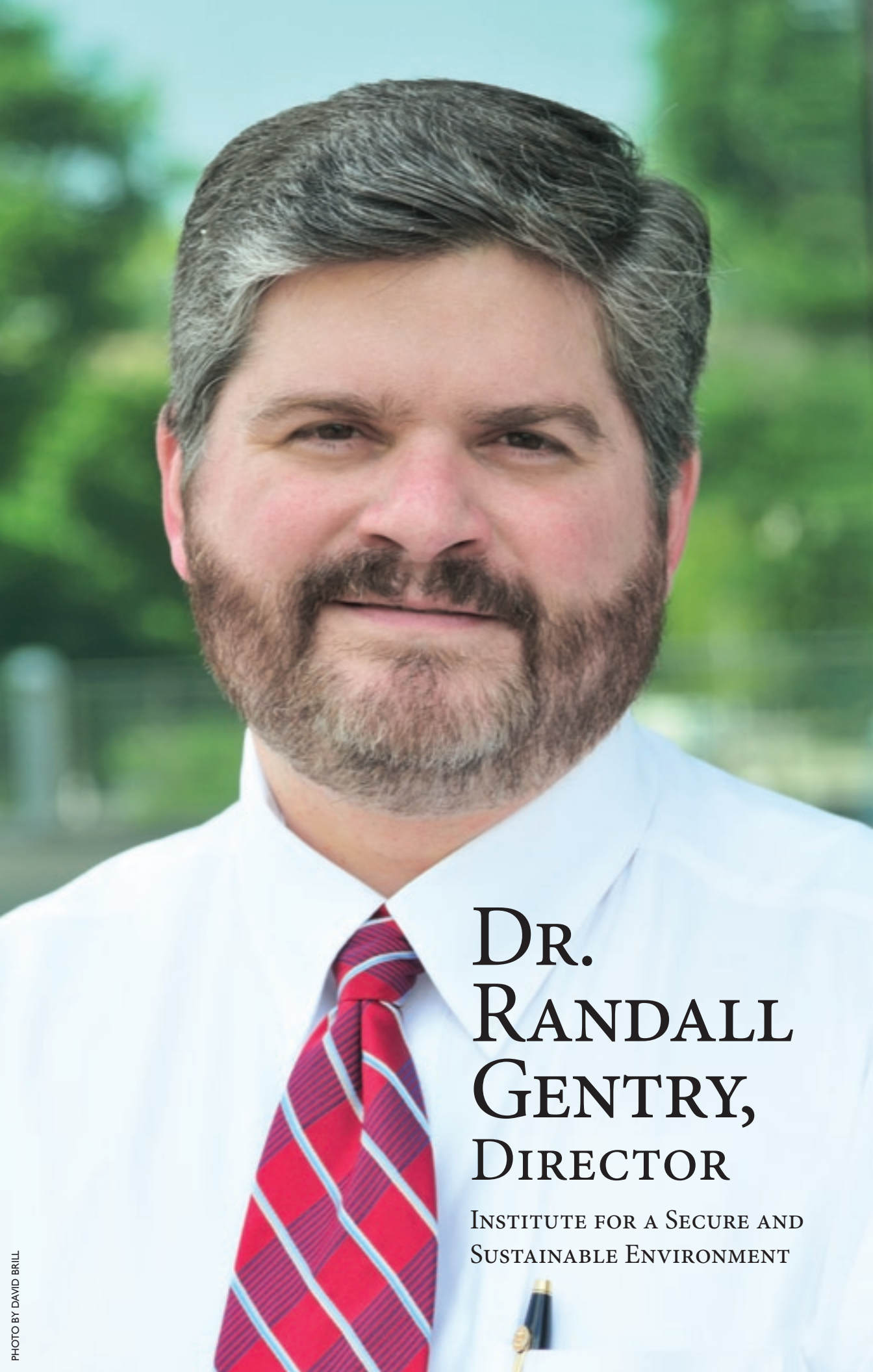




ISSE promotes research and development of policies, technologies, and educational programs that cut across multiple disciplines, engage the university's research faculty and staff, and grow in response to pressing environmental and security issues facing the state, the nation, and the globe.

A professional portrait of Dr. Randall Gentry, a man with grey hair and a beard, wearing a white dress shirt and a red and blue striped tie. He is looking directly at the camera with a slight smile. The background is a blurred green outdoor setting.

**DR.
RANDALL
GENTRY,
DIRECTOR**

INSTITUTE FOR A SECURE AND
SUSTAINABLE ENVIRONMENT

SUSTAINABILITY SCIENCE FOR GLOBAL SOLUTIONS

BY DR. RANDALL GENTRY, DIRECTOR

In April 2006, the Tennessee Higher Education Commission (THEC) approved creation of the Institute for a Secure and Sustainable Environment (ISSE), a Center of Excellence at the University of Tennessee (UT). Since then, ISSE has established an organizational framework and continued to develop its depth and breadth in sustainability science and education for the State of Tennessee.

In harmony with the efforts of the National Academy of Sciences, ISSE has identified a nexus where its sustainability science and policy agenda can thrive and have the greatest impact.^{1,2} It exists at the convergence of three of the more critical factors influencing environmental health and sustainability: the carbon cycle and carbon sequestration, climate and natural systems response, and renewable bioenergy (see Figure 1 right).

While these three foci establish ISSE's overarching research strategy, the institute's specialized centers and programs address a range of other issues that fall under the broad rubric of sustainability. Their stories are presented on the pages that follow, and together, they represent a range of multidisciplinary projects that directly benefit the state, its residents, and its communities.

ISSE's strategic direction has embraced strong

support of faculty, undergraduate and graduate students, and partnerships with Oak Ridge National Laboratory (ORNL). Among ISSE's new partnerships is the Center for Climate Change and Environment, a collaborative effort among ISSE, UT, and ORNL, using, among other resources, the world-class computing capabilities of the two organizations.

In September 2007, the ISSE-based China-US Joint Research Center for Ecosystem and Environmental Change, which occupies research facilities at UT/ORNL and the Chinese Academy of Sciences, convened its first international workshop, Environmental Aspects of Bioenergy Production and Sustainability, at UT. The workshop featured presentations by more than 20 US and Chinese scientists on the sustainable production of biofuels. This fall, the Chinese Academy of Sciences will host a reciprocal workshop in Beijing to continue the discussion. (See "Fueling the Future" on page 20.)

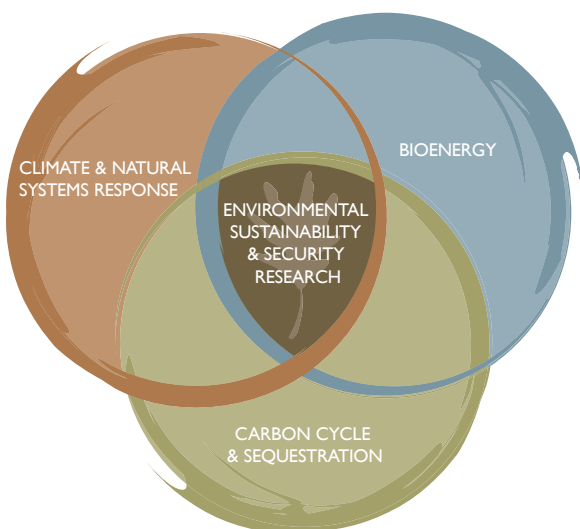


FIGURE 1: NEXUS FOR ISSE SUSTAINABILITY SCIENCE RESEARCH.

¹ Clark, W.C. "Sustainability Science: A Room of Its Own." Proceedings of the National Academy of Sciences, 2007. 104(6): 1737-1738.² Stokes, D.E. Pasteur's Quadrant: Basic Science and Technological Innovation (Washington, DC: Brookings Institution, 1997).

PROGRAMS TO BENEFIT THE STATE

As an adjunct to its focused research, ISSE has pursued a robust outreach program across the state. In this publication we highlight research and outreach activities, as well as projects that are ongoing.

ISSE's Center for Clean Products capitalized on growing corporate and popular interest in product stewardship, green materials, and green consumerism through projects that contribute to sustainable building materials, help rebuild the hurricane-ravaged Gulf Coast, and provide an environmental benefits calculator for the electronics industry. (See "Sustainability Enters the Boardroom" on page 16.)

Our Community Partnership Center advanced its efforts to inventory and preserve historic structures on the UT campus. (See "Stories Told in Brick and Mortar" on page 24.)

ISSE's East Tennessee Clean Fuels Coalition expanded its efforts to help reduce dependence on foreign oil, increase use of alternative transportation fuels, and improve regional air quality and sustainability. (See "Fuel Sell" on page 28.)

The Southern Appalachian Information Node created a Web-based toolkit that provides scientists and resource managers with a systematic approach for collecting and managing data. (See "Managing Mountains of Data" on page 34.)

Our Southern Appalachian Man and the Biosphere program hosted its 18th annual conference and addressed invasive plant species encroaching on the region. (See "Natural Capital" on page 40.)

ISSE's Technology Innovation for Education and Environment program helped organize and execute a workshop spanning two years that showcased ORNL's world-class research facilities and helped the state's teachers hone math and science skills. (See "Formula for Excellence" on page 42.)

The Tennessee Solid Waste Education Project reaches out to thousands of the state's K-12 students, helping to divert tons of trash from the state's landfills and create an environmentally literate citizenry. (See "Trash-can Sustainability" on page 46.)

Our Tennessee Water Resources Research Center

further developed its state-mandated training programs that address construction-site erosion and sedimentation—the leading causes of water-quality impairment in Tennessee. (See "Eroding Values" on page 50.)

ISSE researchers have appeared frequently in the local, regional, and national media as experts on multiple topics, including stream hydrology, nuclear waste, Gulf Coast reconstruction, historic preservation, interstate water conflicts, and alternative fuels. (See "Staff Citings" on page 54.) Our scientists have also published a number of articles in scholarly journals. (See "Publications" on page 59.)

We strongly believe that these activities have helped enhance quality of life, bolster education and awareness of environmental issues, and support the economic growth objectives of the State of Tennessee.

STRATEGY FOR THE FUTURE

For the next fiscal year, ISSE will continue to nurture relationships with academic departments and colleges as well as with ORNL. These strategic partnerships will focus on the areas of sustainable bioenergy production and computational climate modeling and science. The Center for Climate Change and Environment and the China-US Joint Research Center for Ecosystem and Environmental Change represent two specific programs that reflect these research foci. These efforts will be important for the economic growth of Tennessee and will provide national and international visibility for ISSE and the state's investments through its Center of Excellence funding.

If you have any questions or comments about ISSE's projects, programs, and staff, please don't hesitate to contact me.

DR. RANDALL GENTRY, DIRECTOR

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PHOTO BY DAVID BRILL

ISSE

The science that addresses today's and tomorrow's environmental issues must rise from a broad multidisciplinary foundation.

With that in mind, the University of Tennessee (UT) created the Institute for a Secure and Sustainable Environment (ISSE). Dr. Randall Gentry, associate professor in UT's Department of Civil and Environmental Engineering, directs ISSE and leads a core staff of 40 researchers.

A 2007 *New York Times* article cites ISSE as an example of the trend toward consolidating environmental research within self-standing centers at major US universities. ISSE researchers have operated in this multidisciplinary realm for more than 30 years.

AT A GLANCE

ISSE'S SPECIALIZED CENTERS

CENTER FOR CLEAN PRODUCTS works with industry to develop, evaluate, and promote cleaner products and cleaner technologies that minimize pollution at the source and contribute to long-term sustainable development.

COMMUNITY PARTNERSHIP CENTER is a research and outreach center that links university resources with urban and rural community organizations to address local needs and issues.

EAST TENNESSEE CLEAN FUELS COALITION promotes the use of alternative fuels, reduced reliance on foreign sources of oil, and improved air quality for the East Tennessee region. ETCFC is a participant in the national Clean Cities Program of the US Department of Energy.

SOUTHEASTERN WATER RESOURCES INSTITUTE is a multidisciplinary, multi-institutional research entity devoted to the study of science, technology, and public-policy issues related to surface and ground water.

SOUTHERN APPALACHIAN INFORMATION NODE, part of the National Biological Information Infrastructure, is a consortium of public and private partners who work together to build and maintain an integrated information system that serves as the gateway to regional biological information.

SOUTHERN APPALACHIAN MAN AND THE BIOSPHERE program is a public/private partnership that identifies and implements resource management and sustainability activities spanning political and geographic boundaries in the Southern Appalachians.

TECHNOLOGY INNOVATION FOR EDUCATION AND ENVIRONMENT supports research and application of emerging technologies for environmental, energy, and science education and training programs.

TENNESSEE MULTHAZARD MITIGATION CONSORTIUM was formed to assist in reducing future losses from natural and technological hazards by conducting research on various hazards and ways to mitigate their effects, developing educational tools, and working with other state and federal organizations in reducing losses.

TENNESSEE SOLID WASTE EDUCATION PROJECT fulfills the Tennessee Solid Waste Management Act's requirement that solid waste education be provided to the state's K-12 students.

TENNESSEE WATER RESOURCES RESEARCH CENTER is a federally designated state research institute supported in part by the US Geological Survey. The center serves as a primary link among water-resource experts in academia, government, and the private sector.



ISSE FACTS

- **THE ISSE RESEARCH STAFF COMPRISES** economists, biologists, ecologists, hydrologists, political scientists, planners, educators, communicators, chemists, engineers, accountants, sociologists, geographers, information-systems specialists, and historians.
- **STUDENTS IN DISCIPLINES** ranging from engineering to journalism support ISSE research and gain valuable professional experience.
- **IN FY08, ISSE HAD \$7.36M** under contract, and \$2.99M in external research dollars were spent. Key project sponsors include the US Environmental Protection Agency, US Department of Defense, US Department of Energy, Tennessee Valley Authority, the Getty Foundation, US Geological Survey, and Tennessee Department of Environment and Conservation.
- **MORE THAN HALF OF ISSE RESEARCHERS** hold PhDs or other terminal degrees.
- **ISSE TEAMS HAVE WORKED** with more than a dozen rural communities—many of them distressed or disadvantaged—in East Tennessee to develop sustainable growth plans.
- **ISSE SCIENTISTS HAVE COLLABORATED** with more than 100 manufacturers to reduce their products' environmental impacts.
- **FOURTEEN OF ISSE'S STAFF MEMBERS** serve as professors, research professors, or adjuncts in UT's academic departments.
- **ISSE RESEARCHERS SERVE AS TECHNICAL ADVISORS** to or sit on boards for numerous national agencies and organizations, including the DOE Laboratory Energy R&D Working Group, Healthy Building Network, and the National Research Council.
- **ISSE IS BASED AT A FULLY STAFFED AND ACCREDITED UNIVERSITY**, with eleven colleges, more than 1,400 faculty members, and over 300 degree programs. ISSE regularly draws on faculty expertise in pursuing its multidisciplinary research.

DIRECTOR:
JACK GEIBIG

POLICY DIRECTOR:
CATHERINE WILT

ESTABLISHED in 1992 in anticipation of the emerging national and global trend toward product stewardship, cleaner production, and green consumerism.

MISSION: To develop, evaluate, and promote cleaner products and cleaner technologies that minimize pollution at the source and contribute to long-term sustainable development.

ILLUSTRATIVE PROJECTS: Testing Sustainable Building Materials and Practices during Gulf Coast Reconstruction, Electronic Benefits Calculator, Natural Stone Council Project, Pharos Project.

KEY PROJECT SPONSORS: US EPA, Healthy Building Network, National Center for Environmental Research, Natural Stone Council, Rubbermaid Commercial Products, Tennessee Department of Environment and Conservation.

WEB SITE:
<http://isse.utk.edu/ccp/>

SUSTAINABILITY ENTERS THE BOARDROOM

When it comes to the fight to protect the planet, this ISSE center insists on keeping it clean—and green.

By Eric Ogle

As the litany of environmental woes facing the nation and globe grows in scale and complexity—much of it linked to hyper-consumerism and inefficient and wasteful production processes—the industrial community has begun to regard environmental stewardship as a cornerstone of good business. And ISSE's Center for Clean Products (CCP) is poised to help the nation's corporations—and consumers—make the transition to environmentally preferable products and production processes.

CCP was established in 1992 in anticipation of the emerging national and global trend toward product stewardship, green materials, and green consumerism. The timing was propitious; CCP was present at the birth of a new industrial movement that has burgeoned in recent years.

Consider, for instance, that worldwide investments in clean technologies soared 51 percent in the first three quarters of 2006, to \$761 million, according to an analysis by Dow Jones VentureOne and Ernst & Young.

CONVERGENCE OF TECHNOLOGY AND POLICY

Since its founding, CCP's partnerships have devised ways to redesign a wide range of products, including household and industrial cleaners, personal grooming products, product packaging, floor coverings, office furniture and supplies, electronics, automobiles, and modular homes.

Jack Geibig, an environmental and chemical engineer, directs CCP. Catherine Wilt, an environmental planner and political scientist, serves as policy director for the center. Along with ISSE Research Associate Amanda McKenna, also an environmental engineer, Geibig and Wilt bring the skills necessary to develop clean product technologies and shape the policies that promote their adoption.

Under Geibig's technical leadership, CCP works with manufacturers to analyze their manufactured goods and raw materials inventory along the supply chain using criteria such as recycled content, embodied

PHOTO BY DAVID BRILL





PHOTO BY DAVID BRILL

PARTNERS IN CLEAN: (L-R) Catherine Wilt, policy director; Jack Geibig, director; Amanda McKenna, research associate, of ISSE's Center for Clean Products help global corporations improve environmental performance and bolster bottom lines.

energy, volatile organic compounds, and toxic content. From there, CCP researchers quantify the product's life-cycle impacts on indoor air quality, human health, and global climate change, among other criteria. Armed with detailed information about these products, the center can work with suppliers to improve their formulations, products, and production processes accordingly.

Wilt's efforts have resulted in agreements among stakeholders from major industrial sectors to voluntarily divert waste products from landfills. For instance, Wilt facilitated the Midwestern Workgroup on Carpet Recycling. The workgroup, which included carpet industry and non-industry representatives, endorsed a national plan in which an independent, industry-funded organization looks for ways to recycle and reuse old carpet.

In another collaborative effort, Wilt helped facilitate the National Electronics Product Stewardship Initiative, which engaged government regulators, electronics producers, and other stakeholders in discussions to enhance collection, reuse, and recycling of electronics products in the United States.

"When an industry becomes part of the solution, that's good product stewardship," says Wilt, former president of the National Recycling Coalition. "By going through these decision-making processes with

stakeholders, we are providing incentives for products to be manufactured and managed in an environmentally conscious way, creating a beneficial situation for consumers, government, and the industries themselves."

ENVIRONMENTAL CERTIFICATION

In an effort to help guide consumers' purchasing patterns, CCP has worked extensively with Green Seal. Founded in 1989, Green Seal provides science-based environmental certification standards that are credible, transparent, and essential in an increasingly educated and competitive marketplace. CCP researchers have led the development of several Green Seal standards, including the newly developed standard for green cleaning services, GS-42.

To assist consumers, building contractors, and purchasing agents in their decision making, CCP has joined an international partnership to improve the selection process for sustainable construction and building materials. Announced in November 2006, Pharos is an evaluation tool that assesses building materials for their life-cycle environmental and human-health impacts. The tool further evaluates the social and economic impacts associated with raw material sourcing,

The University of Tennessee's Center for Clean Products, under a cooperative agreement with the US Environmental Protection Agency, developed the Electronics Environmental Benefits Calculator, which was recently used by the Green Electronics Council as part of its Electronic Product Environmental Assessment Tool (EPEAT).

EPEAT resulted in the development of IEEE 1680, a Standard for Environmental Assessment of Personal Computer Products.

A report issued by the Green Electronics Council used the calculator to estimate savings of 26.8 million tons of materials by manufacturers building machines following EPEAT guidelines.

Additional calculated benefits of following EPEAT guidelines include a savings of 13.7 billion kilowatt hours of electricity, enough to power 1.2 million US homes for a year; prevention of 61.7 million tons of air pollution, the equivalent of removing 852,000 cars from the road for a year; prevention of 130,000 tons of water pollution; reducing toxic material use by 1,179 tons; and, avoiding the disposal of 45,304 tons of hazardous waste. The full report is available online at <http://www.epeat.net/benefits.aspx>

CCP was recently selected to manage the process of creating the next generation of environmental performance standards for greener electronics. The research grant, in the form of a cooperative agreement with the US EPA, will allow CCP to build upon the work developed through the EPEAT.

~ERIC OGLE
AND DAVID BRILL

manufacture, and delivery of construction materials.

Pharos product evaluations communicate to consumers the key human-health and environmental sustainability indicators associated with a product's manufacture, such as use of renewable materials, embodied energy, or toxic content. Other categories rank corporate practices, occupational and consumer safety, stakeholder equality, and other socio-economic criteria, all of which, says Geibig "will change how consumers think about materials."

For retail consumers, evaluations are printed on a label that's attached to finished products, similar to nutritional labels on foods. For purchasing agents and contractors, the Pharos evaluation is included along with marketing literature and product information. These data are also accessible from the searchable Pharos Web site.

Another large-scale effort to move environmentally preferable building materials into the mainstream has CCP joining regional partners to rebuild the hurricane-ravaged Gulf Coast. Funded by a three-year grant from the US Environmental Protection Agency's (EPA) National Center for Environmental Research, CCP has partnered with the Healthy Building Network, Unity Homes, and Clayton Homes on the project.

"The Gulf Coast presents a tremendous opportunity to mainstream the absorption of healthy building materials and systems in the housing industry," says Geibig. "This project has immediate impact on people in need and allows us to make significant improvements in social and environmental sustainability requirements related to the housing industry."

The project brings a commitment to community health and the environment that extends through all elements of design and materials selection for modular housing.

"Not only are the materials acquired from sustainable sources," says Wilt, "the homeowner can expect lower maintenance and utility bills as well once the homes are completed."

DISAPPEARING WASTE

Though many of CCP's projects are national and even global in scope, Wilt insists on doing what she can to guide the East Tennessee community toward a more sustainable future. In 2005, Wilt helped

found the Tennessee Valley Earth Partnership (TVEP) to promote environmental education and awareness initiatives in the region and has served as the organization's president.

For the past seven years, Wilt has served as co-organizer and chair of the steering committee for TVEP's major annual event, EarthFest, one of the largest Earth Day celebrations in the Southeast.

EarthFest held its first "waste-free" event in 2006 at World's Fair Park in Knoxville, welcoming 10,000 guests and 100 exhibitors but producing only 152 pounds of non-recyclable materials. The 2007 event, which drew 14,000 people, produced only 25 pounds of non-recyclable or composted waste. The Tennessee Department of Environment and Conservation awarded TVEP a 2007 Governor's Stewardship Award for Environmental Education and Outreach.

A NEW MARKETPLACE

According to Geibig, the business community faces increasing pressure to adopt sustainable principles and practices, both in their primary operations as well as throughout their supply chains.

In response, mass-market retailers and institutional suppliers are taking steps to feature greener products in their catalogs and on their shelves. Wal-Mart, for instance, has targeted 20 percent

of its supply chain—168,000 suppliers strong—to offer products that are "environmentally preferable."

CCP was on a short list of environmental research organizations invited to the Wal-Mart "Live Better" Sustainability Resource Fair, held in Rogers, Arkansas, in 2007. There, Wilt and Geibig interacted with CEOs of some of Wal-Mart's leading suppliers, offering their services to companies eager to improve their environmental profiles but in need of guidance in making the transition.

The federal government is also helping to drive the market. EPA Executive Order 13101 requires federal acquisition of recycled, energy-efficient, bio-based, environmentally preferable products and services.

The federal government is the single largest institutional consumer of goods and services in the United States, spending more than \$200 billion annually.

With Wal-Mart and the federal government fueling demand for environmentally superior products and processes, Geibig, Wilt, and McKenna will have no trouble finding clients eager to clean up their acts.

For more information, contact Jack Geibig, 865-974-6513, or email jgeibig@utk.edu, or Catherine Wilt, 865-974-1915, or email catwilt@utk.edu.



COORDINATOR:

Jie (Joe) Zhuang

CREATED in 2006 to spur collaboration among top-tier scientists in China and the United States in response to environmental and energy issues.

MISSION: To address the combined effects of climate change and human activities on regional and global ecosystems and explore technologies for restoration of degraded environments and sustainable production of biofuels.

ILLUSTRATIVE PROJECTS:

Annual workshops, reciprocally hosted in China and the United States, that engage scientists from the two nations in collaborative research into the sustainable development of biofuel technologies.

KEY PARTICIPANTS:

ISSE, the UT/ORNL Joint Institute for Biological Sciences, UT's Center for Environmental Biotechnology, Purdue University Discovery Park's Center for the Environment, the Chinese Academy of Sciences' Institute of Geographical Science and Natural Resources Research and Research Center for Eco-Environmental Science, and the University of Science and Technology of China.

WEB SITE:

<http://isse.utk.edu/jrceec/>

FUELING THE FUTURE

This past September, researchers and national program leaders from China joined UT and other US colleagues in exploring ways to increase global biofuels production while reducing the fuels' environmental impacts.

By David Brill

Despite vastly different political structures and geographic regions, China and the United States face common challenges in meeting growing energy demand while reducing harm to the natural environment.

This past fall, a Chinese delegation of 16 senior researchers and program leaders from the Chinese Academy of Sciences (CAS) and the Ministry of Science and Technology of China visited the University of Tennessee (UT) to participate in a workshop focused on the "environmental aspects of bioenergy production and sustainability."

The workshop built on an initiative launched in July 2006, through which scientists from UT and Oak Ridge National Laboratory (ORNL) joined CAS researchers in establishing the China-US Joint Research Center for Ecosystem and Environmental Change (JRCEEC).

"China and US economies are the globally dominant drivers of fossil-fuel consumption and the release of greenhouse gases," says ISSE Research Director Jie (Joe) Zhuang, JRCEEC coordinator. "For that reason, scientists from both nations must strategically engage in the sustainable development of alternative and renewable energy sources."

US participants in the initiative include ISSE, the UT/ORNL Joint Institute for Biological Sciences (JIBS), and UT's Center for Environmental Biotechnology. ISSE co-sponsored the September workshop with JIBS.

Participating CAS units include the Institute of Geographical Science and Natural Resources Research and the Research Center for Eco-Environmental Science.

The China-UT center occupies research facilities at both UT/ORNL and CAS.



PHOTO BY DAVID BRILL

“The fast-growing bioenergy industry offers extraordinary opportunities for securing world energy, improving environmental protection, and mitigating climatic change,” says Gary Sayler, JIBS director and UT distinguished professor of microbiology, ecology, and evolutionary biology.

Bioenergy production uses rapidly renewable materials, like woody crops and biowastes, as fuel instead of coal, petroleum, and natural gas, which take thousands of years to regenerate.

“But biofuel production—particularly production of liquid biofuels like cellulosic ethanol—poses some significant challenges,” says ISSE Director Randall Gentry. “Substantial demands on land and water resources threaten food security and the biodiversity of ecosystems. The replacement of primary forests and virgin grasslands with energy crops may result in large releases of carbon from soils and forest biomass.”

These releases, says Gentry, “could potentially negate biofuels’ environmental benefits at the point of combustion.”

Through the three-day workshop, scientists explored both the promise and potential liabilities associated with biofuels production, addressing improved processes for converting lignocellulose to ethanol, genomic tailoring of plants and microbes for bioenergy production, landscape design for bioenergy feedstocks, carbon sequestration, and rural economic development associated with bioenergy.

Presenters represented JRCEEC participating organizations as well as the National Science Foundation, US Department of Energy, Purdue University’s Center for the Environment, and the H. John Heinz III Center for Science, Economics, and the Environment.

PHOTO BY DAVID BRILL



CHINA-US JOINT RESEARCH CENTER FOR ECOSYSTEM AND ENVIRONMENTAL CHANGE

ISSE RESEARCH DIRECTOR
JIE (JOE) ZHUANG.

In October 2008, the Chinese delegation will host a reciprocal workshop in China. Eight UT researchers will travel to Beijing and Shanghai along with 15 US scientists and others, including program leaders from the US Environmental Protection Agency, National Science Foundation, US Department of Energy, and the US Embassy in China.

“At the workshop, participants will discuss the long-term impacts of bioenergy production on global environmental change in the context of socio-economic and technology processes,” says Zhuang. “The workshop will seek to develop joint research/education programs between China and the United States in the areas of bioenergy production, feedstock management, and technology transfer.”

Specifically, the 2008 workshop will:

- Evaluate the potential of carbon sequestration through bioenergy production;
- Address the role of biomass management in protection of eco-environmental systems;
- Explore bioenergy strategies for incorporating social and economic factors into natural resources management and restoration;
- Develop a framework for large-scale China-US

joint research on the sustainability and security of bioenergy production; and

- Establish a mechanism to engage students and junior researchers in collaborative, cross-cultural projects that address bioenergy and global environmental change.

At the fall workshop, Purdue University’s Center for the Environment and the University of Science and Technology of China will officially join the partnership. JRCEEC has also submitted a proposal to the US Department of State to advance the China-US collaboration on renewable energy.

For more information, contact Jie (Joe) Zhuang, 865-974-1325, or email: jzhuang@utk.edu.

CHINESE AND US RESEARCHERS gather at UT in September 2007 to explore the environmental aspects of bioenergy production and sustainability.





PHOTO BY DAVID BRILL

ISSE'S PARKER WILL EVALUATE NATURAL CLEANUP PROCESSES AT DoD SITES

Jack Parker, a research professor with the University of Tennessee's (UT) Institute for a Secure and Sustainable Environment (ISSE) and its Department of Civil and Environmental Engineering, has received a two-year, \$187,000 grant from the Environmental Security Technology Certification Program (ESTCP) of the Department of Defense (DoD).

Parker's project will help DoD determine the long-term effectiveness of natural processes to degrade chlorinated solvent contamination on DoD sites. Chlorinated solvents are widely distributed groundwater contaminants that tend to persist in the subsurface environment.

Natural processes that reduce contamination over time, termed natural attenuation, involve naturally occurring microbes in soil and water that degrade toxic chemicals. Natural attenuation also includes other processes, such as volatilization and dilution. These processes occur without human intervention, although they are often utilized in conjunction with engineered systems to meet remediation objectives.

The ESTCP project teams Parker with Carmen Lebrón, Naval Facilities Engineering Service Center; Frank Chapelle, US Geological Survey; Mark Widdowson and John Novak, Virginia Tech; Michael Singletary, Naval Facilities Engineering Command Southeast; and Erica Becvar, Air Force Center for Engineering and the Environment.

For more information, contact Jack Parker, 865-974-7718, or email jparker@utk.edu.

DIRECTOR:

Tim Ezzell

ESTABLISHED in 1994 to create partnerships between the University of Tennessee and communities across the state.

MISSION: To link university resources with urban and rural grassroots community groups, to understand and address the core problems facing low- and moderate-income communities, and to create mutually respectful research and action partnerships that embody and promote equitable and democratic principles.

ILLUSTRATIVE

PROJECTS: The New Norris House, UT Campus Historic Preservation, "Little River, Big Future," Appalachian Teaching Project (Cosby Sustainable Gateway Plan), Knoxville African-American Tour of Cultural Heritage.

KEY SPONSORS:

J. Paul Getty Foundation, US Environmental Protection Agency, Tennessee Department of Environment and Conservation, Tennessee Valley Authority, Appalachian Regional Commission, ALCOA Foundation.

STORIES TOLD IN BRICK AND MORTAR

A Getty Campus Heritage Grant is helping the University of Tennessee inventory its wealth of historic buildings and sites scattered throughout its campus.

By Kris Christen

A Native American settlement. A Civil War battle. Civil rights protests. A World's Fair. These are just some of the events and goings-on that have occurred on the University of Tennessee's (UT) Knoxville campus. The campus, situated along the downtown riverfront, has been a cultural nexus for more than 200 years. Over that time period, numerous buildings have come and gone, but more than a third of the surviving structures on UT's campus today are potentially eligible for placement on the National Register of Historic Places.

"In many ways, this is one of the most historically significant campus sites in the nation," says Tim Ezzell, director of the Community Partnership Center (CPC), a subunit of UT's Institute for a Secure and Sustainable Environment. "We've got some great architecture representing a number of different styles and periods, as well as so many sites on campus that reflect much about the history of the university and the history of Knoxville."

A \$150,000 Campus Heritage Grant is now allowing the university to take full stock of these markers of the past. The J. Paul Getty Foundation, an international cultural and philanthropic institution, awarded the grant in 2006. Key goals include conducting a comprehensive review of historic structures and sites on campus and developing plans for preserving and enhancing them. The idea is to protect and maintain buildings that unite generations of students, alumni, faculty, and staff, says Ezzell, who is overseeing the project.

Indeed, that's why Getty created this program. "American college and university campuses are often museums of great architecture and design. They provide students, faculty, and visitors with both inspiration and a vital link to the past," says Joan Weinstein, interim director of the Getty Foundation. "Our grants have assisted these institutions as they make plans to care for, maintain, and preserve their important historic resources."



SCHOOL ON “THE HILL”

Founded in 1794, UT was the nation’s first non-sectarian institution of higher learning and is the 28th oldest college in the country. Relocated to a prominent nearby hill in 1826, the university overlooked downtown Knoxville and the Tennessee River. The original core campus makes up only a small part of today’s campus, but it remains at the heart of UT academic life and is known to students and alumni simply as The Hill.

Some 220 structures now dot UT’s 550-acre campus, and 35 percent of them are potentially eligible for placement on the National Register, according to Ezzell. Eighty-three of the buildings are more than 50 years old, 19 more than 75 years old, and four more than 100 years old.

Architectural styles run the range from the vernacular or traditional architecture of the 19th century to the modern movement of the mid-20th century, but in the middle is where most of it falls, says Carroll Van West, director of the Center for Historic Preservation (CHP) at Middle Tennessee State University and a UT alumnus. CHP is providing technical assistance for the project.

“Most of the campus is what we’d call Collegiate Gothic, a Gothic revival style that became popular for American universities starting in the 1860s and

HISTORIC PRESERVATIONISTS:

Community Partnership Center (CPC) Director Tim Ezzell and CPC Program Coordinator Eric Ogle in front of Ayres Hall, one of the many historic campus structures they’re helping to preserve.



PHOTO BY DAVID BRILL

HISTORY MEETS HI-TECH IN DOWNTOWN KNOXVILLE

ISSE's Community Partnership Center (CPC) is building a wireless broadband (Wi-Fi) network in downtown Knoxville to encourage asset-based economic and community development. For the first application, the CPC has partnered with several community organizations in Knoxville to create a wireless walking tour to promote African-American heritage tourism.

The tour features 15 historically and culturally significant sites in and around downtown. While at or near each site, with handheld Wi-Fi devices, users can read a brief narrative text about the site's importance and see photos of people, buildings, and locations relevant to Knoxville history. Users can also view a short video on the historic and cultural significance of each site.

The Beck Cultural Exchange Center is the lead community organization on the project. The Beck Center, part of the Knox County Library System, researches, collects, and preserves information and artifacts on African American achievement and culture. Knoxville's Carpetbag Theatre, a performing arts organization, has created digital stories that provide virtual interpretation of each site on the tour. Also involved is the Literacy Imperative, a community development organization in Knoxville's Empowerment Zone that promotes various forms of literacy and workforce development.

In addition to the 15 tour sites, the wireless network will be accessible for users at main public gathering areas throughout downtown such as Market Square, the Old City, Volunteer Landing, and downtown parks and green spaces. The network, which will cover the length of Gay Street, will also be available at other outlying areas and significant historic sites around downtown. A 2.5 square mile wireless broadband network will be available throughout downtown, allowing people to log on for free with any Wi-Fi-enabled device, such as a laptop, PDA, iPhones or other handheld device.

"With this cultural heritage tour, we hope to create an immersive experience for people to view historic photos and learn about notable people, past uses of various buildings, or happenings at significant sites while standing at or near the site," said CPC Program Coordinator Eric Ogle, who manages the project.

The UT Office of Information Technology (OIT) is providing technical support for the project. OIT boasts the largest on-campus wireless network in the nation.

For more information, contact Eric Ogle at 865-974-4562 or email eogle@utk.edu

~ERIC OGLE

remained popular through the 1940s,” Van West points out. “It was a real dominant trend, with different architects giving each building its own feel.”

The Hill by itself hosts quite a collection of Collegiate Gothic buildings erected from 1928–1935, with Ayres Hall being the most impressive example. “Its tower has really been the defining trait of the university,” Van West says, “standing as an icon for everyone who’s been on this campus for the past 80 years.” Morgan Hall, which was constructed in 1921 as the centerpiece of UT’s agricultural campus, is another stunning example of Collegiate Gothic.

Following this period, post-war modern style came into vogue and is showcased by the downtown UT Conference Center, Ezzell says. Then, during the early 1960s, a major campus expansion was undertaken under the auspices of urban renewal. A substantial portion of the main campus, including most residence halls and recreational facilities, was constructed during this period, Ezzell notes. The skyscraper-like McClung Plaza and Tower built in 1967 and the stair-step look of Hodges Library built in 1987 depict this style.

Elsewhere, vestiges of the Victorian era that once dominated Kingston Pike, a major thoroughfare running through the campus, can be found in several former carriage houses and outbuildings that date back to that building style.

“The overall design of the campus has a nice cohesiveness to it, but at the same time, there are interesting little bits of diversity between the buildings that make it fun,” Van West says.

As they move, building by building, Ezzell and Van West’s team are also digging through the archives to track down the stories behind the people who gave these buildings their prominence, as well as the events that took place around them.

“So many things have happened here, and a lot of people have come off this campus who are significant both regionally and nationally,” Ezzell explains. “It’s a rich legacy, and yet very little has been done to date to preserve that heritage.”

PRIORITIZING PRESERVATION

Inventory work began in fall of 2006. In evaluating and prioritizing what to preserve, Ezzell and Van West’s team rely heavily on criteria used by the National Register. These include architectural significance in terms of design; historical significance in terms of events that took place there; and connection to important people locally, regionally, and nationally. Building age and condition will also factor into the assessments.

Additionally, they consider other criteria such as “campus significance,” as there may be sites or structures that are important to the campus or alumni that might not fall under the other traditional criteria, according to Ezzell. The famous campus rock that’s splashed with paint before big games and other events is one example. “It’s not a building and not much of a site, but when they talked about moving it, the campus community reacted very strongly because it’s an important part of the culture and history of this place,” Ezzell notes.

As the two-year project runs its course, “we’ll place all of these properties into their architectural and historical significance,” Van West says. To go with the inventory is a list of the buildings, dates, and basic descriptions and photographs. “We’ll also put together a narrative explaining what we see as significant patterns and events associated with the campus and how the campus changed over time,” Van West adds.

Members of the UT community, including students, faculty, staff, alumni, and the public at large, have played an important role in the preservation planning process. A series of public meetings were held in 2007 at which participants discussed ideas and strategies for promoting and preserving the university’s historic and archaeological resources, Ezzell says. Final recommendations resulting from the project include creation of campus historic districts, interpretive signage, and new policies and processes to help protect and better utilize these important institutional assets.

For more information, contact Tim Ezzell, 865-974-9036, or email tezzell@utk.edu.

EXECUTIVE DIRECTOR:
Jonathan Overly

ESTABLISHED 2002 with funding from the Tennessee Department of Economic and Community Development, Energy Division, to develop a US Department of Energy Clean Cities Program partnership in East Tennessee.

MISSION: To reduce dependence on foreign oil, increase use of alternative transportation fuels, and improve regional air quality and sustainability.

ILLUSTRATIVE PROJECTS: Collaboration with numerous regional fuel suppliers and fleet operators to bolster use of alternative fuels, presentations to regional K-12 schools on alternative fuels, sponsorship of the Annual Run for Clean Air, and half-day biofuel workshops throughout the East Tennessee region.

KEY SPONSORS: UT-Knoxville, US DOE Clean Cities Program, Pilot Travel Centers, Eastman Chemical Company, Oak Ridge National Laboratory, Nu-Energies LLC.

WEB SITE:
<http://www.etcleanfuels.org>

FUEL SELL

While UT researchers explore new automotive energy sources, Jonathan Overly and his East Tennessee Clean Fuels Coalition are boosting the use of the alternative fuels we already have.

By David Brill

On a cool April morning, more than 400 runners gather along Cherokee Boulevard in Knoxville, stretching calves and hamstrings, taking in fluids, and stoking their internal engines with bananas and orange slices.

While the runners fuel up, a fleet of vehicles that includes everything from light-duty trucks to gas-electric hybrids to full-sized Knoxville Area Transit buses occupies a capacious parking lot beside the Tennessee River. All are powered entirely or in part by alternative fuels (alt-fuels)—biodiesel, ethanol, electricity, propane, compressed natural gas (CNG)—and together serve as thematic props for the fifth annual “Run for Clean Air.”

Jonathan Overly, the event organizer, can claim partial responsibility for the incremental—but nonetheless vital—improvements in the air the runners will draw into their lungs as they complete the 5K course.

Overly serves as the executive director of the East Tennessee Clean Fuels Coalition (ETCFC), a regional participant in the Department of Energy’s (DOE) Clean Cities Program, an outgrowth of the Energy Policy Act of 1992. Since 1993, roughly 90 organizations have earned the DOE Clean Cities designation, and collectively they promote alt-fuel production and use across the nation, in addition to more efficient use of traditional transportation fuels.

Overly, who was named coordinator of the year at the 2006 National Clean Cities Convention, also serves as an ISSE senior research associate.

BAD AIR DAYS

East Tennessee is home to some of the nation’s most visited recreation areas, including Great Smoky Mountains National Park. The region also claims a far less laudable distinction—in the American Lung Association’s “State of the Air: 2006,” the Knoxville–Sevierville–LaFollette triangle ranked as the nation’s 14th most ozone-polluted area. In the 2005 report, Knox County had the worst particle pollution in the state.

All of the fuels Overly promotes present cleaner emission profiles than conventional petroleum, but



he regards the biofuels—biodiesel and ethanol—as the low-hanging fruit of the alt-fuels suite.

“Biodiesel is called the ‘clean burn’ because it reduces emissions for almost all airborne pollutants,” says Overly, who himself drives a truck powered by the alt-fuel. “A blend of B20 (20 percent biodiesel and 80 percent petroleum-based diesel) reduces carbon dioxide emissions by 15 percent, sulfur dioxide by more than 19 percent, and particulate matter by 12 percent.”

Ethanol produced from corn, currently the main feedstock for the fuel in the United States, also achieves improvements over petroleum-based fuels in all tailpipe emissions, though the benefits are not as dramatic when lifecycle impacts are factored in.

THE BARREL AND THE DAMAGE DONE

Curbing air pollution is but one of ETCFC’s missions. The other key goals are reduced US dependence on petroleum and the economic growth and development spurred by producing and using alt-fuels.

Currently about 70 percent of the oil used in the US goes for transportation. And more than 60 percent of the petroleum fueling the quarter-billion vehicles operating on the nation’s highways—over 10 million barrels a day—comes from outside the United States, according to the federal Energy Information Administration.

“We borrow over \$250 billion per year for foreign oil,” says Overly. “ETCFC and the Clean Cities Program are helping to devise ways to direct that investment back into the US economy.”

Furthermore, Overly says, gasoline prices fail to reflect the real cost of petroleum, which should include the cost of environmental cleanup, the billions of dollars spent annually to protect oil corridors and oil shipments in the

Middle East, and the cost of transporting petroleum thousands of miles from foreign lands.

Overly hastens to point out that 100 percent of the biodiesel and ethanol, 95 percent of the electricity and propane, and 90 percent of the natural gas we use are produced domestically. Biodiesel and ethanol, which are renewable, promise significant economic rewards to the nation’s alt-fuel producers, including farmers who grow the feedstocks.

The governor of Tennessee, Phil Bredesen, pledged \$72.6 million in research funds and created an alt-fuels working group to “increase Tennessee’s use of renewable alternative fuels.”

MAN WITH A MESSAGE

The realm of education and outreach to increase demand is where Overly’s organization really shines. When Overly established ETCFC in 2002, not a single public or private fleet in East Tennessee was powered by either biodiesel or ethanol. Four or five were using other alt-fuels but only on a relatively small scale. What’s more, few individuals or fleet managers had more than a passing knowledge of alternative fuels or a notion of where to find them.

Today 10 suppliers in East Tennessee can provide biodiesel blends to their customers, and more than 30 public and private fleets use blends ranging from B20 to B100 (pure biodiesel). The alt-fueled fleets in East Tennessee include UT, the Knoxville Utilities Board (KUB), ALCOA Inc., the cities of Sevierville and Gatlinburg, and the DOE facilities in Oak Ridge.

According to Overly, all 900 of KUB’s vehicles run on alt-fuels.

Many of the region’s consumers are burning E10 (10 percent ethanol and 90 percent gasoline) without even realizing it, says Overly. Some 80 percent of the pumps in the region now sell E10.

“Without the efforts of ETCFC, Tennessee would not have been in the position to do what it is doing now with alt-fuels,” says Paul Sloan, deputy commissioner of the Tennessee Department of Environment and Conservation. “Jonathan has gained the confidence and respect of businesses and governmental users.”

ETCFC draws its income from federal and state grants, membership dues, and sponsorship from its partners, which include Oak Ridge National Laboratory, Eastman Chemical, and Pilot Travel Centers. Nu-Energie LLC, a biodiesel production company based in Hawkins County, recently became an ETCFC partner and awarded the coalition \$10,000.

The annual Run for Clean Air is one of ETCFC’s many public events intended to raise awareness and acceptance of alt-fuels among private consumers, as well as with public and private fleet operators. While the Run for Clean Air might be called a “soft sell,” Overly’s crusade to boost alt-fuels use can assume a more direct approach. In March, Overly staged a half-day biodiesel workshop—one of a dozen such events he’s organized since 2004—in Morristown, Tennessee. Through that event Overly made the case for alt-fuels and presented a number of public and private fleet operators who had made the switch to biodiesel and were happy to give their testimonials and offer advice to prospective users.

Similar efforts have contributed to widespread adoption of alt-fuels, chiefly biodiesel, by municipal and county—as well as private—fleets in many of East Tennessee’s 33 counties.

In 2006, Overly reports, alt-fuel use in East Tennessee displaced 5.5 million gallons of petroleum-based fuels and eliminated more than 22,000 tons of carbon-dioxide emissions. Nationally, domestic biodiesel use increased from a half-million gallons in 1999 to 450 million gallons in 2007, according to the National Biodiesel Board (NBB). NBB reports that the 105 US biodiesel manufacturing plants boast an annual production capacity of 864 million gallons.

“Biodiesel is an easy-to-use fuel in that B20 formulations don’t require any modifications to diesel vehicles or their engines,” says Overly. “In fact, Rudolf Diesel’s first engine ran on peanut oil.”

WHATEVER IT TAKES

Though Overly assumes many roles for ETCFC, he regards himself first and foremost as a salesman, and he’s learned that drawing people into the alt-fuels tent can require different messages.

“Some people don’t care all that much about air quality, but I can hook them on buying fuels produced right here at home,” says Overly. “Others couldn’t care less about where their fuels come from, but they care deeply about improved air quality.”

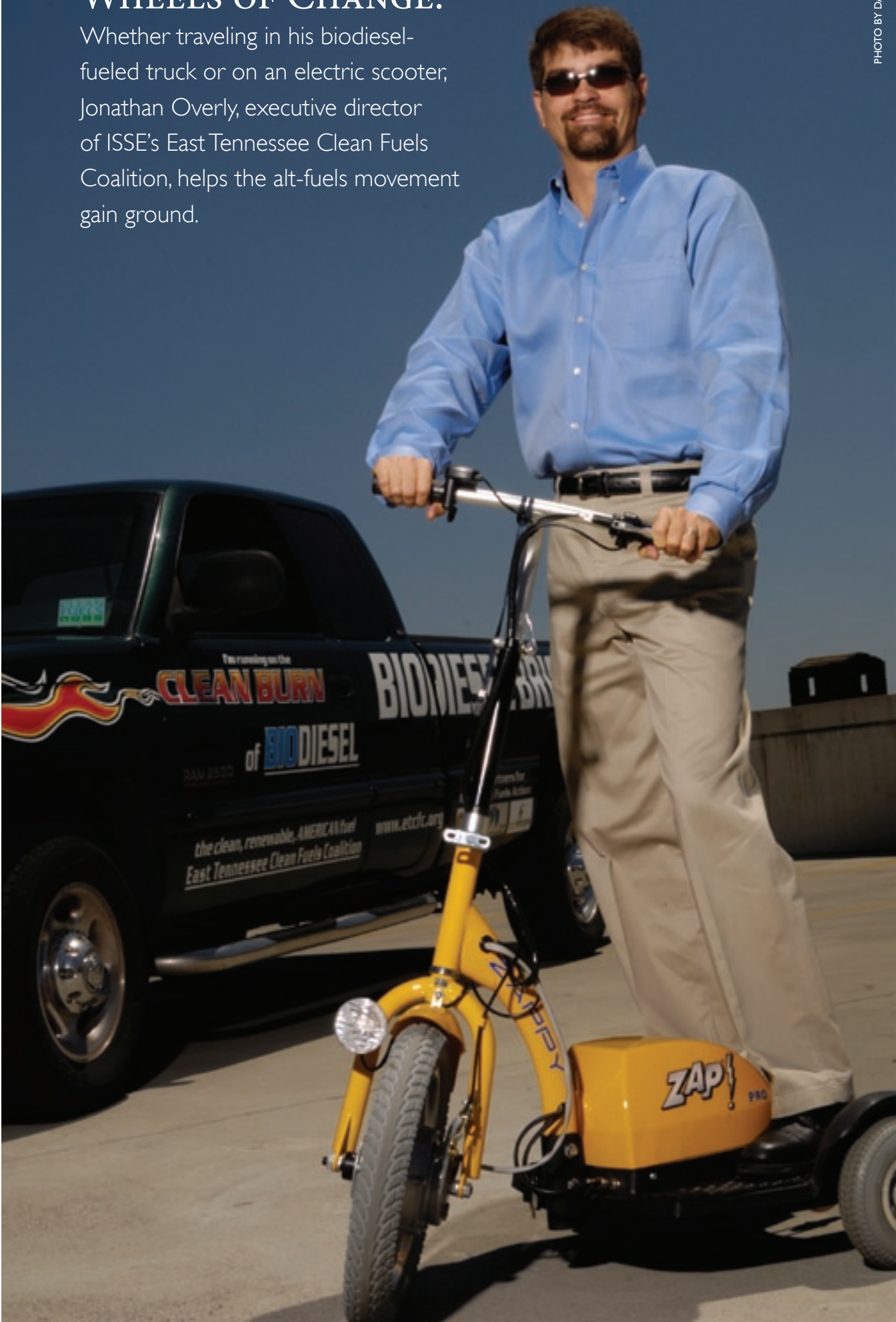
In the end, motivations don’t matter all that much.

“When it comes to adoption of alt-fuels,” he says, “regardless of what prompts it, it’s all good—good for the region, good for the nation, and good for the environment.”

For more information, contact Jonathan Overly at 865-974-3625, or e-mail jgoverly@utk.edu.

WHEELS OF CHANGE:

Whether traveling in his biodiesel-fueled truck or on an electric scooter, Jonathan Overly, executive director of ISSE's East Tennessee Clean Fuels Coalition, helps the alt-fuels movement gain ground.





WEALTH OF EXPERIENCE

These researchers lend collective decades of knowledge to the ISSE research enterprise and have participated at the highest levels of science and policy.



MARY ENGLISH

ISSE Research Leader

PhD, Sociology, University of Tennessee, Knoxville

MS, University of Massachusetts, Amherst

BA, Brown University

Over the past 20 years, Mary English's work has focused on a variety of environmental and energy policy issues, including policies for conventional and alternative energy sources, radioactive waste management, Superfund site clean-ups, and land-use management.

As a parallel, English's research has explored the practical and ethical need to improve environmental decision making. This research has considered, for example, the complexities of identifying "community" members and involving stakeholders as well as the need for appropriate information-gathering and analytic tools.

English is a member of the Tennessee Air Pollution Control Board and the Board on Environmental Studies and Toxicology of the National Research Council (NRC). In July 2008, she was appointed to the new NRC study committee on Health, Environmental, and Other External Costs and Benefits of Energy Production and Consumption. She has served on the NRC's Board on Radioactive Waste Management and several other NRC study committees. English has also served on the US Environmental Protection Agency's National Environmental Justice Advisory Council and the National League of Women Voters' Advisory Committee to the Nuclear Waste Education Project.



WILLIAM FULKERSON

ISSE Senior Fellow
PhD, Chemical Engineering, Rice University
BA, Rice University

Since 1994 William Fulkerson has chaired the Department of Energy (DOE) Laboratory Energy R&D Working Group (LERDWG), an organization of energy R&D managers from 14 DOE laboratories. During 1999 and 2000 LERDWG helped the Under Secretary of Energy analyze the DOE energy R&D portfolio with respect to its adequacy for making progress on DOE strategic goals related to the environment, the economy, and national security. More recently, LERDWG has assisted DOE in planning the National Climate Change Technology Initiative of the Bush Administration and in drafting a strategic plan for the Clean Energy Technology Export Initiative.

Fulkerson served as a member of the Energy R&D Panel of the President's Committee of Advisors on Science and Technology; he chaired the fossil energy task force of that panel. He served as member of the Board on Energy and Environmental Systems of the National Academy of Sciences from 1996-2002.

Recently Fulkerson has been involved with the Seminars on Global Emergencies held annually in Erice, Italy, by the World Federation of Scientists. Before joining ISSE, Fulkerson was associate laboratory director for Energy and Environmental Technologies at the Oak Ridge National Laboratory (ORNL).

Fulkerson, a fellow of the American Association for the Advancement of Science, made a presentation titled "Framework for Managing Climate Change and Recommendations from Erice, 2007" at the scientific session on managing climate change at the conference Energy & Climate: Managing Climate Change and the Recommendations of the World Federation of Scientists, held at the Papal Academy of Sciences, the Vatican, in December 2007.



MILTON RUSSELL

ISSE Senior Fellow
PhD, Economics, University of Oklahoma
MA, University of Oklahoma
BA, Texas College of Arts and Industries

Milton Russell is a professor emeritus of the UT Department of Economics. His current research focuses on analysis of the intersection of energy and environmental policy. Before coming to UT and Oak Ridge National Laboratory in 1987, Russell served as an assistant administrator of the US Environmental Protection Agency (EPA), directing its policy, planning, regulatory development, and evaluation functions. At EPA he developed systems and procedures for implementing the risk-based approach to environmental management. He also began a long-standing involvement with Chinese environmental policy and implementation that he has continued in Tennessee. In 1992, Russell was founding director of the Joint Institute for Energy and Environment, which has since been merged into ISSE.

Russell served at Resources for the Future (RFF) from 1976-1983, and became director of RFF's Center for Energy Policy Research in 1979. From 1974-1976, Russell served as the senior staff economist for energy on the President's Council of Economic Advisers.

Earlier in his career Russell was economics professor and department chair at Southern Illinois University, Carbondale. He has also taught at Iowa State University, Texas Christian University, and the University of Edinburgh, Scotland.

Russell has chaired and participated in numerous national energy or environment advisory committees including those for the National Academy of Science/National Research Council, Department of Energy, and EPA and chaired the oversight review board of the National Acid Rain Program and the Environmental Oversight Committee for the Savannah River Nuclear Site.

**TECHNOLOGY AND
INFRASTRUCTURE
COORDINATOR:**

Thomas Burley

ESTABLISHED in 2000 as a regional node of the National Biological Information Infrastructure (NBII).

MISSION: To improve access to information related to the biological resources of the Southern Appalachian region.

SAIN's core service area includes Alabama, Mississippi, Tennessee, and Kentucky. The node works to link the biological resources of these states to make valuable information more accessible to educators, natural resource managers, policymakers, researchers, and other sister agencies of the US Geological Survey.

SAIN provides information on best sustainability practices, fire management, regional ecosystems, invasive species, and rare species and ecological communities.

KEY SPONSORS: National Biological Information Infrastructure—Southern Appalachian Information Node, Southern Appalachian Highlands Conservancy, US Fish and Wildlife Service—Asheville Field Office.

WEB SITE:
<http://sain.nbio.gov/>

MANAGING MOUNTAINS OF DATA

Two ISSE researchers set out to make sense of decades of research on Roan Mountain and, in the process, create a toolkit that provides scientists and resource managers with a systematic approach for collecting and managing data.

By Noa Davidai

Roan Mountain, which straddles the North Carolina and Tennessee border in the Southern Appalachians, is home to myriad natural community types and rare plant and animal species. In fact, Roan Mountain possesses a high concentration of imperiled biodiversity and thus must be protected.

But how do you protect something if you haven't catalogued all that's there? In the 1980s, researchers responded to that challenge by launching a large-scale botanical survey of Roan Mountain, setting up huge study plots and collecting piles of data.

Today, more than 20 years later, many of its researchers have moved on to new jobs and are dispersed across the country. As they dispersed, the data scattered with them, leaving a puzzle lacking a few key pieces. In some cases, the data were organized and entered in a way that's difficult for contemporary researchers to decipher. In other cases, the data were entered twice, resulting in the duplication and further confusion.

The problem with mismatched and fragmentary datasets quickly became evident to ISSE Senior Research Scientist John Peine, a social scientist for the Southern Appalachian Field Branch of the US Geological Survey (USGS), and Thomas Burley, ISSE research associate. In 2005, Burley and Peine proposed a project to the Southern Appalachian Information Node (SAIN) to conduct an assessment of priority legacy data and information related to the balds of Roan Mountain.

Burley is technology and infrastructure coordinator for SAIN, which is part of the National Biological Information Infrastructure (NBII). NBII is a consortium of public and private partners who work together to build and maintain an integrated information system that serves as the gateway to regional biological information.

Grassy balds are non-forested regions in the southern



Appalachians that are home to rare and sensitive plant species, as well as “islands” of unique plant communities. The balds’ main threats include encroachment by woody vegetation and invasion by exotic species.

DATA DILEMMA

In Tennessee, part of the Appalachian Trail (AT) cuts through one of the Roan Mountain balds. The 2,175-mile AT, part of the National Scenic Trail System, brought Burley and Peine out to the Roan Mountain bald in 2005. The open meadows, long views, and vast variety of plant species were, says Burley, “like nothing I’d ever seen before.” Burley and Peine had traveled to Roan Mountain as part of a project to bring together agencies, organizations, and scientists doing related research along the AT and to promote data sharing and collaboration. The goal was to determine the current status of natural resources along the AT corridor and provide resource managers with the tools they need to make informed decisions.

But as Burley quickly observed, this was a much more challenging task than simply piecing together bits of data from here and there. Over the years, sampling practices had changed, and technical advancements introduced new data-management methods and challenges. As a result, old and new datasets were often incompatible.

Some scientists used shorthand codes, others used Excel or Access spreadsheets, and yet others, particularly those operating in the days before widespread use of personal computers and Global Positioning Systems (GPS) technology, logged their data using pencil and paper.

In addition to the AT project, Peine had also been attempting to utilize past Roan Mountain studies for a larger purpose. Since Roan Mountain is such a “hot spot for nationally threatened and endangered species,” says Peine, “it is ideal for looking at the effects of global climate change.” According to Peine, 171 people had collected experimental and observational

data on Roan Mountain over the past 30 to 40 years. All in all, he and Burley looked over about 900 data documents. But when they tried to synthesize the information, Peine and Burley found the data to be difficult—if not impossible—to interpret. It was, sadly, “a great opportunity lost,” Peine says.

EMBARKING ON A CHALLENGE

This series of events, from visiting Roan Mountain to struggling with unmatched and puzzling datasets, brought about the idea for the Roan Mountain Project. The project’s main goal is to help facilitate systematic data management for on-the-ground resource managers. According to Peine, systematic data collection is vital for today’s scientists but even more important for future research efforts.

Today’s scientists survey natural areas that are rarely pristine or unaffected by anthropogenic influences. Accessible and usable data for these regions that were recorded prior to large-scale human impacts, encroachment of invasive plant and animal species, and increasing issues of climate change would be invaluable, says Peine. Likewise, data collected today will one day preserve a record of past conditions, and it would be a shame to not be able to use it.

“Where data are concerned, older is better,” Peine says. “If you have the foundation data, it makes a place unique because you can compare what’s here now to what was here then. It’s one of the critical elements of our project.”

NBII awarded Burley and Peine two years of funding to pursue the Roan project, which has teamed them with Judy Murray, the Highlands of Roan stewardship director for the Southern Appalachian Highlands Conservancy (SAHC). Over the years, Murray had spearheaded efforts to coordinate the various partners working on Roan Mountain, among them the US Forest Service, US Fish and



Wildlife Service, National Park Service, and the Nature Conservancy.

Nora Schubert, Murray's SAHC seasonal ecologist, was tapped to contact the original research partners and collect existing data on Roan Mountain.

PIECES OF THE PUZZLE

As a guide, Schubert used the Federal Geographic Data Committee (FGDC) standard for geospatial metadata along with the NBII Biological Profile Extension to identify and evaluate the critical components of datasets. The process of creating metadata (essentially, "data about data") for older findings provided valuable insight into the prior research. The FGDC standard is designed to identify the data's critical technical components. In addition, Burley says, it "looks at who was involved, when the research was conducted, and the primary research goals. Answering these questions is at the heart of creating legacy metadata."

To obtain some of the data, Schubert often had to contact the original researchers, among them scientists from the 1980's botany survey on Roan Mountain who had since moved to Mississippi and

Massachusetts. They had kept the hard copies of their data in boxes in their garages with the hope of one day doing something with them, says Burley. Over 18 months, Schubert obtained and organized approximately 12 legacy datasets—chiefly older datasets that provide baseline information. Once Schubert had collected the who, what, when, and why components of a dozen Roan Mountain datasets, Burley organized them and boiled them down to an overview of Roan Mountain legacy datasets spanning from the mid-1980s to 2006. Though this overview is an important part of the Roan Mountain project, it also enabled Burley to develop a Data Management Toolkit that addresses many of the problems identified in the legacy datasets.

A UNIVERSAL GUIDE

According to Burley, the Data Management Toolkit is a "guide/handbook that acts as a review of critical things to think about when planning a research project." Among other elements, the toolkit provides guidelines for best practices of project management and helps research teams



establish a quality assurance plan.

“Overall, data quality is becoming a big issue,” says Burley, “because we are currently experiencing a big Geographic Information System (GIS) boom, with such systems as Google Maps and Google Earth.”

With so many different data resources and data types out there, says Burley, there’s an increasing number of sources of error in data collection. Combining data from different time periods, different sources, and different mapping resolutions requires considerable forethought to bring consistency to the actual data-collection process.

Peine explains that “the Data Management Toolkit provides comprehensive guidelines on how to proceed in designing a data-collection and management protocol.”

Paul Bradley, former district ranger of the US Forest Service-Region Eight, articulated the need for improved data management, in a January 2006 personal letter of support for the SAIN Roan Mountain project.

“Improving documentation of and access to biological data collected on the Roan has long been

a high priority of biologists and managers,” Bradley writes. In fact, “these needs have been recognized as critical to the long term success of management activities taking place within the extremely sensitive and internationally significant resources of the Roan Massif for more than 20 years.”

Organizations such as the US Forest Service and National Park Service are aggressively trying to standardize their data-collection efforts, and the USGS will publish the Data Management Toolkit as an open-file report to make it available to everyone. The toolkit is especially relevant to organizations such as NBII, which focus on using technology to link databases of biological inventories.

Though the Roan Mountain project is officially complete, Peine and Burley continue to pursue related research. “We don’t want to stop just because we’ve produced a final report,” Peine says. He and Burley remain available for consultation on use of the toolkit, and Burley is an experienced trainer in all aspects of the project.

For more information, contact Thomas Burley at 865-974-4251, or email tburley@utk.edu.

INNOVATIVE WEB SITE DOCUMENTS

Small Steps, Great Strides

The effects of human development, including urban sprawl and air pollution, are a particular concern in the Southern Appalachian Highlands due to the proximity of metropolitan areas to national, state, and local parks; private forests; and agricultural land. Working quietly behind the scenes, or on the front lines of community action, motivated leaders are taking strides toward conserving this unique landscape for the enjoyment of future generations.

The efforts of more than 70 organizations in the region have now been assembled and documented on one Web site. The Best Sustainability Practices (BSP) site, supported by the US Geological Survey's Southern Appalachian Information Node (SAIN), recently received backing from ISSE. The organizations highlighted on the site share a sense of urgency in three basic areas of stewardship: environmental conservation, sustainable development, and growth management.

For instance, Sevier County, a tourist mecca for millions of visitors each year, must deal with 775 tons of waste generated each day by visitors and residents. Community leaders found a sustainable solution to its extraordinary waste-management problem by implementing a cost-effective composting-based technology, one of only nine of its kind in the world. The facility receives national and international attention for its innovative approach.

In another effort, a dedicated group of citizens in Cocke County, Tennessee, have fought since 1986 to clean up and restore the Pigeon River, which had been used for the discharge of industrial waste since 1908. The Dead Pigeon River Council was a leader in returning the river, downstream of a pulp and paper mill in Canton, North Carolina, to the relatively pristine quality of the river above Canton.

The BSP Web site has been recently expanded and updated. A brochure highlighting a few of the outstanding case studies is available, and a newsletter was launched in summer 2008. The newsletter is issued via email to dozens of UT faculty involved in sustainability coursework and to more than 30 regional universities and colleges with environmental programs.

In September, Tennessee state planners who consult with 47 communities in East Tennessee will receive training in the use of the Web site. In addition, lesson plans are being prepared to help high school teachers integrate the use of the site in their environmental class work.

A symposium on sustainability, sponsored by the Knoxville-Knox County Metropolitan Planning Commission and featuring Ed McMahon of the Urban Land Institute, enjoyed an overflow crowd in August at the Knoxville Convention Center.

More than 150 BSP brochures were distributed to participants.

The concept of sustainability, once confined to a small group of visionary leaders, is now reaching a critical mass in terms of community awareness and understanding. As stated by Lamar Alexander in the spring issue of ISSE's newsletter, *Indicator*, improving sustainability occurs one step at a time. The BSP Web site has documented over 70 of those important steps.

For more information, visit the BSP Web site: <http://bpappalachia.nbio.gov/portal/server.pt>

To order a copy of the brochure, or to subscribe to the newsletter, email Dylida Ries at dries@utk.edu



DEFENDERS OF THE SOUTHERN APPALACHIANS:

(clockwise from lower left) Thomas Burley, technology and infrastructure coordinator for the Southern Appalachian Information Node (SAIN); John Peine, social scientist for the US Geological Survey; SAIN graduate assistant Nai Wimolrat; and Susan Schexnayder, program manager for the Southern Appalachian Man and the Biosphere project help the region balance economic development and growth with environmental preservation.

PROGRAM MANAGER:

Susan Schexnayder

ESTABLISHED in 1988 as part of the international Man and the Biosphere Program.

MISSION: to promote environmental health, stewardship, and sustainable development of natural, cultural, and economic resources in the Southern Appalachians.

The SAMAB cooperative comprises 13 federal agencies; the natural resources department of the states of Tennessee, North Carolina, and Georgia; and the tribal organization Eastern Band of the Cherokee Indians (EBCI).

SAMAB's nonprofit foundation is the partnership's link to the private sector. Its nonprofit status allows the organization to seek outside funds and grants.

KEY PROJECT

SPONSORS: US Forest Service, US Fish and Wildlife Service, Oak Ridge National Laboratory, Tennessee Valley Authority, US Environmental Protection Agency, National Forest Foundation, National Fish and Wildlife Foundation.

WEB SITE: <http://samab.org/>

NATURAL CAPITAL

Through its annual conference, the Southern Appalachian Man and the Biosphere program assembles key stakeholders to explore challenges affecting management of the region's natural resources.

By Elise LeQuire, Noa Davidai, and Susan Schexnayder

For 18 years, the Southern Appalachian Man and the Biosphere (SAMAB) program has hosted annual regional conferences focused on key issues affecting the economic and environmental health of the Southern Appalachians.

The annual conference is not entirely a science meeting, nor is it primarily a community meeting, says ISSE researcher Susan Schexnayder, who manages the SAMAB program. The SAMAB annual conference is, in fact, “a hybrid,” says Schexnayder, “that brings together academia, government, and regional communities in a forum that encourages information sharing and productive communication.”

SAMAB's annual conference in October, 2007, in Johnson City, Tennessee, focused, in part, on unwelcome invasive plant species encroaching on the region.

“Land and water managers have learned that controlling an invasive plant once it is established in an area is expensive and time consuming, and success is not assured,” Schexnayder says. “Prevention is a preferable approach, and where that's not possible, managers should strive to identify invasives early, before they have a chance to become established.”

As part of the conference, SAMAB hosted a workshop to familiarize land and water managers in the Southern Appalachian region with strategies for preventing—or at least minimizing the possibility of—introduction of invasives on their managed properties.

“Success at limiting new introductions to the southern Appalachians will require the collective efforts of all of us who have responsibility for land and water resources,” says Nancy Fraley, a key organizer of the workshop and leader of the National Park Service's Southeast Exotic Pest Plant Management Team. Fraley noted that a wide variety of people—transportation maintenance crews, park managers, and private landowners, just to name a few—have important roles to play in preventing the spread of invasive plants.

Participants in the workshop included private land managers, foresters, and representatives from several National Forest and National Park units.

Among the presenters were Alix Cleveland, the USDA Forest



Service's Region 8 invasives activities leader; Rita Beard, the National Park Service's invasive plants coordinator; and Richard Schwab, leader of the interagency Burned Area Emergency Response Program.

Each emphasized cooperation, pre-project planning, and the importance of having an invasives specialist, or, at minimum, a botanist, involved in project planning and implementation for activities ranging from road construction to stream restoration.

Bonnie Harper-Lore, with the Federal Highway Administration, made clear the transportation sector's role in controlling invasives, reminding participants that the Federal Highway Administration manages 12 million acres of roadside green space.

David Moorhead of the University of Georgia discussed a range of best management practices for all types of soil-disturbing activities, and emphasized the importance of knowing what is growing adjacent to a managed area. To help build this knowledge, Moorhead and Chuck Barger, also of the University of Georgia, have collaborated on the Early Detection and Distributions Mapping System (www.EDDMaps.org). The system, which serves as a central source of information on invasive plant occurrence, allows new sightings to be reported and verified.

NATURAL RESOURCES AND THE ECONOMY

The take-home message that emerged from the 17th annual Southern Appalachian Man and the Biosphere (SAMAB) conference, held in 2006 in Gatlinburg, Tennessee, is that economic development and population growth can successfully coexist with natural resource stewardship in the southern Appalachians. "Development is inevitable," says Schexnayder. "If we're thoughtful in planning for it, we can sustain growth while providing for environmental protection and land conservation."

A case in point is the Lake James project in Burke County, North Carolina. Rural Burke County, adjacent to Pisgah National Forest and the Linville Gorge Wilderness, has been used for recreation for more than 100 years but recently has been threatened by ecologically destructive development.

Through a partnership among federal, state, and local representatives, a land trust, a private developer, and property owners, planners were able to devise a model of development that meets recreational, conservation, and scenic needs while allowing compatible economic development.

"An economic impact statement of Lake James shows there has been an infusion of millions of dollars, in addition to enhanced recreational and economic opportunities," says panel moderator Judy Francis, community partnerships and economic development liaison for the North Carolina Department of Environment and Natural Resources.

SIMPLE—BUT IMPORTANT—MISSION

Ultimately, SAMAB's goal is to "promote a harmonious relationship between humans and environment," says Schexnayder. With the cooperation of so many organizations, SAMAB has the ability "to facilitate goals that are broader in scope, broader in geography, and perhaps broader than the mission of any other individual agency," she says.

The 2008 SAMAB conference in Asheville, North Carolina, will focus on synthesizing the region's climate variability research with management implications specific to the Southern Appalachians. "The goal," says Schexnayder, "is to share the best science we have about climate variability and management implications so that land managers and community planners can make sure that their activities are effective."

For more information contact Susan Schexnayder at 865-974-5912 or email schexnayder@utk.edu.

DIRECTOR: Sheila Webster

ESTABLISHED in the 1980s to bolster collaboration among UT, scientific resources in Oak Ridge, and educators and researchers.

MISSION: to support research and application of emerging technologies for environmental, energy, and science education and training programs.

ILLUSTRATIVE PROJECTS:

Mathematics and Science Partnership; Teacher Excellence for Advanced Math and Science, Energy Conservation for Students and the Global Community, Hazardous Materials Compliance and Mass-Fatality Incident Training, Tennessee Solid Waste Education Project, Oak Ridge Experience Summer Institute.

KEY PROJECT

SPONSORS: Tennessee Department of Education, ALCOA, Tennessee Department of Environment and Conservation, US Department of Energy, Tennessee Valley Authority, Oak Ridge Institute of Science and Education, National Institute for Environmental Health and Safety, Environmental Technology Energy Business Association.

FORMULA FOR EXCELLENCE

Backed by Tennessee's world-class research resources, a two-year program helps the state's teachers hone math and science skills and open career doors for their students.

By Pam Strickland

As Tennessee competes to improve the quality of science and math education across the state, a new two-year program for high school teachers is helping them capitalize on the state's scientific resources.

The Mathematics and Science Partnership, a project among the University of Tennessee (UT); Oak Ridge National Laboratory (ORNL); Middle

Tennessee Mathematics, Science, and Technology Education Center at Middle Tennessee State University (MTSU); the University of Memphis; and the Oak Ridge Institute for Science and Education (ORISE), engages teachers from throughout the state.

The program started with a series of four-day workshops in Oak Ridge during summer of 2007 designed to expose teachers to current discoveries in the field of science and give them the tools to use that knowledge as they educate their students.

During the initial workshop in July, teachers met with top scientists and educators from UT, ORNL, and ORISE. They toured some of the world's most advanced laboratory facilities and learned about applications of technology not reflected in current textbooks.

For program participant Joy Wilson of Murfreesboro, Tennessee, ORNL had existed more as a historical site than a vibrant place where scientists and mathematicians continue to advance new discoveries that are changing our world.

"I knew the history of the lab's atomic research, and that's all that ever registered when I heard the name Oak Ridge," says Wilson. "I had no idea about the cutting-edge science that's going on there today."

Her opinion changed this past summer when Wilson, who teaches advanced placement calculus, statistics, and physics at Rutherford County's Blackman High School, joined 120 other Tennessee teachers participating in the program.



THE POWER OF INNOVATION

The program's purpose is simple, says Sheila Webster, research program development director for the University of Tennessee's (UT) Institute for a Secure and Sustainable Environment.

"These teachers are learning about the latest innovations taking place in the lab," says Webster, who represents UT in the program. "Through this program, they will be able to integrate those scientific processes and discoveries into the math and science classes they teach."

Teachers taking part in the program will be prepared to teach top-level science classes in their schools and bring innovative approaches to their classrooms. Webster says that, in addition to imparting advanced math and science skills, the program will help expose students to the new career opportunities in the research fields.

"It has been extremely valuable for teachers to see the work at Oak Ridge. It provides them with new perspective and energy to take back to the classroom," says Dovie Kimmins, assistant director of the Math, Science, and Technology Education Center at MTSU." Sheila Webster has done

an excellent job of coordinating with the universities and Oak Ridge officials. It's an excellent balance."

Three teachers representing Rutherford County were among the 40 at the four-day session for Middle Tennessee teachers in July 2007. Separate four-day sessions were also held for 40 East Tennessee teachers as well as 40 teachers from the western part of the state.

To encourage creative learning among her students, Wilson hopes to take them on a field trip to ORNL, where they can observe first hand the pursuit of high-level science.

The teachers who attended the 2007 workshops will spend two years in the program. During the 2007-08 academic year, they met once a month to build advanced content and pedagogy skills.

In July 2008, new teacher groups from West, Middle, and East Tennessee participated in an intensive summer workshop. During the workshop, the educators visited ORNL, the former K-25 site, Y-12 National Security Complex, and the Spallation Neutron Source—key Oak Ridge scientific facilities. They also attended presentations on advanced placement courses and use of technology

TECHNOLOGY INNOVATION FOR EDUCATION AND ENVIRONMENT



EDUCATIONAL BENT: (L-R) Technology Innovation for Education and Environment (TIEE) Director Sheila Webster and TIEE Research Assistants Adam Stout and Maggie Stevens create educational packages that present the latest in science and technology to audiences ranging from school children to environmental professionals.

in the classroom.

During the 2008-09 school year, teachers will devote monthly sessions to developing activities to integrate the materials into the classroom.

The summer sessions explored nanotechnology, aquatic toxicity testing, genomics, and cytogenetics biodosimetry (use of the human body's response to radiation as the basis for accurately estimating exposure).

"It's stimulating for teachers to actually observe the world-renowned research that this lab conducts here in Tennessee," Webster says.

She adds that the exposure helps teachers gain advanced knowledge in their fields of instruction, because much of the information is so new that "it's not yet reflected in textbooks or the research literature."

TENNESSEE NEEDS PROBLEM SOLVERS

That suits Scott Eddins just fine. As the Tennessee Department of Education's coordinator of secondary mathematics, Eddins wants to see students honing their creative problem solving rather than engaging extensively in rote work.

Speaking to the teachers during the 2007 session, Eddins referenced Tennessee business roundtables, where private-sector leaders often "tell us that the important capabilities people need in the workplace are basic problem-solving and communication skills."

For teachers to build those skills among their students, says Eddins, the curriculum must be presented in a relevant way. "Students need to learn process skills. They need to learn how things actually work."

Eddins voiced concern about jobs moving overseas and noted the clear connection between increased employment opportunities and improved math, science, and problem-solving skills.

"The jobs leaving this country are no longer our jobs," he says. "We have two choices: learn to compete or lower our standard of living. Nobody wants to lower the standard of living, so we must focus on innovation and creativity" in preparing students for the workplace.

To that end, students need a "rigorous, relevant

curriculum and sufficient resources," Eddins continues.

Wilson contends that one of the problems is that creative thinking has been taken out of the classroom.

"Students are taught that they can't color outside the lines. By the time they get to the second or third grade, they've learned to play a game called 'what the teacher wants,'" says Wilson. Science, by contrast, requires innovation, rewards unconventional thinking, and often renders unexpected results.

SURMOUNTING BARRIERS

For Wanda Bell, who teaches biology at Grundy County High School in Coalmont, Tennessee, resources are a large part of the problem. But it's just not the resources in the classroom. Some 70 percent of Grundy County High School's nearly 700 students are classified as economically disadvantaged, which affects motivation and self-esteem.

Bell believes that exposing her students to real-world applications of science and technology will help them understand that these skills are essential to a wide range of professions.

Bell was especially impressed by the cytogenetics biodosimetry presentation because each researcher had entered the profession from a different background. The fluidity of careers in science and the ability to pursue new opportunities—provided students are grounded in math and science—imparted an important lesson for Bell. "You can start out being a forester or a computer scientist. Then one thing leads to another," she says. "My kids need to hear that."

Webster maintains that Tennessee possesses unique strength in the fields of science, math, and technology and should serve as a resource for the state's teachers.

"We're fortunate in Tennessee to have access to these amazing scientific resources," said Webster, director of ISSE's Technology Innovation for Education and Environment. "They are a great tool as we look for our state to be more competitive in science and math education."

For more information, contact Sheila Webster at 865-974-4251, or email: swebster@utk.edu.

A MORBID SCIENCE



PHOTO BY DAVID BRILL

REX SHORT, manager of ISSE's Environment, Safety, and Health Education program.



PHOTO BY DAVID BRILL

When mass-fatality incidents occur—the World Trade Center, Waco, Columbine—those who respond must contend with the dead skillfully, tactfully, and with sensitivity toward the living.

Dennis McGowan, former chief of operations for the Fulton County [Georgia] Medical Examiner's Office, rises to a podium, faces 40 or so members of the US Department of Energy's protective forces, and begins with a rather unorthodox introduction to the course he's about to teach.

"With any luck, you'll serve out your entire careers and never have to deal with the stuff we're going to cover over the next three days," he says.

McGowan is deputy director of the National Mass Fatalities Institute (NMFI) of Kirkwood Community College in Cedar Rapids, Iowa. NMFI's "Mass Fatalities Incident Response Planning" course was created in 2002 to help mental health workers, emergency responders, physicians, law enforcement personnel, funeral directors, clergy, coroners and medical examiners, and disaster relief organizations deal with the aftermath of catastrophic events. Since 2002, the course has been offered nearly 30 times across the nation.

McGowan and his NMFI colleagues were in Oak Ridge, Tennessee, in fall of 2007 to instruct the DOE security personnel on the finer points of dealing with incidents that produce enough fatalities to overwhelm local emergency resources. Such incidents, despite the attendant frenzy, demand a thoughtful and methodical response in contending with the dead and the families that survive them.

ISSE co-sponsored the November course offering.

"The goal of the program is to train a diverse group of professionals in the local community to perform specific tasks and help them develop their mass-fatality plans," says Sheila Webster, ISSE research program development director. "At the end of the workshop, participants understand the special circumstances associated with a mass-fatality incident."

NMFI was founded in 2000 with a congressional grant administered through the Centers for Disease Control and Prevention.

"Within the planning and responder organizations, we strive for awareness of the need to prepare for and respond to a mass-fatality event with a cooperative mindset," says Rex Short, manager of ISSE's Environment, Safety, and Health Education programs. "The fewer counterproductive walls and barriers, the more expediently and smoothly we can accomplish the hard work of recovery."

Short coordinates the Mass Fatalities Incident Response Planning course. A 10-module document on CD complements the instructors' presentations and offers additional resources.

For more information, contact Sheila Webster, ISSE, 865-974-1985, email: swebster@utk.edu; or Douglas Feil, Kirkwood Community College, 319-398-5677, email: dougfeil@kirkwood.edu.

Visit the NMFI Web site: www.nmfi.org/

~DAVID BRILL

CO-DIRECTORS:

Catherine Wilt and Sheila Webster

ESTABLISHED in 1995 to address Section 41 of the Tennessee Solid Waste Management Act requiring solid waste education for the state's K-12 students.

MISSION: To enhance environmental literacy and education among the state's K-12 students through curriculum and in-service workshops, classroom presentations, and assistance in planning environmental education events.

ILLUSTRATIVE PROJECTS: Creation of a wide-range of materials and activity guides targeting primary, intermediate, middle, and high-school students across the state; provision of information and resources to the state's teachers; in-school consulting services provided free of charge to the state's schools.

PROJECT SPONSORS: Tennessee Department of Environment and Conservation.

WEB SITE:
<http://www-tnswep.ra.utk.edu/>

TRASH-CAN ENVIRONMENTALISM

A state educational program teaches Tennessee's K-12 students to think before they throw. The effort has helped divert tons of trash from the state's landfills and helped create an environmentally literate citizenry.

By Noa Davidai

A recent US Environmental Protection Agency (EPA) report on municipal solid waste provided a breakdown of the 246 million tons of solid waste produced annually in the United States. Paper and paper products represent 34 percent and yard trimmings contribute 13 percent, while glass, metals, plastics, wood, and food scraps add 5 to 12 percent each. Rubber, leather, and textiles account for the rest. Much of this waste can be recycled or reused.

An examination of Tennessee's solid waste heap would reveal a similar composition, though thanks to the state's innovative environmental education project, the pile is gradually shrinking.

In 1991, the Tennessee legislature passed the Solid Waste Management Act to reduce the burgeoning mound of solid waste entering the state's landfills. Among its provisions, the act required the state to offer solid waste education for its K-12 students. In 1995, the state responded by creating the Tennessee Solid Waste Education Project (TNSWEP), which is administered and housed at ISSE and funded through the Tennessee Department of Environment and Conservation. Through its many educational projects, TNSWEP champions the 3 Rs: reduce, reuse, recycle.

Under the co-direction of ISSE's Catherine Wilt and Sheila Webster, TNSWEP provides three main services: workshops for school teachers and non-school educators, classroom presentations for K-12 students in both public and private schools, and assistance in helping communities plan for events that advance environmental education. These services are coordinated by TNSWEP's two consultants. Carrie Hembree covers East and Middle Tennessee, and Cindy Black handles the western and west-central portions of the state.

TAILORED EDUCATION

TNSWEP offers workshops to current and soon-to-be teachers, and the programs are tailored to each specific audience, school, or district. "We consult with the custodial staff of the school, tour the school, and talk to the teachers about their specific needs," says Hembree.

Though there is no such thing as a "typical" TNSWEP workshop, each program consists of hands-on activities that





EDUCATION FOR SUSTAINABILITY: Tennessee Solid Waste Education Project co-directors Catherine Wilt (L) and Sheila Webster (R) and AmeriCorps member Thea Norris take their environmental message to students across Tennessee.

teachers can offer in their own classrooms. For instance, K-3 teachers might help their students create recycle craft boxes and fill them with cardboard and plastic containers, paper and poster board scraps, used ribbons and wrapping paper, yarn, discarded silk flowers. Students can use these materials to create arts and crafts.

The “Not in My Shopping Cart” activity helps students grades 4-6 identify wasteful product packaging and recognize products packaged in recycled materials.

Hembree and Black also provide the teachers with the most current information on solid waste management and inform them of additional resources available on a variety of environmental topics.

“With environment projects as a whole, and recycling and solid waste in particular, what the teachers need most from TNSWEP is a support system,” Hembree says. “We don’t just give them a resource, but also someone they can call for guidance and advice.”

TNSWEP conducts more than 200 presentations each year to students grades K-12. The presentations, which can be conducted at the school or a local nature center, are grounded in TNSWEP’s environmental curriculum and often

include class activities.

“The teachers are thrilled that in this time of budget cuts, there are still people who are willing to come in and talk about these kinds of issues,” Hembree says.

One of Hembree’s and Black’s favorite activities is titled “Think before You Toss.” For this project, the students have a diverse list of items in their “garbage cans.” The goal is to consider alternatives to throwing these items away and to keep as much as possible out of the landfill.

Prompted by the TNSWEP presentations, Hembree says, students often devise creative ways of their own to reuse solid waste. One student, for instance, had worked with his father to recycle the motor from a broken garden trimmer into a pump for their pond.

REACHING A WIDER AUDIENCE

TNSWEP is also available to help communities plan for environmental education events, such as Earth Day celebrations and EnvironMental fairs. Hembree helps organize Nashville’s annual Earth Day celebration, and Wilt is the co-organizer and chair of Knoxville’s annual EarthFest, one of the largest Earth Day

celebrations in the Southeast.

And as a partner of the Tennessee Pollution Prevention Partnership (TP3) Green Schools Program, TNSWEP provides counseling on recycling programs and general advice on how to become a Green School.

“TNSWEP has been an enthusiastic partner, not only by providing solid waste education statewide to teachers and students, but also by assisting communities with environmental events that reach thousands of people each year,” says Cynthia Rohrbach, coordinator of the TP3 Green Schools Program.

Since TNSWEP’s creation in 1995, Wilt and Webster have witnessed significant changes in attitude towards solid waste in the state. “In particular, we’re seeing a lot more awareness of

waste reduction and recycling efforts,” says Wilt. “Instead of thinking ‘I should recycle,’ Tennesseans now think ‘What else can I recycle?’”

According to Wilt, communities often launch recycling programs following a TNSWEP event. Former TNSWEP consultant Brenda Lee conducted a classroom presentation in Monroe County a few years ago. The teachers and students took Lee’s guidance and created a project that benefited the entire county.

“They developed the ‘Waste Education Station’ with ‘Keep Monroe Beautiful’ as a partner program and expanded their solid waste education offerings,” says Hembree. “At a community level, Monroe County has really shifted its attitude about solid waste.”



TRACKING EMERGING WASTE STREAMS

While TNSWEP continues to spread its environmental message, its co-directors are always looking for new opportunities to expand their reach and impact.

“We are always trying to keep track of changes developing across the country and devise ways to bring those developments into Tennessee classrooms,” says Wilt. “For example, in the last few years, cellular phones have become so pervasive with school children, yet Tennessee kids and families may not know how to manage discarded cell phones.”

In response, TNSWEP consultants now provide information on charitable organizations that refurbish cell phones for needy families.

Educators beyond the state’s borders have taken note of TNSWEP’s effectiveness and often ask Wilt’s permission to use it as a model for creating their own projects.

“People are constantly calling to use parts of the program for teaching purposes,” she says. “It is a good model that could be replicated.”

TNSWEP is currently exploring Web-based models that would distribute the program more widely.

For more information, contact Catherine Wilt at 865-974-1915 or email: catwilt@utk.edu, or Sheila Webster at 865-974-1985, or email: swebster@utk.edu.

For information on the TP3 Green Schools Program, visit the Web site: http://tennessee.gov/environment/ea/tp3/tp3_grschools.shtml



DIRECTOR:

Tim Gangaware

ESTABLISHED in 1964 in response to passage of the Water Resources Research Act, which requires each state to establish an institute within its land-grant university.

MISSION: To facilitate research at universities and colleges throughout the region, promote education and training relevant to water-resource issues, and serve as an information clearinghouse for federal, state, and local government agencies that oversee water-related problems.

**ILLUSTRATIVE**

PROJECTS: Knox-area Adopt-a-Watershed Program, Kids in the Creek, Beaver Creek Restoration Project, Waterfest, Tennessee Yards and Neighborhoods, Tennessee Erosion Prevention and Sediment Control Training.

KEY PROJECT**SPONSORS:** US

Geological Survey, Tennessee Department of Environment and Conservation, Tennessee Valley Authority, Knox County Public Works and Engineering, Tennessee Department of Agriculture Nonpoint Source Program.

WEB SITE:

<http://isse.utk.edu/wrrc/>

ERODING VALUES

Training programs address construction-site erosion and sedimentation—the leading causes of water-quality impairment in Tennessee.

By Kris Christen and Noa Davidai

New road-building projects and the development of large subdivisions and industrial parks are devouring Tennessee's forests and fields, and the dirt and debris draining from construction sites during heavy rains are harming the state's aquatic ecosystems. In fact, a look at the state's list of polluted streams, rivers, and lakes points to sedimentation as the leading cause of water-quality impairment.

"We're one of the fastest growing states in the Southeast, with some of our counties rivaling Atlanta in terms of growth," says Tim Gangaware, director of the Tennessee Water Resources Research Center (TNWRRC), which is housed at ISSE. Tennessee's biggest cities—Chattanooga, Knoxville, Memphis, and Nashville—and the Tennessee Department of Environment and Conservation (TDEC) have had policies in place since the mid-1990s to control stormwater discharges flowing from construction sites, parking lots, and other urban and industrial properties, Gangaware says, but the problem continued to worsen.

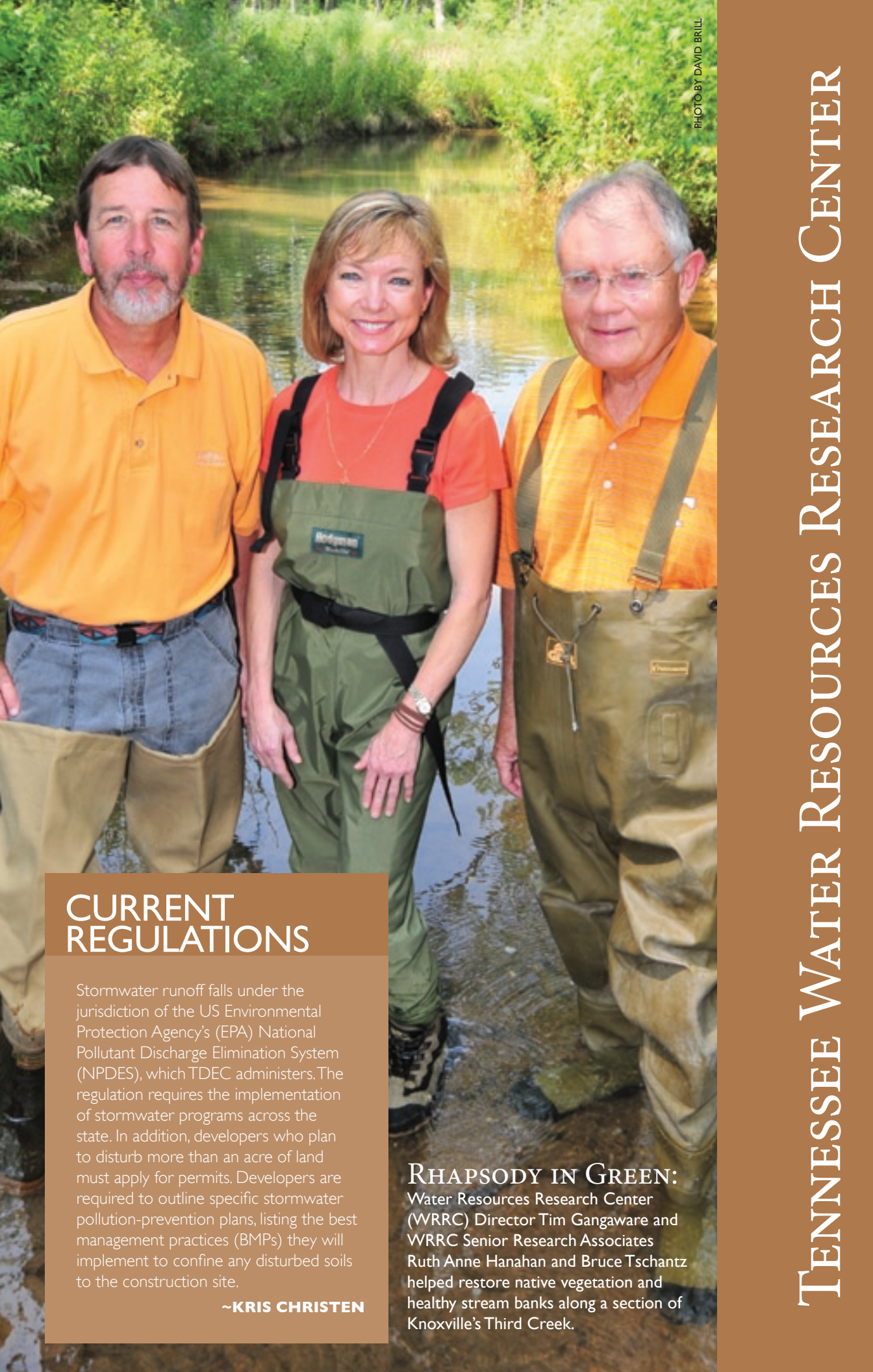
In response, Gangaware, ISSE Senior Research Associate Bruce Tschantz, and John Buchanan, an associate professor in UT's biosystems engineering and environmental science department, worked with TDEC to develop training programs on erosion prevention and sediment control for the construction industry.

Tennessee Erosion Prevention and Sediment Control (TNEPSC) Level 1 is the fundamental course geared at construction workers who are physically on-site. These are the people responsible for installing and inspecting the silt fences used to control sediment runoff and maintaining the on-the-ground best management practices (BMPs).

The workers on each site must be sufficiently trained to keep their construction area in compliance with that site's Stormwater Pollution Prevention Plan (SWPPP).

"In the course, we're telling students what's expected of them, how to properly install and maintain sediment controls, and what to do if these controls don't work," Gangaware says.

Topics covered include the impact of erosion on Tennessee's



CURRENT REGULATIONS

Stormwater runoff falls under the jurisdiction of the US Environmental Protection Agency's (EPA) National Pollutant Discharge Elimination System (NPDES), which TDEC administers. The regulation requires the implementation of stormwater programs across the state. In addition, developers who plan to disturb more than an acre of land must apply for permits. Developers are required to outline specific stormwater pollution-prevention plans, listing the best management practices (BMPs) they will implement to confine any disturbed soils to the construction site.

~KRIS CHRISTEN

RHAPSODY IN GREEN:

Water Resources Research Center (WRRC) Director Tim Gangaware and WRRC Senior Research Associates Ruth Anne Hanahan and Bruce Tschantz helped restore native vegetation and healthy stream banks along a section of Knoxville's Third Creek.

natural resources, the role of state agencies and local officials involved with erosion and sediment control and how they interact, the erosion process and hydrologic cycle, and the most effective vegetative and structural erosion and sediment controls.

BMPs run the gamut from silt fences to buffer strips to mattings to sediment ponds. “No one BMP will address all problems,” Gangaware says. “The course preaches that multiple BMPs in the right places are necessary to keep eroded material from leaving the site.”

The Level 1 course was launched across the state in 2002. Initially, the program was voluntary, but in 2005, TDEC revised the general construction permit, and the TNEPSC Level 1 course became obligatory to anyone inspecting a construction site.

TARGETING SITE DESIGNERS

The TNEPSC Level 2 course, launched in 2003, is intended for the engineers who design SWPPPs. Gangaware advises those taking the Level 2 course that “they’re taking a 16-week graduate course in stormwater hydrology in two days.” Level 2 builds on Level 1 instruction, so individuals taking the Level 2 training must have completed the first course.

“Though the people taking the Level 2 course might never see the construction site,” notes Gangaware, “they’re the ones telling the

construction workers were to put the silt fences, so it’s essential that they have the full training.”

Currently, “you’ve got people designing sediment- and erosion-control plans who don’t really know what they’re designing for and never actually visit the site,” Gangaware says. “A lot of times, the guys installing these BMPs are saying, ‘well, we put it in exactly the way the engineer drew it up, but it just won’t work.’”

The Level 2 course is not mandatory, but it is strongly recommended for the design community.

A STANDARDIZED APPROACH

Some cities, Chattanooga among them, had developed their own training courses on sediment control prior to the introduction of TNEPSC courses. But as individual cities began to draft their own courses, “it quickly became apparent that a contractor who did business in several areas around the state could wind up having to pass a training program in each of those cities,” says Doug Fritz, with the city of Chattanooga. “We kept pressuring the state for a course that would be good whether the developer’s in Cookeville, Jackson, or Chattanooga.”

For more information, contact Tim Gangaware at 865-974-2151, or email gangwrrc@utk.edu.

For information on TNEPSC training, visit: <http://www.tnepsc.org/>



PHOTO BY DAVID BRILL

TNWRRC’s Gangaware, Hanahan, and Tschantz with frequent collaborator Roy Arthur (second from left), Knox County Watershed Coordinator.



PHOTO BY DAVID BRILL

THE CENTER FOR WATERSHED SOLUTIONS

The US Environmental Protection Agency (EPA) has designated the collaborative partnership between the University of Tennessee's (UT) ISSE and the Cumberland River Compact as the Center of Excellence for Watershed Management in Tennessee.

EPA Region 4, which covers eight states in the Southeast, initiated its Centers of Excellence for Watershed Management Program in 2007. In addition to the Center for Watershed Solutions, EPA has designated Centers of Excellence at Clemson University in South Carolina and the University of Georgia in Athens.

This initiative was developed to provide hands-on, practical products and services that enhance water quality and quantity, promote the growth of local stakeholder associations working to improve water quality, and aid communities in creating and implementing locally developed solutions to water issues that affect natural resources and economic sustainability.

To learn more about the Center for Watershed Solutions, contact co-directors, Tim Gangaware (gangwrrc@utk.edu) and Margo Farnsworth (screendoor@bigfoot.com).

In response to the EPA designation, the Center for Watershed Solutions will:

- Identify and address the needs of local watershed stakeholders;
- Partner with other institutions, citizen organizations, and businesses;
- Involve students, staff, and faculty in applying research and conducting activities that provide for water resource management at the watershed scale; and
- Involve the full suite of disciplines needed for comprehensive watershed management.

~DAVID BRILL



STAFF

08/2008—ISSE'S COMMUNITY PARTNERSHIP CENTER (CPC) is part of a consortium of local educational and tourism-related organizations who have established a new wireless Wi-Fi network in the downtown area that will promote Knoxville's black heritage through digital storytelling. Several articles on this project have appeared in the local media: "Wireless cultural tour of downtown almost ready" (KnoxNews.com, Aug. 19, 2008), "Wi-Fi network holds promise for downtown merchants" (knoxvillebiz.com, Aug. 19, 2008), and "Digital stories share Knoxville history" (KnoxNews.com, August 20, 2008).

08/2008—THE PAPER "TEMPORAL VARIATION AND PERSISTENCE OF BACTERIA IN STREAMS" by Shesh R. Koirala, Randall W. Gentry, Edmund Perfect, John S. Schwartz, and Gary S. Saylor, from the July-

August 2008 issue of The Journal of Environmental Quality, has been selected for inclusion in the Research Highlight program by the American Society of Agronomy/Crop Science Society of America/Soil Science Society of America(ASA/CSSA/SSSA). It is also featured in Science Daily.

07/2008—THE "CLEAN WATER ACT BRIEF" submission on a case now before the Supreme Court, co-authored by ISSE Senior Fellow Milton Russell and other economists, has been listed on the Social Science Research Network Top-10 Download List for both the Public Policy Centers Research Papers category and the Industrial Organization and Regulation Journals category for the last two months.

07/2008—ISSE RESEARCH LEADER MARY ENGLISH has been reappointed for a third term as a member of the Tennessee Air

ISSE ADMINISTRATIVE STAFF: (L-R) Accounting Coordinator Benjamin Call; Graphic Artist Bonnie Morris; Program Coordinator Sherry Redus; Director Randall Gentry; Assistant Director, Development, Jean Peretz; Assistant Director, Grants and Contracts, Larry Bell; Accounting Specialist Judy Carver; Administrative Assistant Dylida Ries. Not pictured: Assistant Director, Communications, David Brill.



CITINGS 2007-2008

PHOTO BY DAVID BRILL

Pollution Control Board. She also has been provisionally appointed to a new study committee of the National Research Council: the Committee on Health, Environmental, and Other External Costs and Benefits of Energy Production and Consumption. Appointments to the committee will be finalized after a 20-day public comment period.

06/2008—A SUMMARY REPORT ON THE WORKSHOP ON BIOREMEDIATION MODELING OF MIXED WASTE SITES, a Web-based workshop held in January-February 2008, was co-authored by ISSE researcher Jack Parker.

06/2008—ISSE DIRECTOR RANDALL GENTRY is quoted in a June 10 article in the *Chattanooga Times Free Press* titled “Tennessee: Turning methane into power.”

06/2008—THE SUMMER 2008 ISSUE OF UT’S TENNESSEE ALUMNUS MAGAZINE features a story written by ISSE Director Randall Gentry on graduate research conducted by ISSE’s Amanda McKenna. The article is titled “From Clouds Come Rain—and More.”

05/2008—IN AN ARTICLE ON “BUILDING GREEN,” Knoxville’s WATE-TV highlighted the Center for Clean Products’ EPA NCER project, “Testing Sustainable Building Materials and Practices During Gulf Coast Reconstruction.” Catherine Wilt (CCP director of policy) was interviewed for the accompanying video.

05/2008—ISSE SENIOR FELLOW MILTON RUSSELL is quoted in a story appearing in *Chemical & Engineering News* (Vol. 86, No. 18, pp. 15-21) titled “The Forever Waste.”

04/2008—ON APRIL 17TH, ISSE'S TIM EZZELL (director, Community Partnership Center) hosted a Campus Heritage Workshop to discuss ideas and recommendations to promote historic preservation on the UT-Knoxville campus.

04/2008—ON APRIL 10-12, 2008, ISSE CO-HOSTED A CONFERENCE held at the Downtown Hilton Hotel in Knoxville titled Energy and Responsibility: A Conference on Ethics and the Environment.

04/2008—ISSE SENIOR FELLOW MILTON RUSSELL participated in the Vanderbilt Symposium “Uncertainty in Long-Term Planning: Nuclear Waste Management, A Case Study,” held January 6-8, 2008. Russell presented the paper “Environmental Decisions for Now through the Long-Long Term.” The Symposium sponsors have a tentative agreement that the papers will be published in either a special issue or special section of Risk Analysis. Russell also presented a version of this paper on March 28 at the first of the planned monthly energy and environment lunch discussions sponsored by the Howard Baker Center for Public Policy.

04/2008—ON APRIL 4, 2008, ISSE, THE CENTER FOR ENVIRONMENTAL BIOTECHNOLOGY, AND THE JOINT INSTITUTE FOR BIOLOGICAL SCIENCES co-hosted Dr. Rachel Brennan of Penn State, who presented a seminar on “Solving a Global Water Crisis in a Local Watershed: A Comprehensive Analysis of Chitin as a Multifunctional Substrate for the Treatment of Acid Mine Drainage.” The seminar was from 1-3PM on the UT campus in the Auditorium (Room 300) in Buehler Hall.

02/2008—ON FEBRUARY 25, ISSE AND THE CUMBERLAND RIVER COMPACT were recognized by EPA as the Center of Excellence for Watershed Management in Tennessee. This is only the second Center of Excellence to be designated in the Southeast.

02/2008—ISSE DIRECTOR RANDALL GENTRY was featured in a WKNO (Memphis) radio report on the water dispute between Memphis and the state of Mississippi.

02/2008—BRUCE TSCHANTZ (TNWRRC) made a presentation at the conference Environment Virginia—2008, held at Virginia Military Institute (VMI), Lexington, Virginia, on April 1-3, 2008. The 19th annual three-day conference included a special session (April 1) on dam safety. Dr. Tschantz spoke on the topic “Overview of Safety and Options of Low-head Dams.” The session focused on the general problem of low-head dams in the United States, the hydraulic hazards presented by these dams; major safety, environmental, legal/administrative, social, economic, and management considerations; issues in removing dams; and options for remediating the problem.

02/2008—ISSE DIRECTOR RANDALL GENTRY was quoted in the *Atlanta Journal-Constitution* on Sunday, February 10, 2008, in an article titled, “Mapmaker’s Border Error Raises New Water War Front.”

02/2008—TIM EZZELL (director, Community Partnership Center) is working to preserve UT’s architectural history. These efforts are reported in *The Chronicle of Higher Education*.

01/2008—ISSE'S KIM DAVIS was featured in a story in the *South Knox-Seymour Times* regarding a presentation she gave to the Knoxville Tree Board.

01/2008—ISSE'S COMMUNITY PARTNERSHIP CENTER hosted a “Campus Heritage Workshop” on Monday, January 28, 2008, in the Shiloh Room of the University Center. The workshop explored results of the recent inventory of UT’s historic sites and invited discussion on campus preservation ideas and issues.

01/2008—ISSE CO-HOSTED “SUSTAINABLE TENNESSEE: Bridging Conversations, Showcasing Solutions: A Sustainable Tennessee Regional Opportunity Forum,” on Thursday, January 24, 2008. This one-day meeting was designed to showcase a range of community-based, sustainable solutions and programs by and for businesses, nonprofits, and agencies working in East Tennessee.

12/2007—ISSE RESEARCHERS JONATHAN OVERLY (“Fuel Sell”), and Jean Peretz and Bruce Tonn (“The Public Bang for the Federal Buck”) were featured in articles in the Fall 2007 issue of *Scientia*, the research magazine of UT, Knoxville.

12/2007—TIM EZZELL (director, ISSE’s Community Partnership Center) was featured in a December 10 *Knoxville News-Sentinel* article titled “Grant to Help UT Preserve Its History: Work under Way on Identifying Historic Structures on Campus.”

11/2007—JONATHAN OVERLY, ISSE researcher and executive director of the East Tennessee Clean Fuels Coalition, wrote an article for the November 2007 issue of *BioCycle* magazine titled “Fleets Fuel up on Biodiesel Blends.”

11/2007—ISSE SENIOR FELLOW WILLIAM FULKERSON made a presentation titled “Framework for Managing Climate Change and Recommendations from Erice, 2007” at the scientific session on managing climate change at the conference Energy & Climate: Managing Climate Change and the Recommendations of the World Federation of Scientists, held at the Papal Academy of Sciences, the Vatican, on December 20, 2007.

11/2007—TIM EZZELL (director, Community Partnership Center) was interviewed by *The Tennessean* for a story that appeared in its November 24, 2007, edition titled “Campuses Close in on Wary Neighbors; Residents Fear Loss of Historic Homes.”



11/2007—ON NOVEMBER 12, DR. BRUCE TONN (ISSE’s Sustainability Program leader) spoke at the Annual Owner’s Meeting for the Three Rivers Market, a community-owned natural foods grocery store in

Knoxville. The title of his presentation was “Futures of Cooperative Organizations.”

10/2007—UT PRESS RELEASE: “WATER ACT COULD FUND VITAL UT RESEARCH”: “The Water Resources Development Act (WRDA), passed by the US Congress in September, authorizes funding of \$2 million for UT, Knoxville, for operation of the Southeastern Water Resources Institute (SWRI).”

09/2007—CAMPUS CONVERSATIONS (which airs on UTTV) is a 30-minute television show hosted by former UT Chancellor Loren Crabtree. ISSE Director Randall Gentry appeared on a segment recorded August 13, 2007, to discuss ISSE. Tim Ezzell (director, Community Partnership Center) appeared on a segment recorded August 3, 2007, discussing improvements to the campus environment.



09/2007—LARRY MCKAY (ISSE’s Water Resources Program leader and a professor in UT’s Earth and Planetary Sciences Department), was selected as the Geological Society of America’s Birdsall-Dreiss Distinguished Lecturer for 2008.

09/2007—ON MAY 24, 2007, ISSE SENIOR FELLOW WILLIAM FULKERSON testified before the Energy and Natural Resources Committee of the US Senate at a hearing on coal gasification, synfuels and related topics.

08/2007—UT PRESS RELEASE: “UT RESEARCHERS EARN EPA GRANT TO DEVELOP GREEN BUILDING MATERIALS LIST”: “UT researchers will help make the fast-growing manufactured home industry more environmentally friendly thanks to a new grant from the US Environmental Protection Agency. With more than 1 million homes built since 2000, the industry is having a significant impact on the housing market, and the \$295,970 grant will allow ISSE researchers to study the materials used to construct modular and prefabricated homes.”

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