

# ISSE **indicator**

News from UT's Institute for a Secure and Sustainable Environment

## IMPROVING SUSTAINABILITY, ONE STEP *at a* TIME

*Well, Maybe Two...*



ARTICLE BY: US SENATOR LAMAR ALEXANDER

As the Institute for a Secure and Sustainable Environment's own director, Dr. Randall Gentry, has pointed out, the concept of environmental sustainability pervades virtually every aspect of modern life. What was once considered simple "conservation" of natural resources and other treasures for future generations has grown, along with the Earth's population and its demands, into a more comprehensive approach that seeks to ensure that human life—and our current lifestyles and technologies—can continue to endure and grow.

Thinking in these terms can be a bit overwhelming.

Fortunately, no one person or organization can or should be expected to come up with all the answers. While action is urgently needed on several fronts, it must



be based on broad consensus and the best scientific research available. And it must proceed one step at a time if we are to learn from our mistakes and avoid making anything worse.

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INSTITUTE FOR A SECURE  
AND SUSTAINABLE ENVIRONMENT  
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*The University of Tennessee's Institute for a Secure and Sustainable Environment (ISSE) seeks to promote 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.*

THE UNIVERSITY of  
**TENNESSEE** **UT**

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One of the more pressing issues we face as a nation is our use of fossil fuels, a resource that is not replenishable, pollutes the air, and leaves us economically dependent on volatile regions like the Middle East.

Of course, the federal government has no business picking winners and losers as various groups within the private sector work on a wide array of technologies to meet this challenge. We don't know if the answer lies with cellulosic ethanol, hybrid vehicles,

***“The government can, and should, set technology-neutral targets and limits on pollution for the good of society and to help create momentum for private-sector research and development, guiding the market toward superior environmental performance.”***

biodiesel, hydrogen, some as-yet-unimagined fuel or technology, or, most probably, with a combination of all these. Allowing the market to make that determination is the genius of our free-enterprise system.

But the government can, and should, set technology-neutral targets and limits on pollution for the good of society and to help create momentum for private-sector research and development, guiding the market toward superior environmental performance.

One area where such limits could have a quick and significant impact is within the transportation sector—specifically, fuels for motor vehicles, which account for one-third of the greenhouse gases America produces and two-thirds of the oil we use every day. The US transportation system is the largest in the world, burning 6,300 gallons of oil per second and producing more climate-changing carbon dioxide emissions than any other nation except

China, according to the Energy Information Administration.

In 2007, Congress enacted an amendment that I co-sponsored in the Senate that raised fuel-efficiency standards for cars and trucks for the first time in 30 years. This, according to an expert at Oak Ridge National Laboratory, was the single most important step that Congress could take in the transportation sector to reduce imports of foreign oil and reduce greenhouse gas emissions. Congress has already begun to mandate renewable fuels, and in 2007,

the Senate enlarged that mandate to require 36 billion gallons of renewable fuel to be blended into gasoline and diesel by 2022.

Beyond higher fuel-efficiency standards and renewable fuels, requiring transportation fuel producers to gradually decrease the amount of carbon in their gasoline and diesel is a logical and manageable next step. That is why I've proposed establishing a low-carbon

***“Meeting a 5-percent carbon reduction standard by 2015 could mean replacing 100 million gallons of diesel fuel with biodiesel and 265 million gallons of gasoline with ethanol.”***

fuel standard for transportation sector fuels that sets targets of 5-percent less carbon per unit of energy by 2015 and 10-percent less carbon by 2020. While I do not support an economy-wide cap-and-trade approach to reducing greenhouse gas emissions, I was successful in seeing my low-carbon fuel standard

amendment adopted by the Senate Committee on Environment and Public Works during its consideration of climate-change legislation. My approach to climate change is sector-by-sector; I would institute a cap-and-trade system for fossil-fuel power plants and a low-carbon fuel standard for transportation fuels. One of the benefits of a low-carbon fuel standard is that it is technology neutral.

According to Dr. James Byford, the dean of the College of Agriculture and Applied Sciences at the University of Tennessee at Martin, a low-carbon fuel standard would significantly reduce Tennessee's consumption of gasoline and diesel fuel. For example, meeting a 5-percent carbon reduction standard by 2015 could mean replacing 100 million gallons of diesel fuel with biodiesel and 265 million gallons of gasoline with ethanol. Meeting a 10-percent reduction standard by 2020 could require 200 million gallons of biodiesel and 530 million gallons of ethanol.

Tennessee already has significant investments in the production of renewable transportation fuels. Today we have the capacity to produce about 100 million gallons of corn-based ethanol. We also currently have suffi-

cient biodiesel capacity to produce 100 million gallons and meet biodiesel's share of the 5-percent low-carbon fuel standard. However, our current biodiesel capacity is significantly underutilized. My low-carbon fuel standard will generate new markets for this existing biodiesel capacity and

require the addition of two new production facilities to meet the 10-percent standard.

Meeting the low-carbon fuel standard for gasoline through the governor's Biofuels Initiative—to build new ethanol production capacity from cellulosic material (grasses, wood chips, and agricultural wastes not used for food)—will have a very positive economic impact on rural Tennessee farms and communities. According to Dr. Kelly Tiller, co-director of the University of Tennessee's Office of Bioenergy Programs, this will include 1.2 million acres of new energy crops produced on marginal or underutilized farm land, new farm jobs and incomes, more than one dozen new rural production facilities employing more than one thousand people directly, and many more jobs through industries supporting this new manufacturing base.

A low-carbon fuel standard would not only reduce emissions of carbon dioxide—the primary greenhouse gas cited for causing climate change—but also encourage the use of cleaner fuels produced in the United States, as opposed to importing oil from abroad. That's a win for just about everybody, except terrorist extremists who benefit from Middle East oil revenues.

On a completely separate front, but one that is near and dear to my heart and my home, is the Centennial Challenge Initiative to fully fund

America's 391 national parks by the 100th anniversary of the National Park System in 2016.


I grew up and still live near Great Smoky Mountains National Park, and I firmly believe there is nothing more central to the American character than the Great American Outdoors. We simply must plan ahead so that present and future generations can have these places to enjoy.

I've co-sponsored bipartisan legislation to increase funding for the National Park System by giving taxpayers the opportunity to mark a box on their tax returns each year that would send a contribution to a National Park Centennial Fund. According to an April 2005 poll conducted by Zogby International on behalf of the National Parks Conservation Association, 61 percent of likely voters said they would probably donate to the national parks if given the option to do so on their federal tax returns. Based on the number of tax returns filed in 2002, survey results indicate that this could generate as much as \$650 million a year.

President Bush has done his part, including a 15-percent funding increase for the national parks in the budgets he has sent to Congress over the past two years and encouraging support from private groups. This money would be used to strengthen and expand national park operations, increase staffing, and improve services and facilities through-

out the system.

The president also proposed up to \$100 million a year in federal funding over the next decade under the Centennial Challenge. The money would be used to provide matching funds for private donations for projects to improve parks and provide better visitor experiences. More than 200 projects, with a total investment of \$370 million, have already been identified as eligible for funding through the Centennial Challenge. When Congress, which supports the initiative, approves Centennial Challenge Fund legislation, these investments will benefit parks across the country.

Great Smoky Mountains National Park was itself a gift from the people of North Carolina and Tennessee. It's up to us to pass it along intact to our children and grandchildren—the ultimate manifestation of sustainability. As long as I'm in the Senate, fully funding it, and working to clean the air above it and elsewhere, will be among my top priorities. 

*Lamar Alexander, Tennessee's senior United States Senator, sits on the Committee on Environment and Public Works and on the Appropriations Committee. He is a former US Secretary of Education, president of the University of Tennessee, and state governor.*

INSTITUTE FOR A SECURE AND SUSTAINABLE ENVIRONMENT

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# FIELDS *of* CHANGE

*In cultivating a sustainable future, Tennessee's farmers are retiring plowshares, curbing erosion and carbon emissions, and growing next-generation transportation fuels.*



ARTICLE BY: FORBES WALKER

Tennessee's rural landscape is dominated by farmland and forests, which provide us with our food and fiber, places for recreation, and much of the water we drink. They also have a significant impact on the quality of the air we breathe. Understanding the complexities of any natural system is challenging but nonetheless vital to developing long-term, sustainable solutions.

In recent years it has become clear that the way we manage our natural resources creates impacts that extend far beyond our state's borders. In an ever-changing and increasingly interdependent world, how do we ensure a good quality of life for future generations—both within Tennessee and beyond—while ensuring that we continue to protect and improve the quality of the environment? Clues to the answer may lie in our distant past.

## LESSONS FROM HISTORY

Tennessee's landscape has been changing since humans first arrived here 12,000 years ago. The first settlers to Tennessee were hunter-gatherers who survived by taking game and wild plants from the forests and fish from the abundant streams and rivers. Over time people began to cultivate the local plants and grasses, which they had been collecting from the forests, in agricultural beds closer to their villages. Ancient crops such as Goosefoot, March Elder, Maygrass, and Knotweed were probably cultivated by

Tennessee's earliest farmers.

The growing of these crops on the rich bottomland soils on the banks of our rivers had minimal impact on the surrounding landscape. These crops were naturally adapted to the area, but by today's standards their yields were very low, which meant they could feed only a small human population. Over time, trade with peoples from other regions facilitated the introduction of higher-yielding crops such as squash and corn—crops that had been domesticated in Central America.

These new crops quickly came to dominate the agricultural landscape, and the older, less-productive crops became footnotes in history. Higher-yielding crops meant that more people could be supported, so more and more land came under agricultural production.

Until the 1500s the native population of Tennessee continued to grow and the cultures and civilizations thrived, but the arrival of the first European visitors to Appalachia in the mid-1500s prompted a rapid change in the population and the landscape. During the 1600s and 1700s, European settlers displaced native peoples from the most productive soils. These new arrivals also introduced new crops, livestock, and agricultural methods, and as they did, subsistence agriculture gave way to commercial crops such as cotton and tobacco and the introduction of farming techniques and equipment from Europe. Not all the new techniques were sustainable or beneficial to the environment.



DAVID BRILL

*Eroding Values: Forbes Walker advises Tennessee farmers to park the plow and leave soil intact during planting to reduce soil erosion and the escape of carbon into the atmosphere.*

## CURSE OF THE PLOW

In the 1700s and 1800s the plow, which had been developed to slice through and turn the soils of Europe, was introduced to Tennessee. The efficiency of the plow enabled farmers to cultivate larger areas of Tennessee to raise crops, such as cotton, that could be exported to expand the economy of the growing state. What these transplanted European agronomists failed to grasp, however, was that the soils and climate of Europe and Tennessee are vastly different. The rainfall in Tennessee is much more intense, and many of our more productive soils are prone to erosion. As a consequence, soil erosion became a major challenge for farmers in much of the state. In fact, our rivers ran muddy for many months of the year. As a result of declining water quality, fish began to disappear from some of our rivers.

Today, as you drive through Tennessee, you will rarely see farmers using plows to till their land. Since the 1960s, when Tennessee experienced some of the worst erosion in the nation, the state has been at the forefront in the development of sys-

tems for growing crops that minimize soil disturbance.

Unlike traditional farming, where a plow flays open the land to kill weeds and create furrows for planting, no-till agriculture disturbs the soil only enough to allow placement of the seeds.

Residues of past crops remain on the surface to hold soil in place and add nutrients as they decay.

Currently, Tennessee has one of the highest rates of no-till farming in the United States, if not the world. In 2006, almost 90 percent of our row crops were planted using no-till or other conservation tillage systems. These technologies are now taking hold around the globe.

No-till agriculture provides numerous benefits over traditional plowing techniques: it significantly reduces soil erosion, requires less fuel and labor, and sequesters carbon and thus reduces emissions to the atmosphere along with their associated impact on climate change.

With the adoption of no-till systems across the state, we have seen the amount of carbon in many of our soils increase from less than 1 percent (or about 10 tons per acre of top soil) to about 3 percent (or 30 tons of carbon per acre). With more than 11.4 million acres devoted to farming in Tennessee and 2.7 million of those acres sustain-

ing crops, we are preventing an enormous amount of carbon from entering the atmosphere.

### IMPROVED WATER QUALITY

The legacies of bygone land-use practices are apparent in the names given to some of our state's streams and rivers.

In Pond Creek, a small agricultural watershed in the Sweetwater valley in east Tennessee, two of the tributaries were named Mud



*Just say no to tilling. This field has been planted with minimal disruption to the surface. Residues of past crops hold soil in place and add nutrients.*

Creek and Greasy Branch by the early European settlers. These names reflect the impact that the early settlers had on water quality.

Since 2001, a team from the University of Tennessee (UT) Extension has been working to improve water quality in Pond Creek (and its "muddy" and "greasy" tributaries). The team has collaborated with farmers to develop management systems that not only increase agricultural production but also improve water quality.

Giving cattle access to clean water, placing feeding stations far from bodies of water, and vegetating denuded fields

will keep animals away from the edges of creeks, reduce soil erosion, and keep manure from fouling the water.

The Extension project also emphasizes improvements in pasture management—if farmers can grow more and better-quality grass, their animals will benefit. By improving the quality of the grass stand, less erosion will occur and the grass will serve as a buffer, filtering out a large number of pollutants before they enter the water. Developing methods and strategies to improve water represents a complex task. Before we can achieve improved water quality on a wider scale, we must identify the various pollutants entering creeks and trace their sources.

In 2006, five years after work began to clean up Pond Creek, the Tennessee Valley Authority conducted an assessment of fish species and populations. The assessment suggests that our methods are working and water conditions are slowly improving.

### ENERGY COSTS IN THE MIX

Rising energy costs are playing a key role in redefining our agricultural and natural-resources sectors. As the cost of energy continues to increase, we are forced to rethink the use and re-use of agricultural products and examine more closely the energy value of some materials.

With rising fertilizer costs, farmers are paying closer attention to optimizing their yields to increase their profits, rather than aiming for maximum yields. We may see a switch away from fertilizer-hungry crops such as corn, to crops such as soybeans. Soybeans and other legumes are able to utilize atmospheric nitrogen through a process termed "nitrogen fixation," where a bacterium forms nodules on a plant's roots

*(Fields, continued on page 6)*

(Fields, continued from page 5)

and converts unusable atmospheric nitrogen (N<sub>2</sub>) to nitrogen forms that can be absorbed by the plant (ammonium or NH<sub>4</sub>, and nitrate or NO<sub>3</sub>).

Meanwhile, in recent years, federal and state governments have placed a greater emphasis on the development of bio-fuels—fuels derived from plant and animal products—as a way to reduce our dependence on foreign oil. These bio-fuels also produce fewer carbon emissions when burned than conventional petroleum products, and the plants from which these fuels are produced actually sequester carbon as they grow.

UT and its partner, Oak Ridge National Laboratory, are taking the lead in developing switchgrass, a native warm-season grass, as a biofuel crop for the future. The conversion of switchgrass to ethanol offers many potential advantages over corn and other feedstocks. Because it is a native species, switchgrass is adapted to our climate and soils. It is also a perennial, so does not need to be replanted every year. It has few pests and diseases and can thrive with few, if any, chemical inputs.

Eventually some of our more marginal lands are likely to be planted in switchgrass, which will increase overall production of the crop and achieve increased carbon sequestration.

### GROWING GREEN

Compared with the last couple of hundred years, we in Tennessee have seen dramatic improvements in the sustainability of our agricultural practices. Indeed, an ever-improving grasp of agricultural economics and a better understanding of the functioning of natural systems have helped us develop management systems that are good for the land manager, the consumer, and

the environment.

In just the past decade we have seen rapid adoption of economically sound methods to reduce soil erosion without compromising yields, and we are starting to develop the infrastructure to make switchgrass the biofuel of the future.

In recent years, we have become increasingly aware that our agricultural and natural resources provide us with much more than just our food and fiber. We now recognize that our rural



FORBES WALKER

*From Field to Fuel Tank: “Grassoline”—ethanol produced from the cellulose contained in switchgrass—may help power the future. The native plant is adapted to our climate and soils and can grow on marginal lands.*

areas provide “ecosystem services” that help regulate our climate and cycle nutrients (such as carbon and nitrogen), preventing them from building up to harmful levels.

Meanwhile, our forests are treasure troves of biodiversity, and many of our cultural, spiritual, and recreational sites are found in rural areas. But as more and more Tennessee counties become urbanized, how do we maintain the rural character of much of our landscape? Should we compensate landowners for adopting management practices that maintain a rural area’s aesthetics, preserve biodiversity, and improve water and air resources?

In Europe, a carbon-trading market has emerged, allowing clean industries to sell, or trade, pollution credits to compa-

nies that are unable to achieve carbon-emission targets. Will we see similar markets emerge in North America, where farmers will be rewarded for practices such as no-till planting that increase the sequestration of carbon?

The federal government is exploring market-based incentives to improve air and water quality and reduce emissions of greenhouse gases, including carbon. New York State has already begun to adopt such policies. In the Catskills watershed above New York City, farmers are paid to reduce runoff coming from their fields. Such reductions will allow the city to avoid installing a prohibitively expensive filtration system for its drinking water.

These are dynamic, exciting times for the agricultural and natural resource sectors in Tennessee, and environmental and market changes are forcing us to re-evaluate how we do business. But we must extend our perspective beyond our state borders. What we do in Tennessee affects water quality in the Gulf of Mexico, air quality in the Northeast, and climate around the globe.

Society expects that we not only produce safe food and fiber products but that we do so using methods that prevent harm to the environment. In the 21st century, agriculture will no longer be just about “plows, sows, and cows” but about finding sustainable, long-term solutions to feeding, clothing, and fueling an ever-expanding global population. We are not there yet, but we’re working on it. 🌱

*Forbes Walker is associate professor in the Biosystems Engineering and Soil Science Department of the University of Tennessee’s Institute of Agriculture. Walker leads ISSE’s Agriculture and Natural Resources Program.*

# EPA DESIGNATES ISSE AS CENTER OF EXCELLENCE FOR WATERSHED MANAGEMENT IN TENNESSEE

The US Environmental Protection Agency (EPA) has designated the University of Tennessee's Institute for a Secure and Sustainable Environment (ISSE) and the Cumberland River Compact (CRC) as the Center of Excellence for Watershed Management in Tennessee.

EPA Region 4, which covers Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee, initiated its Centers of Excellence for Watershed Management Program in 2007.

The new Center for Watershed Solutions is only the second EPA Center of Excellence to be designated in the Southeast and the first involving a partnership between a university and a nongovernmental organization.

ISSE and CRC signed a memorandum of understanding (MOU) with the EPA and the Tennessee Department of Environment and Conservation (TDEC) at a ceremony in February during the Green Development Conference in Nashville.

"This partnership combines UT's strength in academic research with the Cumberland River Compact's excellence in education and outreach and agility as a non-governmental organization (NGO)," says ISSE Director Randall Gentry, who signed the document on behalf of ISSE and UT.

"UT faculty, staff, and students have long been involved in conducting research, supporting information dissemination and technology transfer, and assisting state and local governments in formulating policies to provide Tennesseans with abundant clean water," says Gentry.

The Compact, an NGO devoted to education, has a strong reputation for engaging a wide array of stakeholders in creating practical solutions to water challenges affecting the Cumberland River Basin. These stakeholders include citizens, communities, and businesses.

"At EPA, we believe watersheds represent the most logical basis

for managing resources since all the water, both surface and groundwater, within them eventually drains to the same place," said EPA Regional Administrator Jimmy Palmer.

TDEC Deputy Commissioner Paul Sloan commended ISSE and CRC for their work in protecting Tennessee watersheds.

"A Tennessee Center for Watershed Excellence can be an important resource for local governments and stakeholder groups who recognize the need for using a comprehensive watershed approach to resource management," said Sloan.

CRC Senior Fellow Margo Farnsworth noted that the new center "will be able to connect graduate students and additional resources directly to watersheds where on-the-ground work is being done."

ISSE and CRC approached EPA in mid-2007 to become a Center of Excellence. To be designated, an institution must demonstrate

technical expertise in identifying and addressing watershed needs; involvement of students, staff, and faculty in watershed research; capability to involve the full suite of disciplines needed for all aspects of watershed management; financial ability to become self-sustaining; ability to deliver and account for results; willingness to partner with other institutions; and support from the highest levels of the organization.

Some of the benefits of being a recognized Center of Excellence include receipt of EPA technical assistance, pro-

motion of the Center of Excellence among stakeholders, EPA letters of support for grant opportunities, and identification of opportunities for Center of Excellence involvement in local and regional watershed issues.

For information on the Center for Watershed Solutions, contact Randall Gentry at 865-974-4251 or email [rgentry@utk.edu](mailto:rgentry@utk.edu).



DAVID BRILL

*ISSE Director Randall Gentry (seated, right) prepares to sign the memorandum of understanding establishing ISSE and the Cumberland River Compact (CRC) as an EPA Center of Excellence in Watershed Management. James Giattina, director of Water Management for EPA Region IV, is seated at left. TDEC Commissioner Jim Fike (second from right, standing) and Deputy Commissioner Paul Sloan (standing, right) look on. CRC Senior Fellow Margo Farnsworth is seated to Gentry's right.*

# A MORBID SCIENCE

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

ARTICLE BY: DAVID BRILL

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 U.S. Department of Energy's (DOE) 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 (NMFII) of Kirkwood Community College in Cedar Rapids, Iowa. NMFII'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 NMFII colleagues are in Oak Ridge, Tennessee, 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.

McGowan's credibility is solid, even if his resume tends a bit toward the

macabre. He was summoned to New York City in the days following the attacks of September 11, 2001, and he was in Providence, Rhode Island, after Egypt Air Flight 990—with 217 souls on board—plunged into the Atlantic 60 miles south of Nantucket Island in 1999.

The University of Tennessee's (UT) Institute for a Secure and Sustainable Environment (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." ISSE's predecessor organization, UT's Energy, Environment and Resources Center, co-hosted one of the first of the mass fatality workshops with NMFII in the summer 2003 at UT.

NMFII was founded in 2000 with a congressional grant administered through the Centers for Disease Control and Prevention. In a bit of dark irony, Douglas Feil, executive director of Kirkwood's Environmental Health and Safety Training Programs, was on the phone with CDC personnel, discussing the grant, at the instant the first plane crashed into the World Trade Center in 2001.

## PLANNING FOR THE UNTHINKABLE

The odds are good that McGowan's audi-

ence members will, indeed, enter retirement without ever having to deal with a mass-fatality event. But should an incident occur, McGowan assures his audience, "you'll face the ultimate chaos," with scores of wounded scattered among the dead and with only a vague idea of what has happened and an even more tenuous grasp on why. With incidents involving terrorist acts, response personnel must also contend with the possibility that the initial event was only the beginning of a multi-pronged attack.

NMFII's promotional materials feature the headline, "If only you knew it was coming." Though predicting the where and when of such events is nearly impossible, course participants are equipped with the training and tools they'll need to respond quickly and appropriately.

"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 counter-productive 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.

Among the course presenters, Warren Hamlin, supervisor of the Knox County



*The FEMA morgue in Carville, Louisiana, was built in the aftermath of Hurricane Katrina. The facility, which cost \$17 million to build and equip, operated for 10 weeks during the identifications of the hurricane's victims.*

throughout the scene and leaving victims dead and radiologically “hot”?

### LESSONS FROM THE PAST

NMFI was founded on the belief that exploring the cascade of “what if?” questions is essential for contending with those cataclysmic events that defy comprehension but nonetheless have happened—and will happen again.

Consider, for instance, that Oklahoma City was a

[Tennessee] Police Department’s Forensics Unit, discusses law enforcement’s approach to managing a crime scene and the complications that can arise when local, state, and federal agencies converge on the scene in the tense moments following an event.

“Law enforcement’s primary mission is to identify victims and perpetrators and protect evidence,” Hamlin says. “But it may take a while for law enforcement to arrive, so those first on the scene need to help make sure no one tramples on evidence.”

As law enforcement personnel work the crime scene, others begin the process of establishing temporary morgues and locating and identifying decedents. In many cases, identifying remains poses a difficult task.

“In some instances, the incident destroys every trace of an individual,” McGowan says. “In other cases, the only remains of an individual are needed for DNA testing, leaving the family with nothing to bury.”

Day two of the course begins with an elaborate training exercise. Three men

in protective suits move methodically around a mangled black SUV, a casualty of a roadside improvised explosive device (IED). A partially dismembered body [a mannequin]—one of several involved in the incident—spills from one of the doors of the disabled vehicle. Severed body parts—hands, legs, and feet—litter the roadside. The men chart the locations of the ersatz human remains and photograph the scene, gathering evidence.

In essence, the mass-fatalities course trains participants to respond to a welter of questions that begin with “What if...?”

What if these remains were real flesh and blood, instead of molded plastic? What if a roadside IED had actually detonated here in the rural Tennessee countryside? What if the community’s emergency-response resources were stretched well beyond the breaking point? What if the incident was but the first event in a chain of related attacks? What if the protective armor, shielding radioactive materials, had been breached, spreading contamination

vastly different community on April 18, 1995, from what it became at 2 minutes after 9 am on April 19, when Timothy McVeigh’s rented Ryder truck detonated in front of the Alfred P. Murrah Building.

Likewise, at 8:45 am, on September 11, 2001, workers in the North Tower of the World Trade Center went about their daily routines, unaware that within a minute, American Airlines Flight 11 would plow into their building, triggering a scale of destruction and chaos never before witnessed on American soil.

On those respective dates, the Murrah Building and World Trade Center joined a relatively short—but profoundly affecting—list of American mass-fatality sites, which includes Waco, Virginia Tech, and Columbine, along with a number of deadly plane crashes.

In all these cases, emergency response personnel focused their initial attention on assisting survivors, but once the injured had been treated and removed from the scene, responders faced the even more daunting task of contending

*(Science, continued on page 19)*

# WATER RESOURCES SUSTAINABILITY *in the* SOUTHEASTERN UNITED STATES



DAVID BRILL



ISSE Director Randall Gentry is also an associate professor in UT's Department of Civil and Environmental Engineering

ARTICLE BY: RANDALL W. GENTRY, PH.D., P.E.

For humankind, the challenge of sharing resources is a problem ripe for conflict and born in antiquity. This challenge scales all the way from the global perspective down to the almost infinitesimal conflict between adjacent landowners.

Conflicts over limited and often dwindling water supplies have plagued the arid western United States for decades. But only recently has the once water-rich Southeast begun to struggle with an overabundance of demand for this increasingly overtaxed resource.

## ONE RESOURCE, TWO CHALLENGES

The late US President John F. Kennedy once quipped that “anyone who can solve the problems of water will be worthy of two Nobel Prizes—one for peace and one for science.”

Kennedy’s statement points to the true dichotomy of shared water resources. On the one hand, history chronicles the pitched conflicts over quantity—limited supplies of a resource that is vital to agriculture and manufacturing, as well as basic human survival. On the other, we face the challenge of ensuring quality, of managing and protecting our water, of keeping it pure enough for our consumption and for the countless other habitat needs.

We at ISSE continue to develop our

capacities for assisting our region in contending with issues affecting both water quality and quantity. In particular, we have begun to organize and coordinate the research efforts carried out by our multiple centers and institutes devoted entirely or in part to water-related issues.

The **Tennessee Water Resources Research Center**, which devotes itself primarily to the quality side of the dichotomy, engages school children and community groups in programs to help them protect the health of the watersheds in which they live and to understand the dynamism of those systems. The center also offers state-mandated training and certification programs that instruct developers and contractors on methods for controlling sediment and preventing erosion on construction sites.

The **Southeastern Water Resources Institute** is a multi-disciplinary, multi-institutional research entity devoted to the study of the science, technology, and public policy of surface and groundwater issues, with specific attention to safety, disputes, ecology, supply, demand and climate variability.

The **Center for Watershed Solutions** was recently established as a US Environmental Protection Agency Region IV Center of Excellence in Watershed

Management. The center, a partnership between ISSE/UT and the Cumberland River Compact (see “EPA Designates ISSE” on page 7), will provide products and services to enhance the state’s water quality and quantity, promote the growth of local stakeholder associations, and aid communities in creating and implementing locally developed solutions to water issues that affect natural resources and economic sustainability.

The newly formed **Center for Climate Change and Environment**—a collaboration among ISSE, Oak Ridge National Laboratory (ORNL), the UT/ORNL Joint Institute for Computational Sciences, and the UT Department of Civil and Environmental Engineering—will provide tools and information to decision makers on issues associated with climate extremes, water availability, and the use of new computer-based systems for modeling resources.

You can learn more about these centers by visiting the ISSE Web site: <http://isse.utk.edu/centers/centers.html>

### A GLARING NEED

Never in our region’s history have these capabilities been more desperately needed. Indeed, during the past three decades, the Southeast has experienced an increasing number of interstate disputes over its water resources. In the 1990s, Atlanta, then and now one of the nation’s fastest-growing cities, sought to impound and divert additional waters from Lake Lanier, a federal reservoir on the Chattahoochee River in northern Georgia, to supply its increasing needs. Alabama and Florida, linked to Georgia by the Apalachicola-Chattahoochee-Flint River Basin, opposed the move, citing the impacts of the water withdrawals on downriver communities,

fisheries (particularly Apalachicola Bay’s famed oyster industry), and power plants.

In an effort to avoid a protracted legal battle, the three states, in conjunction with the US Army Corps of Engineers, initially attempted to work together in shaping an equitable solution. Those efforts ultimately failed. The drought of 2007 further aggravated the situation.

In February of this year, the US Court of Appeals in Washington ruled that an agreement between Georgia and

*“Under pressure from political constituents, it seems, state governments will always err on the side of protecting their own economic growth needs, infrastructure, and habitat over another state’s interests.”*

the US Army Corps of Engineers for water rights to Lake Lanier is illegal under federal law.

But the 18-year battle is far from over. In March, the *Gainesville* (Georgia) *Times* reported that “there are eight lawsuits in four federal courts regarding water issues between Georgia, Florida, and Alabama.”

Under pressure from political constituents, it seems, state governments will always err on the side of protecting their own economic growth needs, infrastructure, and habitat over another state’s interests. This self-interested grab for finite resources is understandable but certainly not sustainable for the wider region or the nation.

In March, Secretary of the Interior Dirk Kempthorne rued the states’ decision to settle their differences in court, instead of through cooperation, and sent a letter to the governors of the three states. “We understand, and it is unfortunate, that in parallel to our

decision making on interim and revised operations, you will all be working through the Federal courts,” he writes. “It is our hope that developments in the courts will not frustrate further progress in resolving the remaining technical issues we face together.”

### UNWELCOME PRECEDENTS

One of the unfortunate results of allowing courts to settle interstate water disputes is that each case becomes a precedent, slowly nudging the Southeast from its historic adherence to

a riparian system of allocation, which affords shared access to all whose lands abut a body of water, to the system of prior appropriations (known as the “Colorado Doctrine”), which regards water as a form of property separate from a land holding and one that can be bought and sold.

In the West, where water is scarce and major basins are controlled through prior appropriation, he who arrives first and makes beneficial use of a water source owns the right to continue to use it; all those who follow must satisfy themselves with an ever-diminishing share of what’s left. Rampant development and population growth in the Southeast are calling into question the continued validity of riparian systems, which are based on the assumption of ample supplies of water.

Beginning in the 1980s, North Carolina and Virginia engaged in their own water war over the future of Lake

*(Water, continued on page 14)*

# EQUITY, EMPOWERMENT, AND ENVIRON- MENT: A REGIONAL CONVER- SATION



When children conspire to share a piece of pie, sometimes they divvy the job up thus: You cut, I pick. It's a first step towards understanding equity. For residents of communities in the city of North Charleston, South Carolina, however, equity is not so easily achieved.

Median annual income there is \$17,000, and the area is plagued by drugs and crime. When the state's Ports Authority proposed a multimillion-dollar port expansion of the former Charleston Naval Complex, which is situated nearby, \$630,000 was set aside for conservation of coastal birds of prey.

Meanwhile, only a pittance was allotted for community health and educational improvements—just enough, in fact, to train people for around 20 new jobs over five years and offer financial support for only one college student per year.

"Members of the community considered this insufficient to meet their needs," says Ernest (Omar) Muhammad, a natural resource technician with the South Carolina Department of Natural Resources.

Muhammad was one of seven panelists from Tennessee, Georgia, and South Carolina who spoke on January 24, 2008, at a forum titled Equity, Empowerment, and Environment: Sustainable Tennessee: Bridging Conversations, Showcasing Solutions. The forum, held at the University of Tennessee (UT) and hosted by UT's Institute for a Secure and Sustainable Environment (ISSE), was sponsored.  
(Conversation, continued on page 15)

# GLOBAL WARMING: IT'S NOT JUST HOT AIR

*An international who's-who of experts in environmental ethics recently convened in Knoxville. One theme echoed throughout the conference: The future is not for the faint of heart.*

ARTICLE BY: ELISE LEQUIRE

If world energy use continues on the current path, we will double carbon emissions from today's 30 billion tons per year to 60 billion tons by 2055. Yet the alternatives we can draw on to overhaul our basic energy technology systems are not without major flaws, says Robert Socolow, professor of aerospace and mechanical engineering and co-director of the Carbon Mitigation Initiative at Princeton University.

Socolow was the keynote speaker, launching a three-day conference, *Energy and Responsibility: A Conference on Ethics and the Environment*, held April 10-12 at the University of Tennessee (UT).

Currently available technology applied immediately to existing energy production, however, could stabilize carbon dioxide emissions at today's levels while alternative, cleaner sources of energy come on line.

"The more we fear climate change, the less we can allow ourselves to be squeamish about imperfect solutions," Socolow says. In fact, every alternative is problematic and potentially dangerous. "There are no silver bullets." Yet the well-being of rich and poor countries alike depends on our ability to make difficult choices now.

"Climate change forges a planetary identity," Socolow says, noting that the United States contributes the lion's share of carbon to the global total.

## PRESERVING THE FUTURE

Squandering resources today will also affect the well-being of our children and grandchildren for generations to come. This theme was a frequent thread in many sessions at the conference. John Nolt, professor of philosophy at UT and member of the conference organizing committee, called our wasteful emissions of greenhouse gases today a form of domination of future generations by present generations. According to estimates by the International Panel on Climate Change, predicted global warming will affect posterity for more than a millennium.

Using a definition proposed by political scientist Francis N. Lovett, Nolt said that domination of one group of people over another is characterized by an imbalance of power, dependency of the dominated, and an absence of rules.

"Clearly, the current generation holds considerable power over generations to come, without reciprocity," Nolt says. Moreover, future generations are dependent on our actions in the present: They have no way out of the world they inherit, no exit. Finally, in the absence of rules governing our use of natural resources we wield arbitrary power over unborn generations.

Our domination of posterity, however, is not exactly akin to other forms of domination such as sexism or racism, Nolt contends. It is not intentional. We do not



actively seek to inflict harm on future generations, who are voiceless, powerless, and without recourse. Rather, Nolt says, our actions are unintentional and guided by our frivolous, selfish passions.

“Past generations have sometimes sought to improve conditions for posterity,” Nolt says, citing the Preamble to the US Constitution, one purpose of which was to “secure the Blessings of Liberty to ourselves and our Posterity.” Likewise, the National Park Service Act of 1916 bestowed a rich legacy by declaring that the parks should be maintained “unimpaired for the enjoyment of future generations.”

### AN END TO INJUSTICE

We have, in recent history, made great strides in redressing social injustices such as sexism and racism, Nolt says, and now we have the duty to eliminate intergenerational environmental injustice. In other wealthy nations that enjoy a high standard of living, per-capita carbon emissions are less than half those in the United States. Says Nolt: “Our duty, individually and collectively, is to reduce our carbon emissions by more than half—at least to the level of our contemporaries in Europe, the United Kingdom, and Japan.”

Henry Shue, a professor of international relations at the University of Oxford, also took the long view on our

ethical responsibility to the Earth, its inhabitants, and posterity. Until about one generation ago, he says, we were “clueless about climate change.” Our better understanding of the risks, including altered weather patterns and rising sea levels, puts us in an ethical dilemma.

The current generation has to gamble, in a sense, calculating the magnitude of the risk in the face of uncertainty.

“Just because the risk of an event of great magnitude is unknown doesn’t mean it’s small,” Shue says. “That would be like saying, if you don’t know where a city is, it must be small.”

If we continue to engage in what he terms “pointless indulgences” such as big-box houses and gas-guzzling vehicles, we are inflicting an asymmetrical danger and collateral damage on posterity as a result of our lifestyle. In the face of uncertainty, when the magnitude of the risks is unknown, and at a time when the cost of exposing future generations to deadly risks can be moderate, we must reduce our frivolous consumption of resources. “Future generations may not forgive us if we leave them in a pickle,” he says.


In addition to addresses by Socolow and Shue, the conference featured keynote speeches by Richard Morgenstern, a senior fellow with Resources for the Future; Dale Bryk, a senior attorney with the Natural Resources Defense Council and director of the Yale Environmental Law Clinic; and Dale Jamieson, director of Environmental Studies at New York University.

“With financial support from a wide range of departments, colleges, and

research centers at UT, and from outside funders such as the Charter of Human Responsibilities, the Tennessee Valley Authority, Alcoa, and Oak Ridge National Laboratory, we were able to provide scholarship money to help cover travel expenses for some participants,” says Mary English, a member of the conference planning committee. This helped ensure participation by people with widely different backgrounds and perspectives on environmental ethics.

### ENERGY AND RESPONSIBILITY, A BROAD VIEW

Session discussions ranged from the pragmatics of energy choices in business to the concept of justice, capitalism, and energy; from the ethics of technological solutions to environmental problems, to the ethics of planning processes. Grass roots activists from Appalachia gave an overview of local actions to put an end to mountaintop removal coal mining, while panelists from England, Germany, the Netherlands, Canada, India, Australia, and Puerto Rico helped provide a global perspective.

This diversity of perspectives was a result of careful planning on the part of UT’s conference planning committee, and with input from an outside advisory committee. “The purpose of our selection of keynote speakers and other presenters was to foster dialogue among people who tend to operate only within their own arenas, whether academia, government, or business,” says English, who is also a research leader at UT’s Institute for a Secure and Sustainable Environment. 

**For More Information**  
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 or email [nolt@utk.edu](mailto:nolt@utk.edu).

*(Water, continued from page 11)*

Gaston, a reservoir that sits near the shared border between the two states. Virginia Beach, Virginia, another rapidly growing city but one without its own potable water source, launched plans to engineer a 76-mile pipeline to divert water from Lake Gaston. Though the lake is situated in Virginia, its waters spill into North Carolina.

North Carolina attempted to block construction of the pipeline, but following a 15-year legal battle, during which construction of the pipeline continued, Virginia received all the necessary legal permits. The project was completed and dedicated in 1997. Despite the fact that it lost the battle to stop the pipeline, however, North Carolina was understandably concerned over the prospects for future water withdrawals and with the precedent of diversions without a limit on a finite resource.

In the late-1990s, Atlanta sought to purchase large amounts of water from the private water company serving Chattanooga. The water would have been taken from the Tennessee River. Chattanooga, situated on the river, is by all estimates water rich, but the issue involved taking water from one basin and piping it to another. Water used within its basin of origin ultimately returns to its source; water diverted to another basin does not. In drought periods, this problem is compounded and affects water quality and temperatures, which can dramatically affect the operation of power plants in the Southeast that are dependent on the resource for cooling purposes.

The Tennessee legislature responded by passing the Inter-Basin Water Transfer Act of 2000 that, for the first time, gave Tennessee the power to control diversions of surface and groundwater outside the basin of origin.

In recent months, Atlanta's growing thirst is, once again, back in the news, if only indirectly. Georgia has identified two allegedly erroneous surveys—of 1818 and 1826—establishing the boundary between Georgia and Tennessee. Georgia is making a case for moving the boundary north to align with 35th degree of north latitude—the boundary agreed upon in the early 19th century. The adjusted border would slice through the Tennessee River just upstream of the Nickajack Dam and provide drought-stricken Atlanta with access to additional stores of water.

### THE ULTIMATE DECIDER

It is the jurisdiction of the US Supreme Court to address conflicts between states. In January, the court appointed a Special Master to oversee the findings-of-fact related to the use of the Catawba River, a dispute pitting North Carolina against South Carolina. The river's headwaters rise in North Carolina but flow into South Carolina.

In February, the Associated Press filed a story on the controversy, indicating the plans of the South Carolina governor to burden taxpayers with \$1.4 million in legal fees to support a lawsuit against North Carolina. With the suit, South Carolina seeks to prevent two cities in North Carolina—Concord and Kannapolis—from diverting millions of gallons a day from the Catawba River to avert a looming water shortage. South Carolina hopes the case will go directly to the US Supreme Court to avoid years of legal disputes.


In the context of interstate disputes, Tennessee has also been the target of a lawsuit. In this case, Mississippi sued the City of Memphis over Memphis' alleged overdrafting of the Memphis or Sparta Aquifer system, which is a

shared resource between northern Mississippi and west Tennessee, though one lying underground. In February, the federal judge who heard the case dismissed Mississippi's \$1 billion lawsuit, insisting that it exceeded his jurisdiction and should, instead, be heard by the US Supreme Court.

Why have these issues surged to the forefront? Are these cases the dying moan of an antiquated riparian system for allocating the region's water reserves? Is it the reflection of entrenched policymakers and resource managers who have allowed their allegiance to be defined by the artificial constructs of state lines rather than proximity to neighbors who may display license plates of a different color on their cars?

We who live in the Southeast must begin to think and plan collectively for our long-term future, our relationships with each other, and the resources on which we all rely. As it pertains to water, this planning should be done at the scale of the basin, which in most cases involves multiple states and jurisdictions.

We must also begin to incorporate climate impacts into our planning processes and evaluate how extreme events—ranging from droughts to floods to hurricanes—affect our long-term infrastructural needs.

These steps will require a new way of regarding our water resources as well as our interstate relationships, and they must be based on unbiased, analytical sustainability science. In that regard, ISSE and the region's other research organizations can contribute substantially. 

*Randall Gentry directs the University of Tennessee's Institute for a Secure and Sustainable Environment.*  
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# CONVERSATION

(CONTINUED FROM PG. 12)

sored by the Environmental Leadership Program Southeast Regional Network, the Tennessee Environmental Council, and Tennessee Conservation Voters.

As a fellow with the Environmental Leadership Program, Muhammad worked with the Low Country Alliance for Model Communities, a Charleston-based nonprofit organization, to carve \$4 million out of the whole pie of funding slated for environmental projects. That money is being used to leverage a \$40-million grant aimed to create affordable and energy-efficient housing, relieve the tax burden on the elderly, and install monitoring stations to track changes in air quality during port expansion. Part of the money will also be used to create opportunities for minority contractors to bid on small slices of large construction projects.

During the forum's morning session, panelists explored using non-traditional partnerships to address environmental issues. Presenting were John McFadden, executive director of the Tennessee Environmental Council; Elizabeth Eason, a Knoxville architect certified in sustainable design; Madeleine Weil, director of policy and communications with the city of Knoxville; and Jim Deming, executive

director of Tennessee Interfaith Power and Light. All agreed on the importance of staying on message.

"We can fight out the details behind closed doors," said McFadden, "but we need to stay focused in communicating with legislators."

The afternoon session featured concrete examples of diversifying the environmental community to solve local issues. In addition to Muhammad's talk on the North Charleston communities were presentations by Sarah Gaines Barmeyer, water issues coordinator with the Georgia Wildlife Federation and organizer of the Georgia Water Coalition, and Ben Gerhardstein, a graduate student at Emory University who spoke about the link between the built environment, urban sprawl, and obesity.

"This forum was an excellent opportunity to bring together folks interested in sustainability at every scale, from local to regional, and across a diverse range of interests, from social justice to operational planning," said Randall Gentry, director of ISSE.

—Elise LeQuire

## ISSE Staff Citings

**ISSE IN THE MEDIA.** **Catherine Wilt**, policy director for ISSE's Center for Clean Products (CCP), was interviewed on May 2 as part of a WATE Channel 6 (Knoxville) report on Green Building. The report highlighted CCP's project on "Testing Sustainable Building Materials and Practices during Gulf Coast Reconstruction." Approximately 3 weeks earlier, **Wilt** was interviewed by the *Chattanooga Free Press* about environmental impacts and trends related to green building. Earlier in the year, CCP's director, **Jack Geibig**, was interviewed as part of a WATE Channel 6 report on green cleaning products.

ISSE Director **Randall Gentry** was featured in February on WKNO (Memphis) radio in a report on the water dispute between Memphis and the state of Mississippi. He was also quoted in the *Atlanta Journal-Constitution* on Sunday, February 10, 2008, in an article titled, "Mapmaker's border error raises new water war front."

**Tim Ezzell**, director of ISSE's Community Partnership

Center, was featured in a December 10, 2007, *Knoxville News-Sentinel* story titled "Grant to help UT preserve its history: Work under way on identifying historic structures on campus." **Ezzell** was also 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."

**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."

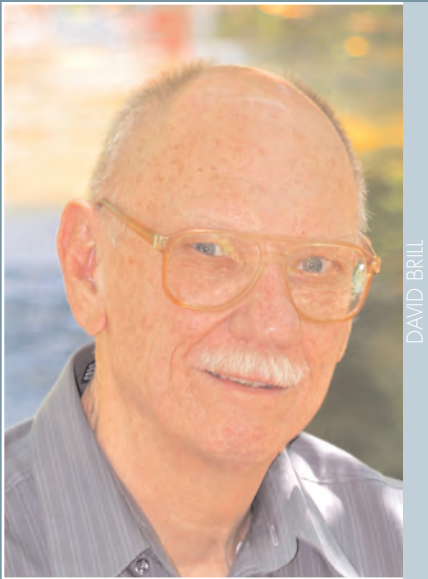
**PRESENTATIONS.** **Bruce Tschantz**, ISSE senior research associate and professor emeritus (civil and environmental engineering), made a presentation at the conference "Environment Virginia 2008," held at the Virginia Military Institute on April 1-3, 2008. The 19th annual conference was a 3-day event focusing on air quality, water quality, and waste, but had a special first-day session on dam safety.

(Citings, continued on page 20)

# OUR TENURE of STEWARDSHIP

*An ISSE senior fellow and former EPA assistant administrator suggests that our strategy for securing a sustainable future should be rooted in lessons from our past.*

ARTICLE BY: MILTON RUSSELL



*Former US EPA Assistant Administrator  
Milton Russell.*

The three “Es,” energy, environment and economics, are tightly linked. Clearly, a responsible university should create and sustain an institutional capacity for treating these linkages as research foci to help the state and the nation prepare for the future. The University of Tennessee foresaw this need over three decades ago—long before other universities did—and has continued the endeavor since. The Institute for a Secure and Sustainable Environment (ISSE) now embodies and expands upon the research and tradition of its predecessors: the Energy, Environment and Resources Center; the Joint Institute for Energy and Environment; and the Waste Management Research and Education Institute.

The reasonable question arises: “What has been learned over the past three or so decades that would help us chart a wise course for the future?” Or, put a different way, from the perspective of those looking back 35 years hence: “What should the country and the world have been doing, way back in 2008?”

In this context, it is short-sighted as well as futile to focus on specific actions, technologies, or policies; the world changes, the opportunities and the constraints shift, and proximate goals and perceptions vary over time. What does not change, however, is the mindset necessary for success, and the processes through which that mindset

operates. This essay, therefore, attempts to lay out what I think has been learned about the basis for principled decisions regarding the course for the future through the efforts of ISSE, its predecessors, and those of other researchers and practitioners.

A beginning point is to consider what has changed. Surprising to many, in terms of all three of the Es, the country and the world are better off. Energy consumption per unit of output has been declining in the developed world, and that decline is spreading as development and build-up of infrastructure continue in the developing countries. Conservation measured in this way is robust. The resource base of nonrenewables (such as oil and natural gas) depended on three decades ago has expanded with better technology and information, even as the cheaper and more accessible deposits have been exhausted and doubts about the future (and relative prices) have risen, especially recently. Alternatives have been encouraged, and technologies and schemes found a generation ago in places like *Popular Mechanics* are now showing up on Main Street—and Wall Street.

## A HEALTHIER ENVIRONMENT

As to environment, it is commonplace to point out that environmental health risks have shrunk in the developed countries in

virtually every dimension. As for the newly industrializing countries such as China, it is, so far, probably a wash; industrial pollution per unit of output has decreased substantially, but output has increased so fast that total emissions seem to be no better than steady, or approximately so; many (not all) serious industrial hazards have been reduced, and numerous “small-scale” sources of risks with large cumulative impacts have been mostly eliminated. For example, open charcoal fires in dwellings have been replaced by improved stoves, electricity, kerosene, or central heating—but automobile emissions have exploded upward. Experience suggests that, with further wealth and development, the shift toward quality of life (in contrast to more goods) will complement the “build-out” of infrastructure in lowering the level of health risk even further and faster.

The ecological side of the environmental risk equation is more difficult to sum. Certainly there have been notable gains in understanding, substantial shifts toward sustainable practice and policy, and remarkable improvements in specific areas, along with declines in threats in others. But there have also been new hazards, further unsustainable encroachment on valued spaces, and declining natural populations of species. And the threat of significant harm from global climate change looms. Rising populations and their demands have taken a serious toll, especially in poorer areas of the world, most tellingly in the tropical/subtropical belt.

### INCREASING PROSPERITY

With glaring, sad exceptions, often associated with sectarian or tribal strife,

warfare, and/or incompetent and rapacious government, the economic picture has also improved, not only in the developed countries, but around the world. It is striking that many, if not all, countries outside the richest ones have been increasing in wealth faster than those already well off. China and India, with their enormous populations, are notable examples. Differences between the haves and have-nots among peoples are shrinking in a proportionate, if not in an absolute, sense. And with the added wealth and income

*“Looking back three or four decades, neither Pollyanna nor the merchants of despair got it all right. Perhaps both contributed needed perspective, however, to the reasonably hopeful state in which we find ourselves now.”*

have come better health through improved diets, cleaner water, and better if still inadequate medical care.

Looking back three or four decades, neither Pollyanna nor the merchants of despair got it all right. Perhaps both contributed needed perspective, however, to the reasonably hopeful state in which we find ourselves now. It is time, though, to start thinking afresh about what is needed to make those who come after us pleased with our tenure of stewardship.

Their approval, I believe, will rest on how well we incorporate into our thinking and into our decisions some hard-won lessons from the transitions that we have weathered in the past decades.

### POROUS NATIONAL BOUNDARIES

The first two of these lessons were highlighted in the “Brundtland” report, Our Common Future, published in 1987. The title itself enunciated one of those lessons: we are all in it together.

Globalization is a reality. When it comes to the three Es, energy price and availability, environmental risks, and economic well-being slip almost effortlessly through national boundaries that are increasingly porous. The second lesson was just as important: Environmental quality in the near and distant term is tied to development—hopefully “sustainable” development. Neither wishing otherwise nor force can prevent the have-nots of the world from progressing, nor should they. Environmental quality simply cannot

be sustained by denying life-enhancing consumption to the peoples of the world. Growth in output is inevitable. Environmentally sensitive growth is an imperative for success.

### ROLES FOR HEART AND HEAD

The third lesson is a difficult one to learn because it requires an uneasy marriage between two contradictory ways of thinking and acting. In brief, it is that we must set our directions and proximate goals using our emotions and following our values and instincts. But we must determine our actions and pursue those goals using clear-eyed reason to evaluate outcomes. Successes and failures in this marriage are manifold in the record. It was the visceral reaction to the pictures of the ozone hole over the Arctic that galvanized the public, but it was hard-nosed bargaining based on technological feasibility, economics, projections of economic consequences by country (and side

*(Stewardship, continued on page 18)*

*(Stewardship, continued from page 17)* deals to create acceptability) that resulted in the Montreal Protocols that are reducing CFCs and thereby replenishing stratospheric ozone.

Environmental groups still pander to the raw emotional appeal of wolves, baby seals, and polar bears to fuel their fundraising but increasingly are willing to utilize cold-hearted and calculated effects of market forces to achieve real environmental improvement. Cap-and-trade policies, in particular, have garnered substantial support.

Most important, perhaps, is the lesson that everything really is connected to everything else. That is, actions must be considered in terms of their holistic effects—not just in terms of their proximate ones. The direct effect of an action may be appealing, but the question is: “What is the sum of all the direct and indirect benefits and costs?” A telling example, of course, is the current controversy over whether net CO<sub>2</sub> emissions rise or fall with the substitution of ethanol and other renewable fuels. And when the second-order effects on food production and ecological impacts of land use are considered, the complexity grows. And, going a step further, when the short-term impact on real income is considered, the questions are multiplied. And, finally, when long-term effects on a multitude of variables—including productive investments for the future—are considered, the story is muddy indeed, in every dimension.

### QUICK FIXES, DAZZLING HOPE

This “connectedness” lesson is associated with an understanding of the danger of quick fixes and fads. The three Es are deeply entwined in the quality of both life and culture, and are not going to be moved very much or very long by the

impact of a single silver bullet. Systemic and long-term shifts are required instead. While such shifts may involve individually small actions (e. g., the replacement of low-efficiency light bulbs), they do not occur and cannot be sustained without a supporting structure that motivates individual concurrence. As important, quick fixes and fads often are grounded in dazzling hope, succored by tunnel vision and premised on an Alice-like belief in “three impossible things before breakfast.” Wisdom and success come from creating a problem-solving culture that promotes and supports such futuristic efforts for their possibilities but does not turn away from the more pedestrian step-by-step efforts to make progress—today and tomorrow. That is, it encompasses a balanced portfolio approach.

The final lesson is perhaps the hardest for decision makers and concerned individuals to incorporate in their thinking processes. It is: Retain the capacity to retrieve error. Decisions will be wrong. Surprises will happen. Plans will go awry. Technologies will fail. Science will evolve.

Recognition of the inevitability of surprises and error leads to two complementary pathways. The first is to foster resilience, that is, the ability to adapt to change in an effective and optimal way. Market mechanisms are the preeminent but not the only embodiment of such adaptation. For example: supply falls, prices rise, amount demanded falls, alternative supplies are encouraged (along with investment for the future), and adjustments are made—all without central direction. There is pain, and it may not be borne equitably, but the total pain is minimized as the system changes and adapts. Facilitating resilience—the abil-

ity to adapt—is a critical component of any sensible approach to global climate change, for example.

Sometimes, however, collective decisions regarding the three Es cannot be made by individual adjustments on the margin but instead involve more or less discrete social choices: Foster nuclear fuel reprocessing? Ban lead from gasoline? Dam the Colorado River? Repeal the Farmland Conservation Reserve Program to increase ethanol production? List the polar bear as “threatened”? What is the pathway, the mindset, with which such collective decisions should be approached?

### THE CAPACITY TO RETRIEVE ERROR


The recent, popular (faddish?) answer has been to invoke the “precautionary principle”—do not take actions unless they are certain to create no harm. This sort of “err on the side of safety” approach embodies the obvious failing of not considering either higher-order effects (see above) or of ignoring the potential benefits from the action. The “dogs that don’t bark” are left out of the decision. The alternative of retaining the capacity to retrieve error is to foresee potential failures and plan for them to the extent possible. And if known remedies to foreseen failures are not in reach, to think again about taking the action, in order to make sure that the expected value of the outcome has really incorporated the potential for unexpected failure. As frequently applied, the precautionary principle is a closed gate. The alternative is not willful neglect of potential problems. It is, instead, to create a well-lighted corridor that exposes pitfalls in time to turn back. Again, global climate change offers an example: there can be little doubt of the wisdom of zero-cost/low-

cost mitigation efforts. Choice of more aggressive actions “depends.”

Fanciful observers might characterize this first decade of the 21st Century as the three Es’ “hinge of history.” The previous three or four decades formed one transition stage: cheap, abundant energy fueled massive progress; environmental concerns came to the forefront in most of the world; and globalization took root and came to dominate the world’s economies. The next three or four decades look to become another: energy prices, sources, and forms will shift to a new phase with unaccounted consequences. The envi-

ronmental and ecological systems will be stressed, with the outcome in doubt. The world economy (not to mention the energy and natural systems) will be challenged by increased globalization as the developing countries, led by China, India, and rapidly transforming Brazil, take their appropriate places at the table and demand an increasing share of the world’s goods. And all of this transition will be compounded in difficulty and risk by global climate change.

In such parlous times, the importance of moving forward while remaining conscious of the hard-won lessons of the past is obvious. The role of uni-

versities and of institutions such as ISSE in formulating, perfecting, and communicating such lessons is as critical for the future as it was in the period coming to a close. 

*Milton Russell is a senior fellow of the University of Tennessee’s (UT) Institute for a Secure and Sustainable Environment and a professor emeritus of the UT economics department. Russell is also a former assistant administrator of the US Environmental Protection Agency, where he directed the agency’s policy, planning, regulatory development, and evaluation functions.*

*(Science, continued from page 9)*

with the dead—80 persons in the Branch Davidian compound in Waco, 168 in Oklahoma City, and 2,752 at the World Trade Center. Cause of death for the World Trade Center victims is officially listed as homicide. The number does not include the 10 hijackers who died in the incident, who are listed as suicides.

After the twin towers collapsed in New York it became evident that local hospitals would not be overwhelmed by incoming patients. In fact, few victims survived. The event did, however, strain the ability of responders to recover and handle the remains of the victims. On top of the huge emotional impact of the devastation, Ground Zero was a crime scene, and human remains were considered evidence.

### **FOR THOSE WHO SURVIVE**

While the focus of a mass fatality response falls on the dead, McGowan makes it clear that the effort is undertaken essentially “for the living.”


One component of the NMFI workshop is designed to help responders deal sensitively and respectfully with victims’ remains, survivors, and family members amidst potentially chaotic situations.

Jim Coyle, a trained counselor and founding member of the Department of Homeland Security response teams, and Lisa LaDue, NMFI co-founder and skilled clinical, social, and mental-health worker, explore the emotional challenges that confront responding personnel as well as the families of the victims.

“Okay, you all are dead,” says Coyle, addressing the DOE participants. “Think about the people who love you, how they’re responding to your death, and how you would want them to be treated.”

Coyle continues the hypothetical. “Let’s imagine a scenario with 400 fatalities,” he says. “For each fatality, 10 family members will show up at the scene, and 15 more will make contact via the phone.”

In many cases, these bereaved family members must be housed, fed, counseled, and kept informed of developments in the recovery effort. Longer-term efforts seek to identify the remains, often through dental records, finger prints, and DNA testing.

According to McGowan, DNA testing for the World Trade Center reached \$20 million fairly early in the operation. Collection of remains continued actively for more than 10 months and is still an open process. 

### **For More Information**

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Visit the NMFI Web site: [www.nmfi.org](http://www.nmfi.org)

# ISSE Staff Citings

(continued from page 15)

**Tschantz** spoke on the topic “Overview of Safety and Options of Low-Head Dams.”

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. He presented the paper “Environmental Decisions for Now through the Long-Long Term.”

**Russell** is also quoted in a story appearing in *Chemical & Engineering News* (Vol. 86, No. 18, pp. 15-21) titled “The Forever Waste.”

**Bill Fulkerson**, ISSE senior fellow, 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.

**AWARDS.** **Tom Burley**, ISSE research associate, was the 2007-08 recipient of the “Outstanding Professional Achievement” award from the UT Department of Geography.

**PUBLICATIONS.** ISSE research scientist **Jie (Joe) Zhuang** has published several new articles: with his colleague Yan Jin, “Interactions between virus and goethite during saturated flow: effects of solution pH, carbonate, and phosphate” in the *Journal of Contaminant Hydrology* 98 (2008); with ISSE’s Water Resources Program Leader **Larry McKay** and other UT colleagues (Andrew B. Kenst, Edmund Perfect, Steven W. Wilhelm, and John F. McCarthy), “Virus transport during infiltration of a wetting front into initially unsaturated sand columns” in *Environmental Science and Technology* 42(4); with colleagues John F. McCarthy,

Edmund Perfect, Lawrence M. Mayer, and Julie D. Jastrow, “Soil Water Hysteresis in Water-Stable Microaggregates as Affected by Organic Matter” in *Soil Science Society of America Journal* 72(1).

**Christian A. Vossler**, leader of ISSE’s Energy and Environmental Policy Research Program, along with colleagues Jordan F. Sutter and Gregory L. Poe, published the article “Experiments on Damage-Based Ambient Taxes for Nonpoint Source Polluters” in the *American Journal of Agricultural Economics* 90(1).

ISSE Director **Randall Gentry** has two new articles in press: with S. R. Koirala, E. Perfect, and J. Kim, “Effective saturated hydraulic conductivity of two-dimensional random multifractal fields,” forthcoming in *Water Resources Research*; with S. R. Koirala, E. Perfect, J. Schwartz, and G. S. Saylor, “Temporal Variation and Persistence of Bacteria in Streams,” forthcoming in *Journal of Environmental Quality*.

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