About ISTC

Our mission is to encourage and assist citizens, businesses, and government agencies to prevent pollution, conserve natural resources, and reduce waste to protect human health and the environment of Illinois and beyond.
For more than 30 years, research at the Illinois Sustainable Technology Center has been highly practical. The center’s scientists and engineers seek solutions to sustainability issues through research and testing, and their knowledge is applied to the needs of Illinois businesses and communities through the statewide network of our Technical Assistance Program (TAP).

Fostering sustainability while also focusing on bottom-line success includes taking advantage of a myriad of strategies. ISTC is at the forefront of developing and implementing these strategies related to water, energy, and waste. With the addition of the Industrial Water Treatment services group in 2017, the TAP program continues to grow to better serve all of Illinois.

The center’s chemists and environmental engineers focus on promising technologies and collaborate with others in Illinois and around the world on ideas to conserve resources and protect the environment and human health. Through its Sponsored Research Program, ISTC also funds partner organizations to extend its capabilities.

This report highlights some of our technical assistance and research efforts from the past year and a half. It also provides an overview of our long-running Sustainability Awards program and our outreach and education initiatives.

Whether it be designing microfiltration innovations for water reuse, pilot testing systems to remove contaminants, or educating businesses and the public on sustainability issues, ISTC’s research and technical assistance programs continue to help the state’s economy, people, and environment.

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These are certainly interesting times for those of us in the applied research and science fields.

More and more we see so many avenues where science and technology can offer invaluable improvements to our quality of life. We at ISTC are committed to pursuing our mission by examining promising developments in areas such as public health, clean water, reduction of waste, renewable or alternative energy sources, and conservation.

We continue to focus on economic development and job creation as fundamental outcomes of our efforts in sustainability. Innovations in carbon capture, carbon utilization, and bioenergy can create demand for job training, new products, new markets, and green jobs that never existed before.

While we adjust to the fluctuating funding environment at the federal and state levels, we are diversifying our portfolio of interests and expertise. We will continue to respond to the needs of Illinois’ businesses and people to deliver innovation and research that help us thrive in a changing environment.

Our Technical Assistance Program maintains our service to businesses, municipalities, and manufacturers. Since 1987 we have cultivated expertise in environmental engineering and lean manufacturing to help companies and reduce hazardous and toxic materials, cut waste, and conserve water. The result has been healthier communities and a competitive and growing business sector.

Our approach to sustainability remains that we help improve what works, we adapt to changing conditions, and we strive to be responsive to new opportunities for the benefit of our state.

Kevin C O’Brien
Director, Illinois Sustainable Technology Center
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ISTC offers one-stop assistance on a broad range of sustainability solutions.
Technical Assistance Program offers customized consulting

Since its inception, staff with the center’s Technical Assistance Program (TAP) have worked throughout the state with a range of clients—from small municipalities to giant manufacturing plants. TAP has been recognized for offering experience-based, unbiased perspectives on ways to conserve water, reduce energy use, eliminate waste, prevent pollution, and be good stewards for the community and the environment.

These customized consultations often save money and drive innovation for the facilities and communities. ISTC engineers know that determining what will work in each situation depends on seeing old problems from new angles. New approaches developed by ISTC research, or just coming onto the market, or in use in other companies/industries can be modified and introduced in small-scale trials inside a client’s plant. This allows managers to understand the applicability of the technology to their local needs and processes. Next, a scaled-up pilot may be undertaken before major capital expenditures are made to integrate the changes into their operation.

While it is not a regulatory agency, ISTC also has expertise in helping businesses keep abreast of, and in compliance with, new and emerging regulations.

The Technical Assistance Program also organizes the annual Illinois Sustainability Awards to highlight the achievements of Illinois companies, communities, and organizations.

TAP’s WatchH₂O program provides water assistance. The average U.S. business uses more than 49,000 cubic meters of water per $1 million in revenue. Increased demand for finite water resources creates higher costs and presents significant risk. TAP engineers provide a detailed picture of a site’s water use and consumption patterns, including cost analysis, highlighting payback and environmental benefits.

“Using conservation and new technologies, we’ve seen manufacturing plants cut process water by 90 percent. Non-contact cooling water is also reusable with minimal polishing. Aging distribution infrastructure in cities and increased competition for limited groundwater are already making water costs trend upward. Smart businesses make the most of their water supplies.”

– Dan Marsch, environmental engineer

To enhance these capabilities, in the spring of 2017 TAP welcomed the addition of the Institutional Water Treatment (IWT) services group, which moved from the Illinois State Water Survey. The IWT services group provides professional water treatment advice to facilities equipped with institutional water systems, including cooling towers, chillers,
boilers, etc. The program results in assuring public health and safety along with substantial annual savings in costs of chemicals, energy, water, and maintenance in industrial and potable water systems. “I’m excited to be working more closely with this excellent program that has been running since 1949,” said Mike Springman, an ISTC environmental engineering and new leader of the IWT.

“The IWT service group complements our other technical services very well,” explained Deb Jacobson, senior operations manager for TAP. “It is a great addition to our ongoing work on water treatment, and the group expands our reach to many other facilities in the state.”

In addition to water, there is room for a great deal of improvement in the energy efficiency in many sectors. TAP’s engineers are helping industrial sectors take advantage of new energy efficiency technologies, enhanced recycling strategies, and product life cycle approaches to reduce their energy use.

Through its ZERO WASTE ILLINOIS program, ISTC’s experienced engineers help organizations achieve zero waste. ISTC engineers evaluate the complete process, looking for ways to cut the costs and other impacts while optimizing material use. A few production enhancements can capture materials suitable for recycling inside the plant, or for beneficial use in-house, or for sale to other companies. The zero waste team conducts waste audits and assessments for a variety of businesses, universities, and research laboratories.

### Technical Assistance Program

#### TAP Focus Areas

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#### TAP Results in 2016

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<td>OVER $1.1 MILLION Saved</td>
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<td>CO₂ EMISSIONS REDUCED BY 9,686 METRIC TONS</td>
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<td>4,979,831 GALLONS OF WATER SAVED</td>
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<td>10,606,054 KWH OF ENERGY SAVED</td>
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<tr>
<td>NON-HAZARDOUS WASTE REDUCED BY 241,646 LBS</td>
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TAP Technical Notes

- TN16-127 Case Study:

- TN16-126 Illinois Governor’s Sustainability Award Winner: Hoffer Plastics, Inc. 2016.

Zero Waste Case Studies
- Reducing & Recycling Waste:

Awards highlight trend toward sustainability for Illinois companies and communities

Over the past 30 years, the Illinois Sustainability Award (ISA) has developed into the state’s top recognition for companies, communities, and other organizations committed to environmental
We encourage Illinois Sustainability Award (ISA) applicants to track the various cost savings and environmental outcomes that result from their efforts.

Here are the cumulative metrics of our 2016 award year applicants.

**WATER USE REDUCED BY 112 MILLION GALLONS**

**ELECTRICITY USE REDUCED BY 36.9 MILLION MWh**

**2,315 TONS OF NON-HAZARDOUS SOLID WASTE ELIMINATED**

**80,625 TONS OF SOLID WASTE RECYCLED**

**CO₂ EMISSIONS REDUCED BY 1.4 MILLION EQUIVALENT METRIC TONS**

**$7.5 MILLION IN ANNUAL SAVINGS (REPORTED BY APPLICANTS)**

Sustainability along with economic success. Each year the award acclaims the efforts of applicants who find ways to cut waste and save water and energy on their way to growing great companies, good jobs, and healthy communities.

Twenty-five trophies were awarded in 2016 at the Nov. 1 ceremony at the Union League Club of Chicago. Eight organizations won for the first time. Abbott Laboratories earned its 15th award. For a complete list of the 2016 award winners, visit: http://www.istc.illinois.edu/info/govs_awards_prev_winners.cfm.

“Abbott Laboratories’ success illustrates a trend among Illinois corporations and communities where sustainability is transcending mere tactics and becoming part of the bedrock of the organization’s identity,” according to ISTC director Kevin O’Brien. “If you look through the winning entries over the years, there is a definite trend. A decade ago we began to see a deepening commitment, cross-functional green teams, sustainable strategic planning, and even public commitments to defined goals.”

The awards event highlighted two of ISTC’s research projects on energy (CO₂ capture) and water reuse (wastewater to energy using algae).

Two veteran sustainability professionals delivered keynote addresses. John Bradburn, global waste reduction manager for General Motors, described how GM moved from recycling to recovery of scrap materials for repurposing and reuse at its plants. Kim Frankovich, global sustainability director of Wm. Wrigley Jr. Co., explained how privately held Mars chooses global partnerships and transnational expertise to set sustainability goals, embracing renewable energy, sustainably sourced ingredients, and social justice.

A decade ago GM totaled the revenue it was earning from recycling: $1.147 billion. That was a seminal moment for Bradburn, a 38-year veteran in the sustainability field. Instead of sending these materials to recyclers to be remade into virgin materials, GM created new markets that would accept their wastes as-is. Bradburn described numerous areas where the multinational giant formed cooperative ventures to help near its goal of being
100 percent landfill-free. Sustainability, according to Bradburn, is about economics, jobs, and community resilience. “Health ties to economy, economy ties to jobs, jobs tie to sustainability, the environment, and making the world a better place.”

For Wrigley and parent company Mars, Frankovich said science and collaboration guide sustainability. “We believe in the science of climate change and in 2010 we set targets about what that science told us.”

The corporation’s sustainability plan employs the Planetary Boundaries Model, and Frankovich said Mars’ leaders rely on the model to set targets in company operations, supply chains, and beyond for greenhouse gas (GHG) emissions. The company has committed to achieving zero GHG emissions from fossil fuels at its factories by 2040. In addition, Mars has joined the Science Based Targets corporate initiative, which uses their collective influence to promote science-based targets in addressing climate change.

Frankovich said Mars also uses social science such as Oxfam International’s Safe and Just Space for Humanity report to measure its impacts on human rights “up and down the value chain.”

The company has worked with the World Resources Institute to develop science-based sustainability targets for the private sector for land and water use. The United Nations’ 17 Sustainable Development Goals have also helped Mars’ thinking in terms of how they might go further. The company selected eight of those goals most salient to their business to track over the next 10 years.

More about the keynote presentations is available at http://www.istc.illinois.edu/infogovs_awards_2016_speaker_presentations.cfm.

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Small companies save big with tech advice

In smaller, rural communities technical assistance professionals usually have a more difficult time identifying companies that would benefit from their services. ISTC’s award-winning ICORE (Illinois Conservation of Resources and Energy) program takes a grassroots approach to identify partners and stakeholders with contacts at municipalities, organizations, associations, and agencies. Networking spreads the word of the benefits of third-party business assessments.

“In big urban areas it is easy enough to find companies that will benefit from sustainability improvements that will save them money,” said Mike Springman, who delivers ICORE services with fellow ISTC environmental engineer Dan Marsch. “We wanted to find a way to share what we offer to the whole state, in particular businesses located in rural communities.” Dan is based in Peoria, Illinois. Troy Walker joined the ICORE staff as a technical assistance engineer in 2014, working out of the Champaign office.

ICORE offers customized assessments, resulting in recommendations to conserve energy, reduce water consumption, reduce hazardous materials/wastes, reduce greenhouse gas (GHG) emissions, and save money. In 2015, ICORE expanded to include the Economy, Energy, and Environment (E3) assessment program, a technical assessment model created by the U.S. EPA and other federal agencies.

At two recent assessments at Illinois food companies, a range of recommendations were identified, such as improved efficiencies in compressed air, process heat, motors, lighting, water/wastewater, and minimization of food waste.
Caseyville’s AdvancePierre Foods implemented more than half of the recommendations, some right after the site visit. “Very good information and details emerged from the audit, which we are still working on,” said Michael Doeden, plant manager of the company’s St. Clair County facility. Upgrading old electrical equipment is saving the company $6,000 a month, Doeden said. Other ideas, like metering for wastewater sewage credits, will be adopted down the line, he added.

“The assessment…generated a list of task items we hadn’t considered,” said Stephanie Fahrner, vice president for operations of King’s Food Products in Belleville, Illinois. “Overall the project/participation will improve us as a company—through savings, efficiency, and employee and environmental safety.”

Between 2008 and 2016, ICORE assistance has saved $24 million, 160 million gallons of water, 1.9 million Therms of natural gas, and 209 million kilowatt hours of electricity, and has eliminated 20 million pounds of waste, 433,000 pounds of hazardous waste, and 200,000 metric tons of CO₂ emissions.

For more information about ICORE/E3 assessments for your organization, visit the technical assistance pages at http://istc.illinois.edu/.

The economic and environmental impact of Great Lakes manufacturing

Pollution prevention technical assistance programs in the Great Lakes region benefitted from an extensive “snapshot” of chemical and greenhouse gas emissions and pollution prevention activities from 20 industrial sectors with a report synthesizing public data. Published in 2016, “The Economic and Environmental Impact of Great Lakes Manufacturing” provides the region’s policy makers and pollution prevention programs with a resource to help prioritize their efforts.

Prepared by the Great Lakes Regional Pollution Prevention Roundtable (GLRPPR) hosted at ISTC, the report offers a data-driven approach to pollution prevention that combines data from the Toxics Release Inventory (TRI), the U.S. EPA Greenhouse Gas Reporting Program, and the Census Bureau’s County Business Patterns. Fact sheets are being compiled to highlight data for the six states of U.S. EPA Region 5 and for a variety of industry sectors. “Spotlight on U.S. EPA Region 5’s Food Manufacturing and Processing Industry” is the first of the sector publications. “Spotlight on Illinois’ Manufacturing Sector” is the first of the state-focused fact sheets. Future work will include using the compiled data to develop a tool to allow users to visualize the emissions and economic data by state, chemical, and industrial sector using a variety of different methods, including GIS.

The analysis of TRI data for emissions by sector from 2009 through 2013 showed that for Illinois the highest emitting industrial sectors were food manufacturing and processing (in 2009) and primary metals (from 2010-2013). Both of those industries also ranked in the top three for economic impact. The report also examined pollution prevention practices and toxic chemical reductions for each industrial sector. The chemicals and primary metals industries achieved the highest toxic chemical reductions in the region from 2009-2013.

“In one case, the team was able to save a food manufacturer $75,000 through efficiencies achieved in compressed air and lighting, reducing their energy consumption by 892,000 kWh within six months of ISTC’s assessment, which prompted them to look for other saving measures.”

Authors of the report were Phyllis Bannon-Nilles, Laura L. Barnes, and Suma Vangala. The work was funded by a grant from the U.S. Environmental Protection Agency’s Pollution Prevention Information Network grant program.
ISTC research on water ranges from new approaches for water use efficiency and water reuse to understanding the fate and transport of contaminants and ways to improve water quality.
Toolkit for sustainable water use grows

ISTC is improving the efficiency of water use in commercial and industrial sectors. It conceived and sponsored the One Billion Gallon Water Challenge over the past few years to encourage water conservation in Illinois and has acquired new capabilities in treating waters for and from industrial use. These include electro dialysis, capacitive deionization, and membrane distillation. These technologies complete the existing suite of membrane technologies at ISTC, such as ultrafiltration and reverse osmosis, allowing a full range of process development.

ISTC will be piloting these technologies for use in hardness removal from surface water and groundwater, improving water recovery in reverse osmosis, and reducing water consumption in cooling towers.

In conjunction with these efforts, ISTC’s TAP program is developing a new water unit with technical expertise in zero-blowdown cooling tower technologies (see page 7).

Team tests nanoparticle membrane for filtration

ISTC’s Nandakishore Rajagopalan and Wei Zheng, as well as experts at the Metropolitan Water Reclamation District (MWRD) of Greater Chicago, are part of a team working to improve the filtration of household drinking water using new ultrathin nanoparticle-based membranes to remove trace organic contaminants (TrOCs). The project received funding from the U.S. Department of Energy.

Argonne National Laboratory and the University of Chicago developed these strong, porous membranes, which can be “dialed” to trap different contaminants by engineering the ligand on the nano-particle surface. A ligand is a molecule that binds to a central metal atom to form a complex that helps to protect the nanoparticle and introduces additional functionalities. Laboratory measurements have demonstrated the nanoparticle-based membranes can selectively filter out molecules as small as two micrometers, yet have water permeability far higher than conventional polymer-based membranes.

TrOCs, a particular focus for MWRD, include hormones, pesticides, prescription medications, personal care products, synthetic industrial chemicals, and chemicals formed during wastewater and drinking water treatment processes. Even at very low concentrations, these compounds can negatively affect aquatic environments and are of concern for human health.
Tests show electro-oxidation works for disinfecting water

As part of its water quality work, ISTC tested the performance of an electro-oxidation system from Clearwater Plasma. The system is capable of processing up to 25 gpm.

Oxidation using hypochlorite (bleach) is commonly used for disinfection and degradation of contaminants in water. ISTC testing revealed that the system can reliably produce hypochlorite of varying concentrations using salt water as a source. The concentrations produced are a function of the salinity of the feed water.

The system is well suited for treating fracking waters and for disinfection of waters in industrial systems such as cooling towers by generating hypochlorite from the salts present in the feed waters themselves—negating the need for external supply of hypochlorite.

Other testing showed that the system can also treat emerging contaminants in water, such as ibuprofen, which can be oxidized by hypochlorite.

Groundwater studies find contamination

A recently published article in the journal *Science of the Total Environment* describes studies conducted by the Illinois State Water Survey, Illinois Natural History Survey, and ISTC that found contamination in Illinois groundwater from 11 prescription medications, over-the-counter medications, and personal care products. The study of spring and cave streams in southwestern Illinois detected these contaminants in 89 percent of samples. In addition, three hormones were detected in 23 percent of groundwater samples.

The area consists of karst terrain that readily allows bacterial and chemical contamination from animals and humans to enter underground streams and springs. Contaminant levels were well below human dosages, but even low levels may affect aquatic and cave-dwelling organisms. Additional ISTC research on pharmaceuticals and hormones is discussed on page 18.
Project examines use of algae to treat wastewater

Algal wastewater treatment will be evaluated for improved nutrient removal at one of the world’s largest treatment plants, the Metropolitan Water Reclamation District of Greater Chicago (MWRD). Under the leadership of ISTC research scientist Lance Schideman and Thomas Kunetz from MWRD, the project will upscale and enhance algal wastewater treatment technologies that are being tested on the U of I’s South Farms to treat livestock manure. The system expanded to a small-scale pilot study in spring 2017 at the Urbana wastewater treatment plant. This project is expected to culminate with a 50,000 gal/day pilot at MWRD next year to demonstrate scalable algal nutrient removal technologies that produce valuable co-products. For instance, the harvested algal biomass could be used as an animal feed or a feedstock for biochemical and biofuel production processes.

Collaborators develop screening tool for water contamination

ISTC, the Illinois State Geological Survey, and the Illinois State Water Survey collaborated on research that successfully demonstrated fluorescence spectroscopy as a screening tool in tracing suspected sources of hydraulic fracturing fluid contamination from oil and gas operations.

It was shown that the concentrations of the natural organic matter present in typical groundwater and surface waters greatly influence the ability to detect infiltration of these types of produces waters. Detection of infiltration of produced waters into natural waters with low organic carbon background was achievable down to the part-per-million range; however, as the background organic carbon increased, the detection limit of the technique also increased.

Samples included produced water, fracturing water, groundwater, and surface water samples. Absorption and fluorescence spectra were obtained for all aqueous samples collected as well as five chemical additives used in oil and gas extraction.

The work was funded by Prairie Research Institute (PRI)’s Matching Research Awards Program. Publication of the report is pending.
PCPPs

Pharmaceuticals and personal care products emerge as aquatic pollution threat

With funding from the U of I Extension and in partnership with Illinois-Indiana Sea Grant (IISG), ISTC organized and hosted a national conference on “Pharmaceuticals and Personal Care Products in the Environment” on April 4, 2016. Over 80 attendees were on hand to hear talks and participate in discussions on research, education, and policies related to PCPPs. The event included perspectives from academic and government research laboratories, as well as veterinary and human health impacts.

Building on that 2016 conference, ISTC and IISG held a second conference titled Emerging Contaminants in the Aquatic Environment (May 31-June 1, 2017, in Champaign). This not only included PCPPs but also microplastics, polyaromatic hydrocarbons, algal toxins, perfluorinated compounds and other flame retardants, and agricultural bactericides. Over 85 people participated in the two-day conference.

In addition to the conference, a tour of ISTC’s laboratories and a technology demonstration was offered. Over 30 people attended the lab tour and demonstrations that showcased ISTC’s novel research on emerging contaminants and solutions to reduce these contaminants in the environment. A video summarizes this work: https://youtu.be/YERkmYP5Pqk.

On June 2 the technology demonstrations were offered to farmers and farm operators, wastewater treatment professionals, sustainability professionals, and researchers. The demonstrations...
asked for feedback on the feasibility of the technologies in a real-world setting. Responses from the attendees were positive, and several were interested in learning more about the technology after further testing is completed.

The demonstrations were of a simple method developed by ISTC’s Wei Zheng and Laurel Dodgen of using corn oil to remove hormones from liquid manure in lagoons, which may be used as irrigation water on farms. It was tested at a swine farm wastewater lagoon on the U of I’s South Farms and demonstrated that up to 95 percent of some excreted compounds (specifically hormones) could be removed from the wastewater.

Also demonstrated was technology developed by ISTC’s Lance Schideman and his graduate students that uses algae to remove nutrients from wastewater and then turns the algae into energy via hydrothermal liquefaction to create liquid fuel and other bioenergy products. The process also can remove a number of antibiotics and hormones from the wastewater.

The collaboration with IISG and the U of I Extension also resulted in additions to statewide medicine take-back opportunities and workshops for 35 Illinois teachers to incorporate the topic of PPCPs into their curriculum for middle and high school science classes. The curriculum resources are available at http://web.extension.illinois.edu/unusedmeds/educators/curriculum.cfm.

The partners also surveyed healthcare professionals and the public in spring 2016 to assess their general knowledge on PPCPs in the environment and proper unwanted medicine disposal. From this input ISTC and IISG developed brochures, posters, and videos for healthcare professionals at hospitals, clinics, and pharmacies to use in speaking to their patients/clients about the importance of proper medicine disposal.

In January 2017, ISTC sent independent pharmacies in Illinois a letter about the importance of unwanted medicine disposal programs, a poster describing the steps the public can take when disposing of unwanted medicines, and a video link (https://www.istc.illinois.edu/research/contaminants/PPCPs_in_the_environment/videos/) with more information about medicines’ impact on the environment and talking to patients about proper disposal. The educational video will be sent to additional pharmacies, clinics, and hospitals as well as health-related professional programs to increase awareness of how to talk to patients about proper disposal and impacts of improper disposal on the environment.

ISTC PPCP research also resulted in publications concerning how irrigation from rural wastewater lagoons carries PPCPs and hormones into soil, and how plants grown in that soil could take in and accumulate the chemicals and a number of presentations.

Researchers campuswide met twice during 2016 and once in spring 2017 at ISTC as part of the PPCP consortium group (now renamed the Emerging Contaminants Consortium) to discuss their findings and future directions in the field.
ISTC is looking at the capture and use of CO₂ and exploring new energy sources and ways to reduce energy use in a number of industrial processes.
Energy research plays a growing role in carbon storage

ISTC is working with the Illinois State Geological Survey (ISGS) on research funded by the U.S. Department of Energy to match carbon “sources” (facilities that generate CO₂) with carbon “sinks” (facilities that can use or store CO₂). Dubbed “CarbonSAFE,” this program will evaluate the feasibility of establishing a commercial-scale (50+ million metric tons) CO₂ storage plant in Illinois and will plan future strategies for creating a supply chain for captured CO₂.

ISGS successfully led a program to permanently store 1 million tonnes of CO₂ in the Mt. Simon Formation 7,000 feet beneath the Archer Daniels Midland facility in Decatur, Illinois. Underground carbon storage is one solution being pursued to keep industrially sourced carbon out of the atmosphere.

The CarbonSAFE projects also include a pre-feasibility study to evaluate the geological suitability for underground carbon storage at another site in East Central Illinois.

Partners retrofit U of I power plant for carbon capture

An effort has begun to use captured carbon and build a supply chain around this commodity. The first step in the process is to build a large-scale pilot facility to capture CO₂ from the University of Illinois’ Abbott Power Plant.

“The goal is to not only evaluate technologies, but also demonstrate at a large pilot scale how communities may be able to monetize captured CO₂,” said ISTC director Kevin O’Brien. The effort provides a unique opportunity to create jobs and build new markets, he said.

In preparation for a large-scale deployment, a multi-national partnership of industry and academia completed a one-year design phase study of retrofitting the U of I’s Abbott Power Plant with next-generation carbon dioxide (CO₂) capture technology in a project funded by U.S. DOE. Engineering and planning specifications were completed to install technology of industrial partners Linde Group and BASF at the coal- and natural gas-burning electric plant. A decision on implementation of the large-scale project, totaling some $75 million, is expected from DOE in 2017.

In a separate project, researchers at ISTC and ISGS are taking a potentially transformational approach to carbon capture with a biphasic CO₂ absorption process that involves multiple stages of liquid-liquid solvent phase separation for post-combustion CO₂ capture. This approach could dramatically improve energy efficiency, lower the equipment cost and footprint, and maintain operational simplicity at plant sites. Partners in the work are the U of I’s Applied Research
“Without advances in coal energy technology, increasing capital costs of using other fuels will mean much higher energy costs at home and at work,” said O’Brien.

**Illinois forms new Carbon Dioxide Utilization and Reduction Center**

ISTC is partnering with others at the Prairie Research Institute and University of Illinois to form a Carbon Dioxide Utilization and Reduction (COOULR) Center. The center is based on the concept that using captured CO₂ in a manner that generates revenue will be vital to make carbon capture economically viable and to establish a market for captured carbon within Illinois. The center will examine various approaches to the use of captured CO₂. Other key partnerships will be Southern Illinois University and various community colleges.

**Army tests Illinois tech that converts sludge to energy**

In a project that began in May 2017, the U.S. Army Medical Research and Material Command at Fort Dietrich, Maryland, is testing hydrothermal conversion technology developed at the U of I that disposes of wastewater sludge by turning it into energy.

The pilot-scale reactor developed by ISTC’s Lance Schideman and Yuanhui Zhang from the Illinois Department of Agricultural and Biological Engineering will convert these organic materials into a syn-gas that can be used for power production. Instead of expending energy to sterilize and break down organic wastes for landfilling, the one ton-per-day reactor can use the sludge to produce over 2 million BTUs/day of syn-gas energy, which can produce about 200 kilowatt-hours of electricity. In addition, instead of expending energy to dry the feedstocks, as in most
biofuel processes, wet feedstocks are essential to the reaction.

“In a hostile theatre, it is dangerous to supply fuel by truck to run electric generators,” said Schideman, the researcher who has led the development efforts at ISTC. “The ability to supply renewable energy on-post promotes readiness and minimizes its environmental impact.”

“The system’s small size and portability also make the approach appealing for deployment at military installations here and abroad,” said Stephen Cosper, an engineer with the U. S. Army Corps of Engineers’ Construction Engineering Research Laboratory in Champaign who has spent a sabbatical year collaborating with researchers at ISTC.

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Cris Alvarez, a junior geology major at the U of I from Quito, Ecuador, is helping ISTC screen ways to remove toxins from biomass-to-energy (B2E) wastewaters.

Most of the focus of B2E processes has been on the energy products; there is not much in the literature to date about dealing with B2E by-products, according to John Scott, ISTC’s senior analytical chemist.

ISTC is conducting research on pairing municipal wastewater treatment with energy production by growing algae in the wastewater, which is high in nutrients, and then harvesting the algae cells for the oil they naturally contain. Processing the algae using hydrothermal liquefaction leaves behind a conglomeration of chemicals in the wastewater that must be treated before disposal.

Alvarez applied for the laboratory assistant position because of his interest in geochemistry and environmental topics. The work gives him valuable experience spanning the range of detoxification strategies, including oil separation, activated carbon, resins, membrane filtration, and distillation. Cris said his mastery of lab procedures and technical precision should be an advantage when he applies for graduate studies.

Opportunities abound for Illinois wastewater treatment efficiencies

A statewide study of wastewater treatment plants in Illinois with an emphasis on performance metrics was performed. A survey was sent to over 200 wastewater treatment plants (WWTPs) in Illinois; 77 plants responded. Of these, 14 were large wastewater treatment plants with flows between 10-100 MGD and those plants were further analyzed to capture performance metrics.

Data for these large WWTPs indicated an average daily cost for treatment of $200/MG (includes energy and biosolids disposal). This information was used to provide benchmark data for treatment plants and correlate energy use to organic loading of influent and effluent streams, biogas production, and sludge utilization. The results showed a wide variation in energy efficiency of the plants and major opportunities for improvement through biogas recovery.
ISTC researchers are examining the value of many materials seen as waste products and finding new uses in order to save companies money and conserve other resources. In addition, they are investigating “greening” products to protect the environment.
Study shows how recycled materials hold up

A two-year study funded by the Illinois Department of Transportation on the chemistry of asphalt binders should improve the use of recycled material in making long-lasting roads.

Recycling of used pavement materials and roofing shingles lowers construction costs and keeps asphalt waste out of landfills. An optimal mix of recycled and new materials is needed to achieve long-lasting pavement. ISTC and the Illinois Center for Transportation partnered on the study to correlate the composition and chemical characteristics with how they weathered and aged under traffic. The final report, “Modeling the Performance of RAS (Recycled Asphalt Shingles) and RAP (Reclaimed Asphalt Pavement) Blended Asphalt Mixes Using Chemical Compositional Information,” was published in early 2017.

An ISTC collaboration with North Carolina A&T University reported significant similarities between petroleum-derived binders and binders made using bio-oils produced from plants (Miscanthus, corn stover, wood pellets) and animal (swine manure) waste.

Team gathers data on use of wood waste for fuel

ISTC led a study of the use of wood waste as a renewable fuel source. Wood could be a renewable, carbon-neutral heating source for nurseries, farm buildings, animal production facilities, animal care facilities, correctional centers, schools, or in rural areas where natural gas is not available. The work gathered information on availability of waste wood, furnaces, and cost comparisons with other fuels.

An open house is planned for 2017 to demonstrate the results at a nursery business outfitted with a wood-burning system. The Metropolitan Mayors Caucus of Chicago and the Illinois Institute for Rural Affairs at Western Illinois University are assisting with economic and market analyses as well as surveys to understand user needs and other factors that likely affect decisions to adopt a wood-based heating system. The U.S. Forestry Service funded this work.

Engineer writes the book on eco-friendly lubricants

Senior research engineer Brajendra K. Sharma has spent years redesigning vegetable oil molecules to mimic the properties of petroleum lubricants, producing biodegradable machine lubricants that can be safely used in environmentally sensitive work places, such as for forest, agricultural, and marine applications. In 2016 he co-authored the book Environmentally Friendly and Biobased Lubricants, published by CRC Press, which
surveys research in the growing field. Sharma also designs renewable bio-
additives to improve the performance characteristics of eco-friendly
lubricants. Just as with petroleum lubricants, additives improve the
lubricity, oxidative stability, friction, wear, and corrosion resistance of the
base material.

Analysis finds dangerous brew in old bottle

Assessment of the contents of a “medicine” bottle recovered by the
Illinois State Archaeological Survey (ISAS) during a dig at Meredosia,
Illinois, revealed a dangerous stew of heavy metals and all 16 primary
polyaromatic hydrocarbons (PAHs) now regulated by the U.S. EPA as
carcinogens. John Scott, senior analytical chemist at ISTC, conducted
the analysis, which also showed compounds consistent with coal tar,
pine tar, and essential oils suggesting cumin and thyme.

High-resolution mass spectrometer measurements showed strong
evidence that the bottle, labeled “Thomson’s Compound/Syrup of Tar/
For Consumption,” was spiked not just with alcohol, but also with the active
compound in marijuana (THC - delta9-tetrahydrocannabinol).

Case study on reducing waste

The largest Midwestern crude oil refinery, Marathon Petroleum
Corporation in Robinson, Illinois, partners with vendors for equipment
recycling and oil re-processing across its organization. Its green
team (Committee for Awareness and Responsibility of Environmental
Stewardship–CARES) involves all refinery departments in looking for
ways to reduce its environmental impact.

The city of Robinson also benefits from Marathon collection events
for electronic waste and household hazardous waste and from four
certified Wildlife Habitat Council Sites. Marathon was a 2016 Illinois
Sustainability Award winner, and its sustainability efforts are detailed in
a new ISTC case study: http://hdl.handle.net/2142/96061
Kimberly-Clark Corp. in 2016 recognized the University of Illinois as one of the two most robust participants in the company’s national glove recycling program.

Zero Waste Illinois initiated an effort in 2014 at its laboratories in Champaign and then on the U of I campus to recycle single-use nitrile gloves. Millions of the gloves are used at U of I each year in research and instructional labs as well as by maintenance and food service operations. These are now recycled and made into useful products, including outdoor furniture and bike racks.

An iconic Block-I sculpture made of beverage bottles was ISTC’s gift to campus during Earth Week 2016.

Graduate students Hursh Hazari and Nahid Akarm, under the guidance of Joy Scrogum, ISTC sustainability specialist, crafted the edifice to educate students about how much plastic is discarded in the U.S. The mighty Block-I was made of more than 2,300 bottles, roughly the number of bottles thrown away every 1.45 seconds in the U.S. The sculpture emerged out of ISTC’s effort to characterize waste streams in University buildings, a project funded by the U of I Student Sustainability Committee.
Sponsored Research Program

A part of ISTC’s mission to provide economic and environmental benefits to Illinois industry, communities, and other constituents, the Sponsored Research Grant Program supported nine new projects in FY2016 and completed several earlier ones.

The Sponsored Research Grant Program is funded by the State’s Hazardous Waste Research Fund (HWRF) to advance our knowledge and understanding in the areas of hazardous waste remediation, pollution prevention, water quality and water conservation, as well as other environmental issues important to the state.

**Toolkit aids household hazardous waste collection**

The Champaign County Regional Planning Commission and ISTC developed a Local Government Toolkit for improving household hazardous waste (HHW) collection in Illinois. HHWs include motor oil, gasoline, herbicides, insecticides, cleaning products, paints, and solvents. Outside the Chicago area, there are no full-time collection centers for these materials. The toolkit was an outgrowth of a study of a seven-county area of central Illinois. Current practices, opportunities, and stakeholder opinions were reviewed and combined with a survey of best practices nationwide to help identify and implement a strategy to improve HHW collection options. ISTC published TR-063 on this work.

**Work continues on cooling tower water conservation**

One consequence of carbon capture efforts to reduce CO₂ emissions is increased water use—as much as 80 percent more by U.S. Department of Energy estimates. Hence, there is a need to demonstrate technologies that will conserve water in these processes. Cooling tower water conservation is one major opportunity addressed with this project. This continues work from an earlier HWRF-funded project. Those results will be published later in 2017.
Technology concentrates ultrafine solids

ISTC has validated a concept to concentrate ultrafine solids in wastewater through two previous projects with funding from the Illinois Clean Coal Institute. The system has applications in the food, biotech, and industrial sectors. The University of Illinois has filed for intellectual property protection, and the application is making its way through the United States Patent and Trademark Office. This current project is evaluating a prototype of a scaled-up version to further develop this technology.

Project examines strategies for HTL wastewater

ISTC is a leader in hydrothermal liquefaction (HTL), a way of producing energy from high-moisture waste material. One downside is the high organics and high volume of wastewater generated that needs careful treatment. This project is examining treatment options (see related article on p. 23).

PRI initiative gathers data on contaminants

This project is part of the Prairie Research Institute’s Resilient Watershed Initiative in the area of Ottawa, Illinois. The project builds on PRI’s knowledge of the Fox River watershed and ISTC’s lab capabilities to evaluate contaminants in water and sediments. The data will assist in the development of recommendations for dredging and other mitigation strategies for contaminants in the lower Fox River and for planning flood control strategies.

Sampling looks for herbicides in Illinois rivers

Water samples were collected from March to June 2017 from farm drain tiles emptying into the Salt Fork and Spoon River as well as from the rivers themselves at several locations. The samples are being analyzed for a number of herbicides (glyphosate, atrazine, acetochlor, and metolachlor) and the bactericide nitrapyrin to determine off-field transport of these compounds.

Study looks for ways to boost plastic recycling

The low recycling rate of waste plastics contributes to waste getting into rivers and lakes and to the landfill burden and the potential for chemicals to leach into the environment. This study is examining recycling rates in communities throughout Illinois and developing strategies to increase those rates. The waste plastics could then be recycled to make other products or to produce oil. This would benefit the environment and businesses. ISTC is coordinating these efforts with the Illinois Recycling Association (IRA).

Sponsored Research Program Publications

Research Reports

- RR-132 Reduction of Non-Revenue Water through Continuous Acoustic Monitoring / Hughes, David; Venkatesh, Chandan. 2016.

Technical Reports

- TR-065 Characterizing the Effects of Thermochemical Bioenergy Production Processes on Emerging Contaminants and Wastewater Reuse Potential / Schideman, Lance; Zhang, Yuanhui; Sharma, B.K.; Pham, Mai. 2017.
- TR-063 Improving Household Hazardous Waste Collection Options for East Central Illinois / Monte, Susan; Bartles, Bart; Sreedhar, Deepika; Gopal, Jayanthi. 2016.
Global Collaboration

The potential impacts of technological solutions are global, and ISTC researchers are developing strategic partnerships to maximize their work.

U.S. Army Corp of Engineers

The yearlong seminar series co-organized by ISTC with the U.S. Army Corps of Engineers Construction Engineering Research Laboratory (CERL) about ongoing sustainability projects of mutual interest yielded new insights into national and international technology needs and ways we might collaborate.

Through that relationship, ISTC’s Lance Schideman presented an overview of available water and wastewater technologies as part of the “Operational Water Panel - Options for UN Piloting” during the Department of Defense (DOD)-United Nations Technology Workshop on Aug. 17, 2016. The workshop, at the National Defense University, Washington, D.C., was in response to presidential guidance to support UN Peacekeeping operations around the world with DOD experience to enhance effectiveness and environmental impacts.

Stephen Cosper, a veteran environmental engineer at CERL, a division of the U.S. Army Corps of Engineers’ Engineer Research and Development Center (ERDC), presented an overview of solid waste management technologies at the workshop. Cosper spent a 12-month sabbatical at ISTC, participating in a series of successful collaborations. (See page 22 for more information on ISTC-DOD water treatment project.)
**Electric Power Institute**

The Electric Power Institute of China hosted a visit of ISTC and Illinois State Geological Survey researchers to discuss joint research on reliable and affordable power generation, while reducing air pollution resulting from large power-producing plants. A follow-up meeting at the University of Illinois occurred in July 2017.

**Instituto de Tecnologia Aplicada e Qualificacao**

A collaboration with Brazil’s Instituto de Tecnologia Aplicada e Qualificacao was formed to explore research collaborations with Brazilian universities and companies to help manage the country’s energy needs.

**Indian Institute of Petroleum**

A pilot-scale demonstration was performed with the Indian Institute of Petroleum that evaluated the inclusion of waste PVC (polyvinyl chloride) in the plastic stream for pyrolysis and co-processing of waste plastic with petroleum fractions.

**University of Leeds**

A partnership with the Energy Research Institute at the University of Leeds, United Kingdom, yielded advancements in biofuel production from microalgae. The team conducted testing of the continuous hydrothermal liquefaction process for converting microalgae into bio-crude oil, a key step for scaling up technology to a commercial scale.

A second collaboration with the University of Leeds is exploring the development of a fast and accurate method to determine the stability of biochar (charcoal formed by heating biomass in the absence of oxygen). A goal of the work is to find a way to predict the mean residence time of biochar, which can vary from decades to millennia. Long residence times are key to the potential use of biochar to sequester carbon dioxide.

**University of York**

ISTC hosted Dr. Alistair Boxall and some of his colleagues from the University of York in May 2016 so they could learn more about our research on pharmaceuticals and personal care products in the environment and other topics. Dr. Boxall, Professor in the Environment Department at York, is a well-known researcher on PPCPs and presented a webinar on the topic.

**University of Birmingham**

Brajendra K. Sharma of ISTC is collaborating with researchers at the University of Birmingham, UK, under the BRIDGE (Birmingham-Illinois Partnership Discovery, Engagement and Education) program. The project is titled “Towards a Global Network for Drop-in Biofuels.” The research groups are working to consolidate and extend a collaboration concerning bio-oil using novel catalysts and reactor technologies.

In June 2017 ISTC received another BRIDGE grant to support collaboration between ISTC researchers, other U of I iSEE Water Scholars, and scientists from University of Birmingham. The creation of the international Water Assembly is meant to raise the profile of research across both institutions, complement academic research with applied field research, and make U of B-U of I the go-to place for water-related research.

The project proposes two workshops, one here and another at U of B, to bring experts together to discuss further collaboration topics, identify research themes and future sources of funding. The U of B team plans to visit in Fall 2017, while the U of I team plans to visit their campus in Spring 2018.

**Kuwait Institute for Scientific Research**

In partnership with the Kuwait Institute for Scientific Research, ISTC is studying the thermal degradation kinetic parameters of polypropylene (PP) plastics and comparing them to those of a polypropylene/starch blend (PP/S) (70/30 wt%) taking into account the effect of photo degradation caused by natural weathering.
Communicating Science

Sustainability Seminar Series

For the past 10 years, ISTC has organized seminars on various sustainability topics. Sustainability related to buildings, business, water, energy, pollutants, and more have been covered, and all seminars are archived on the ISTC website www.istc.illinois.edu. Currently ISTC is working on captioning all past seminars.

Spring 2016:
Water Conservation & Behavior Change

February 11
Rick Manner – Executive Director, Urbana & Champaign Sanitary District
“What is Forty Billion Gallons of Sewage Plant Effluent Worth?”

March 3
Aaron Durnbaugh – Director of Sustainability, Loyola University Chicago
Loyola University Chicago: Gallons Saved & Shared

March 17
Mark Davis – Conservation Biologist, Illinois Natural History Survey, Prairie Research Institute
“Upper Midwest and Great Lakes Landscape Conservation Cooperative – Coastal Conservation Workgroup”

April 12
Robert Marans – Research Professor, Institute for Social Research, University of Michigan, Ann Arbor
“Monitoring Sustainability Culture at the University of Michigan”

April 15
Molly Lunn – Deputy Director, Office of Recycling, Illinois Department of Commerce and Economic Opportunity
“Partnering with ISTC to Grow Illinois’ Clean Economy”

April 28
Charles Curtiss – Retired Manager, Institutional Water Treatment Program, Illinois State Water Survey
“Evaluation of Zero Blowdown Cooling Towers with Soft Water Makeup”

May 3
Alistair B.A. Boxall – Professor, Environment Department, University of York, Heslington, York, UK
“Drugs Down the Drain: How can we assess and manage the impacts of medicines in the natural environment?”

Spring 2017: Environmental Contaminants

February 16
Mary Turyk – Associate Professor of Epidemiology, School of Public Health, University of Illinois at Chicago
“Diabetes and Persistent Organic Pollutant Exposure in the Great Lakes Fish Consumption Study”

March 2
Michael Lydy – Professor in the Departments of Zoology and Chemistry & Biochemistry, Southern Illinois University at Carbondale
“Are Pyrethroid Insecticides a Threat to Aquatic Non-Target Species?”

March 16
Sarah A. Zack – Pollution Prevention Extension Specialist, Illinois-Indiana Sea Grant (IISG) and University of Illinois Extension
“Microplastics in the Aquatic Environment”

April 13
Yujie Men – Assistant Professor, Department of Civil and Environmental Engineering, University of Illinois at Urbana-Champaign
“Roles of Nitrifiers in the Removal of Micropollutants during Wastewater Treatment Processes”

April 27
Alan Steinman – Director of Grand Valley State University’s Annis Water Resources Institute (MI)
“Lake and Wetland Restoration: A Tale of Three Systems”

ISTC Videos

ISTC videos are available on YouTube.

2016 Illinois Sustainability Award
Keynote Address - GM’s John Bradburn
John Bradburn, global waste reduction manager at General Motors Corporation, has helped create opportunities to advance the prospects for the environment, communities, and his company.

Engineered Solutions for Emerging Water Contamination
ISTC has developed engineered solutions for two areas of concern related to the contamination of human water supplies and the aquatic environment. This video gives a taste
of what attendees saw at the tech tour for the 2017 Emerging Contaminants in the Aquatic Environment Conference (ECAEC17), May 31–June 1, and for the Free Technology Demonstration on June 2.

Honoring Sustainability Champions of 2015
This video highlights the achievements of four 2015 Illinois Sustainability Award winners: Shedd Aquarium, Cook County Department of Environmental Control, Carus Corporation, and Cook County Sheriff’s Recycling Program.

Loyola University’s Gallons Saved and Shared Project
A Billion Gallon Water Challenge project, Loyola University Chicago cut its water use with a student-led program of plumbing retrofits and a behavior-change campaign. The program also allowed scientific study of more effective strategies for encouraging environmentally positive behavior on a college campus.

Mr. Sewer Multi-stage Biofuel Technology
“Mr. Sewer” is a multi-stage waste-to-biofuel production system under development at ISTC. This system can remove both organics and nutrients in municipal wastewaters and turn them into renewable energy resources. Processing of the wastewaters is combined with algae farming in a way that amplifies the energy production while cleaning the water for potential reuse applications. The nutrients support algal growth, and the algae are then harvested for use in biofuel. Amplified by the sun’s energy and continuous nutrient reuse, an optimized system can harvest three to 10 times the energy contained in the wastewater. Calculations based on a commercial-scale demonstration plant on the University of Illinois campus indicate the technology is well suited to generate fuel or revenue from wastes at the scale of a small city or a self-contained military installation.

New Bioways for Highways
ISTC researchers and colleagues at the University of Illinois have received funding to implement the proposal in this video. Interdisciplinary researchers at the U of I have determined that millions of dollars can be made by turning plants grown along Illinois highway rights-of-way into energy.
Networked Leak Detection Technology Using Sound Demonstrated

A Billion Gallon Water Challenge project funded through the ISTC Sponsored Research Program in 2015, this technology demonstration dealt with acoustic sensors designed to be permanently placed in fire hydrants in a greater Chicago neighborhood in a multi-channel wireless network to provide real-time 24/7 leak detection in buried distribution systems and demonstrated accuracy of 90 percent.

Pharmaceuticals and Personal Care Products in the Environment and at Home

ISTC conducted a survey in 2016 of nurses and other healthcare professionals that indicated they were interested in receiving more information about proper medicine disposal so they could talk with their patients. ISTC and colleagues at Illinois-Indiana Sea Grant (IISG) created a 10-minute video on the subject of proper medicine disposal and how PPCPs might affect the environment.

Technology Demonstrations

A technology demonstrations showcased ISTC’s novel research on emerging contaminants and solutions to reduce these contaminants in the environment and is summarized in a recent video.

Public Engagement

For 2016 through June 2017, ISTC staff published over 30 journal articles and reports. In addition, they delivered more than 50 presentations at conferences and workshops throughout the U.S. as well as abroad.

Since the fall of 2015 and continuing through spring 2017, ISTC has organized monthly forums with their counterparts at the U.S. Army Engineer Research and Development Center, Construction Engineering Research Laboratory (ERDC-CERL) in Champaign to discuss sustainability topics and potential collaborations. The ISTC-CERL forums are open to all at U of I who are interested; topics have ranged from innovations in construction and roadway materials, water use and reuse, and emerging contaminants to flooding, weather, energy, and biofuels.
Brajendra K. Sharma named Society of Tribologists and Lubrication Engineers fellow

Sharma one of six new fellows of the Society of Tribologists and Lubrication Engineers and was honored at the 71st STLE Annual Meeting and Exhibition in May 2016.

ISTC recognized in State Electronics Challenge

ISTC was one of seven organizations across the nation to earn gold level recognition in the State Electronics Challenge for their commitment to “green” the lifecycle of their electronic office equipment. This is the third year in a row that ISTC has earned gold, the top recognition level, which requires that organizations complete the general requirements and all three lifecycle phases.

ISTC receives recognition from Illinois National Guard

A plaque was presented to Technical Assistance Program personnel this spring in appreciation of a 20-year collaboration to help the Illinois Army National Guard meet its commitment to sustainable operations using sound environmental management practices.

As the lead contact with the Illinois Department of Military Affairs (IDMA), ISTC environmental engineer Mike Springman has helped develop requirements for their Environmental Management System, solid waste management planning, pollution prevention planning, hazardous materials planning, and a range of environmental compliance assessments and audits. He also managed remediation projects and implemented green chemistry upgrades at military installations.
TAP expertise has helped IDMA embrace the goals of the Army Strategy for the Environment by planning early for environmental impacts in their operations.

**Grants**

Laura Barnes was awarded $137,000 by the U.S. Environmental Protection Agency for the Pollution Prevention Information Network Proposal for the Great Lakes Regional Pollution Prevention Roundtable (GLRPPR) through Sept. 2018.

Dan Marsch was awarded $240,908 by the U.S. Environmental Protection Agency to continue the Illinois Conservation of Resources—Economy, Energy and Environment Program (ICORE3) through Sept. 2018.

Nandakishore Rajagopalan and Wei Zheng received $189,331 from Linde North America for “Carbon dioxide utilization in CAFOs.”

John Scott and Nandakishore Rajagopalan received $5,794 from the Small Business Innovation Research (SBIR) program for “Bayes optimal wastewater classification using noisy sensors.”

Lance Schideman received $44,935, through a sub-award from Helios-NRG (U.S. Department of Energy) for “Efficient capture of CO2 from fossil fuel power plants using algae and conversion to value added products.”

Lance Schideman received $107,796 from the U.S. Army Construction Engineering Research Laboratory for “Pilot Demonstration of Hydrothermal Conversion of Wet Organic Wastes for Improved Waste Management and Renewable Energy Production.”

Brajendra K. Sharma, Sriraam Chandrasekaran, and Nandakishore Rajagopalan received $61,275 from the Illinois Department of Transportation for “Implementation project proposal: Cost savings and revenue potential from IDOT rights-of-way.”

Michael Springman received $70,000 from the Illinois Department of Military Affairs for “Development of an integrated solid waste management plan and update of the 2010 Pollution Prevention Plan.”

An award for supporting the Illinois National Guard Environmental Office over the last 20 years was presented by Illinois Adjutant General, Maj. Gen. Richard Hayes Jr., to Mike Springman, Joe Pickowitz, and Shantanu Pai of the Illinois Sustainable Technology Center’s Technical Assistance Program on April 28 at Camp Lincoln. Photo by IDMA.
In June 2016, ISTC and Illinois-Indiana Sea Grant organized two teacher workshops on Pharmaceuticals and Personal Care Products in the Environment for middle school and high school teachers and pre-service teachers to learn more about PPCP issues and work on curriculum on that topic. The curriculum is available at [http://web.extension.illinois.edu/unusedmeds/educators.curriculum.cfm](http://web.extension.illinois.edu/unusedmeds/educators.curriculum.cfm). Photo by Jim Dexter.
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