Andy Burnham** talks about plug-ins on a *Scientific American* interactive presentation at <http://www.scientificamerican.com/article.cfm?id=interactive-plug-in-hybrids>

JUNE 2010

In the *EarthTimes* article "SAE International Introduces New Standard to Measure Exhaust Emissions and Fuel Economy of Hybrid Vehicles," Argonne engineer **Mike Duoba** talks about the new SAE Standard J1711, which describes the recommended practice for measuring exhaust emissions and fuel economy of hybrid vehicles. View the article at <http://www.earthtimes.org/articles/press/fuel-economy-hybrid-vehicles,1364360.html>

The ability of a plug-in electric vehicle to reduce greenhouse gas emissions depends on where you live, according to a report from Argonne National Laboratory. **Michael Wang** and **Amgad Elgowainy** talked to *International Business Times* about the report in "Hybrids Often Greener in the Other State." Read the article at <http://www.ibtimes.com/articles/30890/20100625/plug-in-hybrids-greenhouse-gas-emissions-differ-by-state.htm>

Argonne system analyst **Linda Gaines** discussed the lithium shortage myth with the *New York Times* in its article, "USGS's Lithium Find Means Little for Mythical Shortfall." View the complete article at <http://www.nytimes.com/gwire/2010/06/21/21greenwire-usgss-lithium-find-means-little-for-mythical-s-62051.html>

Plug-ins and U.S. "petroleum addiction" are discussed in the article "Crude Habit," by *National Journal Magazine*. **Don Hillebrand** is quoted on Argonne's PHEV research at http://www.nationaljournal.com/njmagazine/cs_20100619_3491.php

Engineer **Mike Duoba** is quoted in the *Washington Post* article, "More Electric Cars Means Finding New Standards to Measure Efficiency." He discusses how there is no clear language for describing the efficiency of electric cars. Read the complete article at <http://www.washingtonpost.com/wp-dyn/content/article/2010/06/07/AR2010060704242.html>



Forrest Jehlik

Forrest Jehlik, mechanical engineer at Argonne, authored the *CircleTrack* web article, “Project GREEN Dyno-Engine: Understanding the EFI Engine’s Performance,” about green racing engine dynamometer research. View his article at http://www.circletrack.com/enginetech/ctrp_1009_project_green_dyno/index.html

After the second year of competition in the EcoCAR Challenge, students from Mississippi State University won first place with their extended-range electric vehicle. **Argonne** provides management and support for EcoCAR. Read the *Wired* article at <http://www.wired.com/autopia/2010/06/mississippi-state-ecocar-118-mpg/#ixzz10l8JSG7g>

Argonne researcher **Khalil Amine** is quoted in *Green Car Advisor’s* article, “Beyond Li-ion: Researchers Pursuing Lithium- and Zinc-air Batteries,” at <http://blogs.edmunds.com/greencaradvisor/2010/06/beyond-li-ion-researchers-pursuing-lithium-and-zinc-air-batteries.html>

MAY 2010

In “Supercomputers Put Charge into Battery Research,” *HPC Wire* talks to Argonne chemist **Larry Curtiss** about the hows and whys of lithium-air battery research. Read the article at <http://www.hpcwire.com/features/Supercomputers-Put-Charge-into-Battery-Research-93637374.html?ref=374>

Argonne’s symposium, *Computational Perspectives*, looked at energy storage options for advanced vehicle technologies. **Daniel Abraham, Khalil Amine** and **Jeff Chamberlain** were quoted in the *Medill Reports* article, “Argonne Battery Symposium Looks to Electric Cars with a 500-mile Range,” viewable at <http://news.medill.northwestern.edu/chicago/news.aspx?id=164424>

“Lithium-air is where we’re going,” **Don Hillebrand**, director of Argonne’s Center for Transportation Research told the *New York Times*. “You can’t foresee the future, but right now, that’s the place where I think we see the endpoint, the end solution for...the battery everybody’s looking for.” Read the article, “Will Lithium-air Battery Rescue Electric Car Drivers from Range Anxiety?” at <http://www.nytimes.com/cwire/2010/05/07/07climatewire-will-lithium-air-battery-rescue-electric-car-37498.html>

APRIL 2010

Argonne National Laboratory is looking for ways to combat the potential energy surge a growing demand for plug-in hybrid cars could cause. *Medill* talked to Argonne engineer **Les Poch** about the smart grid in the article, “Smart Grid Could Thwart Rising Energy Costs from Electric Cars,” viewable at <http://news.medill.northwestern.edu/chicago/news.aspx?id=163826>

FASTRAX

SEPTEMBER 2010

Larry Michaels gave a presentation at the Hybrid Truck User Forum titled “Using a Model-based Design Approach to Accelerate Electric Drive Introduction” on September 29.

Christopher Powell received the Best Conference Paper award for his work, “The Effects of Diesel Injector Needle Motion on Spray Structure,” written for the 2010 ASME-ICE meeting. The award was presented in September at the 2010 ASME-ICE meeting in San Antonio, Tex.

Dan Santini gave a presentation at a Clean Cities electric vehicle webinar on September 16. His topic was “Regulatory Influences That Will Likely Affect Success of Plug-in Hybrid and Battery Electric Vehicles.”

Argonne research engineer **Thomas Wallner** lent his expertise this year to Chicago’s Museum of Science and Industry for an interactive exhibit that illustrates how combustion works. Experience portions of this *Science Storms* exhibit on Argonne’s transportation website at www.transportation.anl.gov/features/2010_msi_wallner.html



Thomas Wallner hosts a combustion video at Chicago’s Museum of Science and Industry.

Riccardo Scarcelli presented the paper, “CFD and Optical Investigations of Fluid Dynamics and Mixture Formation in a DI-H₂ ICE,” at the 2010 Fall Technical Conference of the ASME Internal Combustion Engine Division in San Antonio, Tex., in September. The paper was co-authored by **Thomas Wallner** and **Hermann Obermair** from Argonne, and Sebastian Kaiser and Victor Salazar from Sandia National Laboratories.

Raj Sekar was honored at the 2010 ASME-ICE September meeting in San Antonio, Tex., “for many years of loyal and worthy contributions on numerous committee assignments within the Internal Combustion Engine Division [and for] guidance and leadership in the division activities to the benefit of the engineering profession and the ASME.”

Andrew Ickes presented a study co-authored by **Neeraj Shidore** and **Thomas Wallner** on “Impact of addition of ethanol and butanol as oxygenates on efficiency and emissions of a direct injection spark ignition engine using steady state and transient test procedures” at the Directions in Engine-Efficiency and Emissions Research (DEER) Conference in Detroit, Mich., in September.

Thomas Wallner presented the study, “Correlation between Speciated Hydrocarbon Emissions and FID Response for Blends of Gasoline with Ethanol and Butanol” at the 2010 Fall Technical Conference of the ASME Internal Combustion Engine Division in San Antonio, Tex.

Linda Gaines presented her talk, “To Idle or Not to Idle: That is the Question,” along with a poster of the same name by Gaines, **Terry Levinson** and **Steve McConnell** at the DEER Conference, Detroit, Mich., September 27-30.

Ali Erdemir and **Osman Eryilmaz** presented their invited plenary talk, “The Role of Hydrogen and Deuterium in Tribological Performance of Diamondlike Carbon Films: An Imaging TOF-SIMS Study,” at the 2nd International Conference of Science of Friction in Nagoya, Japan, September 13-17.

AUGUST 2010

Argonne hosted the U.S.-China Electric Vehicle and Battery Technology Workshop on August 30 to September 1, sponsored by the U.S. Department of Energy and the China Ministry of Science and Technology. The workshop endeavored to create opportunities for discussion on initiatives between the two countries in order to make electric vehicles a reality. For more information, visit http://www.transportation.anl.gov/features/2010us_china_conference.html

Linda Gaines presented her invited talk, “Lifecycle Analysis for Lithium-Ion Batteries,” at Plug-In 2010, San Jose, Calif., on July 26-29, and at the U.S. China Battery Meeting, Argonne National Laboratory, August 30-31.

Marianne Mintz of Argonne and Jim Wegrzyn of Brookhaven National Lab presented their paper, “Benefits and Barriers to Renewable Natural Gas as a Vehicle Fuel,” at the Wastecon 2010 Conference and Exhibition in Boston, Mass., on August 14.

JULY 2010

Ann Schlenker presented her talk, “Accelerating the Commercialization of Advanced Technology Vehicles,” at the Progressive Insurance Auto X Prize Leadership Summit held on July 27-28.



Ali Erdemir

Ali Erdemir was named a fellow of the American Society of Mechanical Engineers (ASME). The Fellow designation is the highest elected grade of membership in ASME. Fellowship is conferred upon members with at least 10 years of active engineering practice who have made significant contributions to the profession. Erdemir's research interests include surface engineering, tribology, lubrication, nano-structured and nano-composite coatings, diamond and diamondlike carbon films, engine tribology, and more.

Argonne is partnering with Kentucky on the Kentucky-Argonne National Battery Manufacturing Research and Development Center. The center will help develop and deploy a domestic supply of advanced battery technologies for vehicle applications that will aid in securing U.S. energy independence, reduce greenhouse gas emissions and help in strengthening the economy. Argonne is the federal government's lead laboratory for applied advanced battery R&D.

Linda Gaines presented her invited talk, "Battery Materials Availability and Recycling," at the Building a U.S. Battery Industry for Electric Drive Vehicles NAS Review in Livonia, Mich., July 26-27.

Argonne researchers **Ali Erdemir** and **Osman Eryilmaz**, and Mustafa Urgen and Kursat Kazmanli of Istanbul Technical University presented their invited talk, "Advanced Tribological Coatings for Automotive Applications," at the 10th Biennial ASME Conference on Engineering Systems Design and Analysis (ESDA 2010) in Istanbul, Turkey, July 12-14.

JUNE 2010

The **Argonne**-managed EcoCAR student vehicle competition announced its winners of the Year Two round: students from Mississippi State University placed first in finals held in San Diego, Calif.



Mississippi State University won the EcoCAR Year Two competition.

after designing and building an exceptional biodiesel extended-range electric vehicle (EREV). Virginia Tech earned second place with an ethanol EREV design and Penn State came in third place with their biodiesel EREV vehicle.

Linda Gaines presented the talk, "Lean, Green, and Legal: Idling Reduction is a Win-Win-Win Proposition," at the TRB Summer Meeting, Raleigh, North Carolina on June 7-9.

Ali Erdemir presented his invited talk, "Design of Novel Nano-composite Coatings for Severe Tribological Applications," at the Gordon Research Conference on Tribology held in Waterville, Maine, June 27 to July 2.

A paper presented by **Neeraj Shidore**, **Anant Vyas** and **Jason Kwon** at the 2010 SAE World Congress was selected for future publication in the prestigious SAE journals. It is titled "Impact of Energy Management on the NPV Gasoline Savings of PHEVs."

MAY 2010

Argonne and New Energy and Industrial Technology Development Organization (NEDO), a Japanese government organization for energy technology R&D, have signed an MOU for cooperative information exchange in the field of energy storage technology. The partnership, including workshops and research information exchanges, is expected to contribute to the diversification of energy supply and assist in the prevention of global warming.

Argonne researcher **Khalil Amine** is the 2010 winner of the Battery Division Technology Award of the Electrochemical Society (ECS). The award is given to those individuals who have made outstanding contributions to the technology of primary and secondary cells, batteries, and/or fuel cells. The intent of the Technology Award is to recognize recent contributions to the field that can be expected to have an impact on future battery and/or fuel cell applications.

Thomas Wallner presented a paper (co-authored with Rich Frazee of AVL North America) titled "Study of Regulated and Non-regulated Emissions from Combustion of Gasoline, Alcohol Fuels and Their Blends in a DI-SI Engine" at the SAE 2010 International Powertrains, Fuels and Lubricants Meeting in Rio de Janeiro, Brazil in May.

Linda Gaines presented her talk, "Idling Reduction Makes Sense," at the Alternative Fuels and Vehicles Conference, Las Vegas, Nev., May 10-12.

Jim Miller served as a member of the International Council on Clean Transportation (ICCT) Advisory Committee for the ICCT Electric Drive Project. The first meeting of this committee was held May 25, in San Francisco, Calif.

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.

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