Environmental Research & Education Foundation
Lighting a path to sustainable waste management practices

newsletter

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EREF Awards Largest Grant Ever, Plus 3 More, for Solid Waste Research

The EREF Board of Directors is pleased to announce the award of a project in excess of $1 million on elevated temperatures in MSW landfills in addition to three other research grants for solid waste research, which were awarded after a robust vetting process.

Understanding and Predicting Temperatures in Municipal Solid Waste Landfills

Investigators: Craig Benson, University of Virginia, Morton Barlaz, North Carolina State University, Marco Castaldi, City College of New York and Scott Leuttich, Geosyntec Consultants
Start Date: Dec 2014
Award Amount: $1,060,591

While there are a number of landfills in North America that are experiencing elevated temperatures, there is only anecdotal evidence as to the underlying cause. Some of these elevated temperature landfills have received industrial wastes that are known to release heat, but others have not. Some elevated temperature landfills are deeper and

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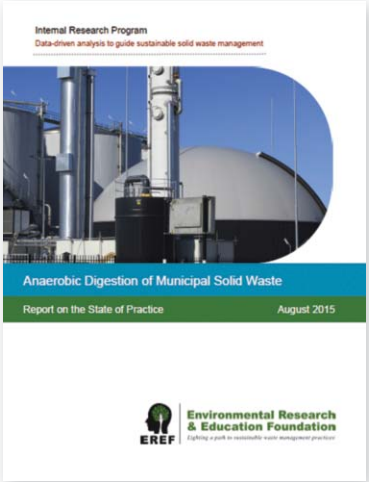
A Year of Growth for EREF's Internal Research Program

EREF's Internal Research Program (IRP) seeks to aggregate industry-related data and policy information, providing valuable unbiased analyses to benefit the solid waste industry and the communities it serves. Over the past year, the program has grown significantly. EREF published the first two reports resulting from IRP projects in August, a major milestone for the program. Previously, analyses and results were shared solely through presentations at state and national conferences.



Both IRP reports explore various technologies for utilizing waste as an energy feedstock. The first, titled *Using Municipal Solid Waste (MSW) as a Biofuel Feedstock*, examines the environmental impacts of MSW conversion via landfill gas-to-energy, waste-to-energy incineration,

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Chairman's Message

It is with great pride that I write my last letter as Chairman of the EREF Board of Directors. When I became Chairman in 2014 I outlined 3 goals for my 2 year term. I'd like to update you on the progress of meeting those goals.

1. Fund $1 million per year in research and scholarships

Before he passed away in 2013, EREF Board member Bob Stearns, Chairman and Co-Founder of SCS Engineers, challenged the EREF Board members to fund $1 million per year in research projects. I'm thrilled to announce that we have met – and exceeded – this goal. From 2013 to 2015, EREF has averaged over $1,030,000 in annual spending on research and scholarships, including a record-breaking 8 scholarships being awarded in a single year in 2015.

2. Invest in research that provides a tangible return on investment to EREF's stakeholders

Recognizing that there are specific research topics that are more urgent than others, having potential impacts that are both long and short term, EREF issued a request for proposals intended to address high need topics, as identified by the solid waste industry via the EREF Board of Directors and Research Council. One of these topics is elevated temperatures in landfills. Last year EREF awarded a research grant for a project entitled "Understanding and Predicting Temperatures in Municipal Solid Waste Landfills." The award amount is in excess of $1 million and is the largest single award EREF has given in its 23 year history. The project will provide critical insight into a phenomenon that has puzzled the industry for the past few years. At the completion of this project, landfill owners and operators will have a practical and validated methodology to predict heat accumulation in landfills, which can be used to identify situations that might result in elevated temperatures and support the development of best management practices that prevent excessive heat generation, and evaluate the feasibility of remediation strategies.

3. Make EREF the go-to organization within the industry for continuing education

EREF's Continuing Education Program provides quality and technically beneficial online courses, live webinars and in-person Regional Summits. The success of these programs continues to grow, allowing members of the solid waste industry to improve and excel in their professional field as well as maintain professional licensing. EREF held a webinar on the elevated temperatures in landfills project mentioned above in conjunction with Waste360 University and more than 294 people participated. Earlier this year EREF held a Regional Summit on the management of MSW organics in San Jose, California. Held in collaboration with the California Refuse Recycling Council, the Summit boasted attendance of 100 people, one of whom commented that "I thought this summit was one of the best and most well rounded summits that I have attended! I left feeling more knowledgeable and with many more ideas than what I came in with."

I'd like to thank the EREF staff, my fellow EREF board members, industry equipment manufacturers, haulers and other waste industry members who have been instrumental in the ongoing transformation and growth of EREF. EREF exists and grows because of your generosity and your belief that fact-based scientific research sustains our industry.
The relationship between our industry and the mission of EREF has never been stronger and I am excited to see what the future holds for this organization.

Respectfully,

Richard Burke
Chief Executive Officer, Advanced Disposal
Chairman, EREF Board of Directors

President's Message

EREF has seen tremendous growth over the past 5 years, with the significant expansion in research dollars spent and new scholarships awarded, the addition of two programs: continuing education and internal research, as well as substantially increased industry support. For this, I cannot express how thankful we are to have stakeholders and supporters who see the value of EREF's mission.

To continue providing a strong value-add back to the solid waste and sustainability fields, EREF is continually evaluating what we do. As part of this effort, 2015 marks a year where the foundation re-evaluated its strategic goals and objectives. This process occurs every 5 years and represents a time to reflect on past successes and challenges and set new targets for better serving our stakeholders through our mission.

Feedback obtained from our stakeholders as part of this process has been overwhelmingly positive, but identified a number of core areas that EREF can continue to grow. By maintaining strong core programs we continue to fund critical research, provide scholarships, acquire relevant industry data, and educate industry personnel. Our mission doesn't stop there. In the coming years, EREF will expand efforts to include a focus on waste issues in the utility sector, as well as spearhead efforts on understanding how sustainability decisions are made by product manufacturers who understand that waste generated from their goods are a key factor in the sustainability equation.

As part of expanding the foundation's mission into these industry sectors, the EREF Board of Directors has set a 5-year strategic goal to "Substantially increase annual funding of research, scholarships and internships." Currently, EREF funds over $1 million each year and our target is in 5 years to be funding between $2 to $3 million. Based on our estimates, if EREF can fund research, scholarships and internships at this level then we will be able to substantially multiply the impact the foundation has on advancing solid waste management practices and sustainability.

As always, EREF welcomes your feedback. We rely on our stakeholders to help steer the foundation's activity to support the industry. Please feel free to contact me directly at 919.861.6876 ext. 102 or bstaley@erefdn.org.

Kind regards,

Bryan F. Staley, Ph.D., P.E.
EREF President and Chief Executive Officer

Give the Gift of Education

Give the gift of education this holiday season!
All EREF Online Courses and Internal Research Program Reports are **20% off** through December 31, 2015! Use promo code HOLIDAY15. Visit www.erefdn.org

EREF's 21st Annual Charitable Auction Raises More Than $2 Million!

The 21st EREF Annual Charitable Auction broke records by raising more than $2 million to further EREF's mission to fund and direct solid waste management research and educational initiatives – and it was all thanks to the amazing generosity of industry members and supporters.

The 2015 Live Auction took place on Wednesday, June 3 at WasteExpo in Las Vegas, Nevada and was preceded by an open bar reception sponsored by Big Truck Rental. Professional auctioneer Gary Seybold of Ritchie Bros. Auctioneers auctioned off 31 lots of donated containers, equipment, trips, outings with industry executives and garbage trucks.

Auction attendees were also asked to make donations to the EREF Scholarship and Internal Research Programs. In addition to the $5,400 of personal donations made, The Detachable Container Association (DCA) and PTR Baler & Compactor Company each made donations of $10,000. Additionally, Truck Country and Freightliner made a contribution of $22,500.

In its 5th year, the Silent Auction raised over $44,000 and included donations such as top of the line electronics, equipment and sporting event tickets from 34 WasteExpo exhibitors.

And finally, the 2015 Raffle prize was a 1954 Chevrolet 3100 1/2 Ton Pickup 5 Window sponsored by Trucks & Parts of Tampa. Tickets were sold for $100 each and proceeds went to the Boys & Girls Club of Southern Nevada. Republic Services then made a matching donation to EREF. The lucky winner was Todd Kirschenheuter of Bluewater in San Leandro, CA.

The EREF Annual Charitable Auction is the foundation's largest fundraiser, so far having raised more than $16 million to further EREF's mission, and is a direct result of the generosity of members of the National Waste & Recycling Association (NW&RA) who donated the incredible items up for auction this year at WasteExpo. EREF would like to thank everyone who made the 21st Annual Charitable Auction a record-breaking success! •

2015 EREF AUCTION
LAS VEGAS • June 2-3, 2015

Gary Seybold, Ritchie Bros. Auctioneers with EREF CEO Bryan Staley

Silent Auction

Live Auction Bidders

Thank You to the Following Companies and Individuals That Donated to the EREF Auction:

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More Than $47,000 Raised for the EREF Internal Research & Scholarship Programs!

EREF would like to thank the following individuals and companies for their generosity in helping to educate the next generation.

Danny Vaught
Pat Carroll
Ron McCracken
Brad Nelson
Josh Thompson
Brion Maguire
Anne Wyrsch
Anne Germain •

PTR Baler & Compactor Company

DCA

EREF Interns at the Auction

Truck Country and Freightliner

EREF Awards A Record Eight Scholarships for 2015

The EREF Board of Directors is pleased to announce the award of a record eight scholarships.

Lori Clark

SUNY Stony Brook, Ph.D.
EREF Scholar 2015

Project: A Novel Treatment to Hydrogen Sulfide Contaminated Landfill Gas

Capturing landfill gas for energy production is widely practiced across the United States, however, a large portion of landfill gas is flared off for various reasons. The primary gases produced at a landfill are carbon dioxide and methane with small amounts of hydrogen sulfide (H_2S) and other gases. H_2S is a toxic, corrosive, and odorous gas that can damage engines and at high enough levels must be treated. Landfills collecting construction and demolition (C&D) debris produce H_2S levels (thousands of ppm) that can inhibit landfill gas to energy production and be costly to deal with. With the help of the Advanced Energy Research and Technology Center at Stony Brook University, Wehran Energy, and Brookhaven Landfill, Lori is studying a novel approach to removing H_2S from landfill gas. The objective is to improve the economics of sulfur removal and increase the potential of landfill gas recovery for energy production.

The team has been studying the effectiveness of the current sulfur treatment system at Brookhaven landfill from the C&D and ash cells using gas chromatography. They've simulated a new gas treatment system using small scale reactor vessels in the lab that employ lab created nano sized particles (in place of the larger conventional media) that act as a catalyst separating H_2S and biochar. This technique has the potential to reduce the volume capacity required for housing the media used to filter landfill gas. The team is partnering with Brookhaven landfill and Wehran Energy to scale up the project with a pilot study on site. After completing a pilot study, they plan to do feasibility and cost study. This can assist landfills with meeting state and federal environmental regulations at a better cost. This can also potentially boost energy production at landfills by generating a cleaner landfill gas and reduce the environmental impact associated with C&D waste.

Lori Clark is a native of Long Island and Southern California. She has a bachelor's degree in Resource Conservation (Brigham Young University), a master's degree in Marine Environmental Science (Stony Brook University) where she worked in a trace metal clean laboratory, and is currently a Ph.D. candidate in Technology, Policy, and Innovation at Stony Brook University with a focus on energy and the environment. While pursuing her bachelor's degree, she volunteered in South Africa and later began working on wilderness assessment in Utah and advocacy in Washington DC. Following her master's degree she did research on striped bass migration and contributed as a co-author on the state of NY/NJ harbor estuary reports for the Hudson River Foundation, NYC for three years. She later moved to California where she began a teaching career in earth and ocean sciences and became an associate professor of environmental science and technology at Moorpark College (8 years). While there, Lori developed curriculum and programs related to general environmental science, energy conservation, and solar technologies. Through her studies and work she came to be very interested in the development of local energy from municipal waste. She was able to find a program at Stony Brook University where she could pursue research in this area.

Laura Mast

Georgia Institute of Technology, Ph.D.
EREF Scholar 2015

Project: Chelant-Enhanced Selective Leaching and Capture of Rare Metals from Coal Ash

Rare earth elements (REEs) have played an invaluable role in the development of clean energy technology and high tech manufacturing. High global demand along with global scarcity has sober implications for future development. To address this supply issue, it is crucial that alternative resources and methods are developed for the recovery of REEs.

Research has shown that solid wastes such as coal combustion ash and incineration ash may be promising alternative sources of REEs due to their high concentrations in these waste byproducts. However, many obstacles exist before recovery of REEs from the above solid wastes becomes industrially viable and practical. Many knowledge gaps still exist, including a better understanding of the distribution of REEs in the coal and incineration ashes, as well as more efficient and environmentally sustainable methods to extract and recover REEs from these solid wastes.

The focus of the project will be to develop chelant-assisted methods for extraction, separation and recovery of REEs from coal and incineration ashes, which will achieve higher efficiency and selectivity and be more environmentally sustainable than conventional metallurgical methods. Chelants with different functional binding sites and geometry exhibit different complexation affinity toward different metals. Appropriate selection, design and employment of chelants will be developed to achieve the most effective and selective method. To assess the performance and robustness of the chelant-assisted method and impact of different ash matrices, the method will be applied to a range of representative waste ashes, which will be fully characterized in parallel.

The development of a robust, environmentally sustainable, efficient and selective REE extraction method will expand the role of resource recovery in industry as well as improve the fundamental understanding of the complexation chemistry of REEs and mineral dissolution in ashes. Most importantly, this project will help prepare the solid waste industry with better tools and knowledge to promote resource recovery in the treatment and management of solid wastes.

Laura Mast graduated with Honors in Chemistry in 2014 from Vanderbilt University. While at Vanderbilt, she was awarded a Beckman Scholar Award and studied ligand functionalization and nanomaterial synthesis and development with Dr. Janet Macdonald. While minoring in Environmental and Sustainability Studies, Laura extended her training and passion for environmental issues beyond the science, building a comprehensive understanding of sociopolitical and economic contexts as well. She is currently a second year graduate student and President's Fellow at the Georgia Institute of Technology, where she is pursuing her Ph.D. in Environmental Engineering. Working with advisor Dr. Ching-Hua Huang, she has developed a research project combining her love of research and passions for environmental chemistry and materials science in resource recovery, namely the development of novel chelant-enhanced selective leaching and extraction methods for rare earth elements and other valuable materials from solid wastes.

Following her Ph.D., Laura hopes to continue her work in resource recovery as an industry researcher and consultant. Improvements in technology for sustainable waste management will become more important in the future as demands for resource recovery continue to increase. Eventually, she hopes to enter into public policy surrounding hazardous and non-hazardous waste management.

Judd Larson

University of Wyoming, Ph.D.
EREF Scholar 2015

Project: Stimulating Autoinduction of Biofilm Growth to Enhance Cellulose Stabilization

Research into bacterial quorum sensing has revealed that self-produced chemical signals, called autoinducers, have been linked to the induction of biofilm growth, among other phenotypes such as virulence, swarming motility, antibiotic resistance, competence, and extracellular polymeric substance production. The solubilization of the organic fraction of municipal solid waste (OFMSW) is the rate-limiting step in the anaerobic biological stabilization process and is rate-limited by the amount of attached biofilm. Judd Larson's research focuses on enhancing the anaerobic solubilization rate of the OFMSW by stimulating the autoinduction of more biofilm growth. Since autoinducer-2 (AI-2) is an interspecies quorum sensing molecule linked to inducing biofilm formation and anaerobic solid waste biodegradation is conducted by a multi-species consortium of bacteria and archaea, Judd's research focuses on measuring and stimulating AI-2 production to enhance biofilm growth and increase biodegradation rates. Furthermore, since cellulose and hemicelluloses make up between 45% to 75% of the dry weight of MSW and are 90% of its methane potential, Judd's research focuses on enhancing the solubilization of cellulose.

The specific objectives of his research are to:

1. Identify microbial stressors that can enhance AI-2 production and anaerobic cellulolytic biofilm growth.
2. Measure the increased rate of cellulose solubilization due to enhanced biofilm growth from AI-2 stimulation and AI-2 addition.
3. Determine the types and amounts of the major cellulose degradation products from enhanced biofilm growth and compare to that of the non-stimulated systems.
4. Measure the increased rate of methane production due to enhanced biofilm growth.
5. Predict the increased degradation rates of solid waste from enhanced biofilms.

Judd Larson was born in Lenoir, North Carolina and raised in Bradenton, Florida. He earned his Bachelor's and Master's degrees from the University of Florida in Environmental Engineering Sciences in 2004 and 2006, respectively. For his Master's thesis, Judd had the unique opportunity to have a 48-acre bioreactor landfill as his laboratory, where he studied the pres-

sure-flow relationships of different horizontal injection line designs. He then moved to Columbus, Ohio, to work at CDM (now CDM-Smith) where he had the good fortune to work with a tremendous group of people on a variety of civil and environmental projects involving solid and hazardous waste design and engineering, storm water quality analysis and hydraulic modeling, sanitary sewer inflow and infiltration, wastewater treatment plant design and engineering, water treatment plant design and engineering, potable water pipeline design and construction, trenchless technologies, air quality analysis, groundwater remediation, and environmental life cycle analyses.

Olga Kachook

Yale University, MS
EREF Scholar 2015

Project: Integrating Zero Waste and Extended Producer Responsibility Practices into Corporate Waste

Olga will focus on the intersection between consumer product waste and the environment; namely, why certain corporations have willingly taken on advanced strategies for managing their product's life cycles, how other businesses can adopt similar strategies, and what positive effects this may have on a corporation's bottom line.

Zero waste is a business principle that goes beyond traditional attitudes towards materials management, such as recycling or composting materials. Instead, it takes a whole system approach to the immense flow of resources and materials through a product's life cycle. Zero waste strategies seek to first minimize waste and reduce consumption and then maximize recycling and other processes. The end goal is to ensure that products are designed in order to be eventually reused, repaired, or recycled back into nature or the marketplace. A concept closely integrated with zero waste is extended producer responsibility (EPR). As a strategy, EPR integrates the environmental costs associated with goods throughout their life cycle into the initial market price of products, and involves take-back programs that create an end-of-life destination for products. Olga plans to research what distinguishes companies that have embraced and advanced EPR from those that have struggled to create end-of-life solutions for their products and processes. She would like to identify what accounts for the differences in companies' attitudes towards product life cycles. Currently, research has shown that a combination of government regulations and policies, cultural and societal norms, consumer demand, and company culture and values are having the strongest influence on the development of EPR within corporations. Ultimately, Olga plans to investigate what it would take for EPR to be adopted more broadly, especially by companies based in the United States.

Olga Kachook graduated from the University of Washington with a Bachelor of Arts in Business Administration and a minor in Environmental Studies. After graduating she spent three years working with a Seattle-based environmental consulting firm, primarily implementing resource conservation programs for the public sector. This involved researching and authoring reports on sustainability planning, sustainable consumption, and regional green business programs. Olga also participated in the design and implementation of several cutting-edge pilot programs that tested the effectiveness of community-based social marketing strategies on increasing recycling and composting at multifamily properties. In addition to consulting, Olga also led an internal marketing and communications team of five people, including deliverables, day-to-day organization, and planning of marketing initiatives.

Olga is pursuing a Master's of Environmental Management (MEM) at Yale University's School of Forestry and Environmental Studies, where she will focus on whole-system sustainability strategies for businesses. She enjoys hiking, photography, and travel, most recently visiting her native Belarus.

Nicholas Hotzelt

Clemson University, MS
EREF Scholar 2015

Project: Landfill Leachate Valorization for Commodity Methane Generation

Landfill leachate is a regulated waste at every landfill operating in the United States. It is monitored and controlled to prevent environmental impacts, and to date there have been few reasonable markets for this ubiquitous waste. This project seeks to develop a new market for landfill leachate by a two-step conversion process that uses microbial biomass as an intermediate between leachate and methane production.

The broad objective of Nick's project is to demonstrate that landfill leachate can be converted to methane using a two-step microbial process that involves microbial biomass as an intermediate, where the microbial biomass generated from leachate consumption becomes the feedstock for methane production in a controlled anaerobic digester.

This research advances the prospects of converting landfills to a source of renewable energy. At most current landfills, the methane gas that is formed during the break down of organic waste leaks into the atmosphere and contributes to global warming. The process that Nick is working on will turn a significant environmental problem into a renewable energy solution.

Nicholas Hotzelt received his Bachelor of Science in Environmental Engineering from Clemson University in December 2014. He is currently a second year Master's candidate at Clemson studying Environmental Engineering with an emphasis area in surface and subsurface transport. Nick has been involved with numerous organizations over his time at Clemson including Engineers without Borders, Clemson Engineers for Developing Countries, and is currently serving on the executive board of the American Water Works Association (AWWA) student chapter. In his free time he enjoys attending sporting events, traveling and spending time with friends and family.

Kat McCarthy

Green Mountain College, MS
Robert P. Stearns/SCS Engineers Scholar 2015

Project: A Strategy for Organics Diversion

Organics diversion is considered by many to be the next frontier of recycling. The US EPA estimates that organic materials, including paper, yard trimmings and food scraps, make up the largest component of municipal solid waste. For commercial businesses in the hospitality sector, it costs money to both acquire and discard these materials. In addition to the financial implications of this problem, there are also environmental and social impacts associated with wasted food, such as resource use, pollution, and food insecurity. This represents an opportunity to develop a comprehensive suite of services for organics diversion that promotes waste prevention, donation, and composting. In communities across the country resources exist to redirect and compost uneaten food. However, there is a lack of technical expertise and a business model to enact such a program.

Through this project, research will be conducted to evaluate the feasibility of developing a business that offers commercial generators a comprehensive suite of services for organics management. Through research and a review of case studies, Kat will seek to understand best practices and parameters for such an entity. Objectives for the project include: (1) investigate business strategies and economic models that may be applied to the development of organics diversion programs; (2) research elements of organics diversion systems that feature prevention, donation, or composting; and (3) identify opportunities to draw on existing resources within the local community to implement cost-effective operational strategies. By researching the basic parameters of effective entities through the lens of the triple bottom line (people, planet, and profit) it is hoped that a framework can be created to evaluate local market viability for the development of such an organization. While this project will focus on a location in upstate New York, it is anticipated that frameworks and lessons learned will be transferrable to other communities across the country. By undertaking this research through the lens of business, reliance on under-funded local municipal programs will be reduced, helping expand organics diversion efforts more rapidly.

Kat McCarthy holds a bachelor's degree in Environmental Studies from Ithaca College. During her time as an undergraduate, she developed a passion for materials management through her work as the student recycling coordinator. Since 2006 she has been employed by the Tompkins County Solid Waste Management Division where she is currently the Waste Reduction and Recycling Specialist. Through this position, Kat coordinates 4R efforts (reduce, reuse, recycle, and rebuy), including the ReBusiness Partnership, green purchasing initiatives, food scrap recycling and curbside recycling programs. Her most recent work has focused on a curbside food scraps recycling pilot and residential drop spot program.

Kat has been trained as a Master Composter and has a strong interest in organics diversion. In 2006, she helped found Ithaca CRT, which supports local event coordinators in organizing and staffing educational Compost, Recycling, and Trash stations for attendees. Since 2010, she has served on the board of NYSAR3, the New York State Association for Reduction, Reuse, and Recycling. During her years of service as a regional representative with the organization she has acted as board secretary and currently chairs the organization's Organics Council. Kat is also a co-owner of EcoJarz, a company that specializes in drink tops and accessories to support glass jar reuse. Kat is currently pursuing an MBA in Sustainability at Green Mountain College.

Brent Perdue

University of Texas at Austin, MS
EREF Scholar 2015

Project: Analysis of Municipal Landfill Diversion Ordinances

Brent's research will analyze municipal landfill diversion ordinances utilizing case studies of large urban areas. The research aims to explain and explore existing landfill diversion ordinance development and examine successes and failures of landfill diversion ordinance case studies.

Many municipalities are grappling with issues of solid waste management out of budgetary, economic development, and/or environmental concern. Governmental regulatory environments and market conditions varies across metropolitan areas. No "one-size-fits-all" solid waste management solution exists. The research will focus on attempting to answer this question: What effect do municipal recycling ordinances have on landfill diversion of recyclable and compostable materials?

Brent's research will survey and compare several U.S. municipal landfill diversion ordinances. In addition, Brent will investigate international political and economic structures and policies that influence solid waste management in the context of Santo Domingo, Dominican Republic.

Brent Perdue grew up in Austin, Texas and attended the University of Texas at Austin. After receiving a double major Bachelor of Arts in History and Government, Brent worked for seven years as co-director of the nonprofit Ecology Action of Texas, a recycling service provider and environmental education organization. During his time at Ecology Action, Brent also served for four years on the City of Austin Zero Waste Advisory Commission – the City of Austin Resource Recovery Department's citizen oversight board.

Brent is pursuing two master degrees at the University of Texas at Austin in the LBJ School of Public Affairs and the School of Architecture's Community and Regional Planning program. Brent is interested in the relationship between cities, businesses, consumption, and zero waste planning and policy.

Arlene Janousek

Simon Fraser University, MS
EREF Scholar 2015

Project: Comparing Waste Management Impacts on Conventional vs. Organic Food Supply Chains

The agriculture industry is responsible for a variety of economic, social, and environmental impacts. Furthermore, the global food system is one of the world's most resource intensive practices, using large portions of available water, and land. While some aspects of the sustainability of conventional agriculture, organic agriculture, and food waste have been researched, there are few studies that examine producer food waste or that compare conventional and organic agricultural waste patterns. Multiple researchers have acknowledged a lack of data and information about food waste at different levels of the food supply chain. Food waste is a major concern as it is estimated that at least 30% of the food that is grown globally is never consumed by humans.

To address this knowledge gap, Arlene is working with farmers in the Lower Mainland region of British Columbia to assess their food waste practices. Arlene is conducting interviews and case studies to gain an in-depth understanding of farmer's perceptions of food waste as a sustainability issue, and to better understand if and how farmers are attempting to reduce or sustainably manage food waste. Additionally, Arlene will be comparing findings from organic and conventional food producers to assess how food waste volume and management differs between agricultural methods. The aim of this research project is to establish baseline information regarding on-farm food waste and best practices for reducing and managing on-farm food waste.

Arlene Janousek considers herself lucky to have grown up in beautiful British Columbia, Canada. In 2013, Arlene received an undergraduate degree from UBC Okanagan in Geography. During her undergraduate degree, Arlene worked in Ottawa for the Government of Canada and participated in numerous campus activities. After working for a hydroelectricity company for two years, Arlene decided to pursue a masters degree in Resource and Environmental Management (Planning) at Simon Fraser University. Arlene's research interests include sustainable development, environmental planning, and sustainable food systems. Arlene hopes that her research will contribute to the establishment of a more sustainable and efficient food system. In addition to school, Arlene enjoys photography, travel and exploring Vancouver and the surrounding areas. •

About EREF's Scholarship Program

The EREF scholarship program recognizes students with academic excellence, professional involvement and an interest in solid waste management issues at the doctoral and master's levels. Doctoral/post-doctoral scholarships are given in memory of Francois Fiessinger, P.E., Ph.D., a graduate of Rutgers University, who was a founding director of the foundation; and by EREF. Master's scholarships are made possible by the late Robert P. Stearns, P.E., DEE of SCS Engineers and Robert J. Riethmiller of PTR Baler and Compactor Company. Additional scholarships include the Waste Industries Scholarship Honoring Lonnie C. Poole, Jr., an EREF founder and Director Emeritus, and the Carl J. Apicella of American Environmental Group, Inc.

EREF Board of Directors Tours Complexe Enviro Progressive

In March 2015 Progressive Waste Solutions celebrated the official opening of its renewable natural gas facility, the largest of its kind in Canada and one of the largest in North America. During its June Board meeting, the EREF Board of Directors toured the facility located in Terrebonne, Quebec, near Montreal. Complexe Enviro Progressive is converting landfill gas to natural gas which is then delivered to the TransCanada pipeline network, via an injection point adjacent to the landfill site.

The facility is designed to process approximately 10,000 cubic feet per minute of incoming landfill gas. The gas generated at the site is the equivalent of fueling 1,500 trucks for 20 years. The new plant will also result in the avoidance of greenhouse gas emissions of approximately 1.2 million tonnes of carbon dioxide over a 10-year period. Landfill gas is recognized as a renewable energy source by regulators across North America.

Birds found in numbers can be a real problems for landfill operators. After a sharp decline at the end of the 19th century, the seagull became a protected species in 1917. As the species has few natural predators and knows capitalize on various power sources, it has thrived over the decades. Aware of the problem, a Regional Committee for consultation and coordination was set up to find solutions to the behavior of gulls. What used to be BFI Canada joined the Committee, along with several partners. The Committee's project was to evaluate different methods, including scaring in engineered landfills. The results showed that a falconry program reduced site traffic more markedly than any other gull technique. It is also considered ethically and environmentally, two requirements of the Department of the Environment. Complexe Enviro Progressive works with Falcon Environmental Services (http://faucon.biz/) and its wildlife control program to scare wildlife away before using more extreme measures. The falconry program can claim it will always be effective because it is based on a predator prey relationship. As well as being a highly effective control technique, the falconry program is perceived by the public as an acceptable, natural way to control wildlife. •

Ven Poole of Waste Industries greets one of the falcons used to keep gulls away from the landfill

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Regional Summit on Sustainable Solid Waste Practices & Research

Meeting Focus: Management of MSW Organics

EREF's one and a half day Regional Summit, held July 16-17 in San Jose, California focused on managing organics in solid waste and brought together over 100 leaders from industry, academia and municipal and state agencies such as CalRecycle. Government policy developments and industry trends related to MSW organics in the state of California and beyond were presented along with research into managing food waste, recycling, composting, waste-to-energy and more.

The Summit was organized in collaboration with the California Refuse Recycling Council and also featured a half day of site visits to local MSW organics processing facilities. •

(right) Sustainable Alternative Feed Enterprises (SAFE) housed at Garden City Sanitation demonstrated a new and exciting process of converting food waste into animal feed.

(below) Zanker Recycling and Zero Waste Energy Development Company provided an in-depth guided tour through some of the largest C&D processing and dry anaerobic digestion facilities in the country.

(Internal Research Program continued from cover)

and gasification/Fischer-Tropsch. The report also explores how current infrastructure could be used to support an MSW-to-biofuels industry. The project, a collaboration with researchers at North Carolina State University, received grant funding from the Biofuels Center of North Carolina. Results show that deploying any of the studied MSW conversion technologies alongside curbside recycling is favorable from a global warming perspective, with gasification providing the largest reduction.

The second report, titled *Anaerobic Digestion of MSW: Report on the State of Practice*, provides a comprehensive analysis on the use of anaerobic digestion (AD) to manage MSW organics in the United States. The report presents an overview of digester microbiology; includes analysis of tonnage, capacity, and biogas production at AD facilities; and examines state, local and corporate policies that impact organics management.

To date these two reports have brought key waste data to a diverse set of stakeholders, including: environmental consultants, equipment manufacturers, oil and gas companies, financial sector professionals, state and federal regulators, environmental advocacy groups and other researchers. Interest in the findings spans worldwide. The reports have been used in North and South America, the Caribbean, Europe, the Middle East, Asia, and Australia. Both reports can be ordered through the EREF website.

The next report that will be released is a study on waste generation, recovery and disposal of MSW in the United States. For this analysis, EREF has used a facility-based methodology to provide new insight on the amount of waste recycled, composted, incinerated, and landfilled in the U.S. for both 2010 and 2013. The project has involved aggregating tonnage and material data from the nearly 9,000 waste management facilities that handle MSW material across the United States. By using this approach, EREF has demonstrated the amount of waste generated and managed in the US is significantly higher than estimated by the US EPA.

In addition to providing analysis on important waste sustainability topics, the IRP program allows undergraduate and graduate student the opportunity to assist with data aggregation and trend analysis. Initially comprised of 3-5 interns each semester, the program has grown to 10 students in 2015, an extension of EREF's mission to educate the next generation of solid waste researchers and technical personnel. •

EREF Makes History on the Green

EREF broke records by raising more than $340,000 at its 2015 EREF Fall Classic and Networking Event. The tournament, co-sponsored by Advanced Disposal and Republic Services, was held on September 17 at Cog Hill Golf and Country Club in Lemont, Illinois. The event kicked off with a Welcome Reception, co-sponsored by New Way and Rehrig Pacific, on September 16 where guests mingled with friends and colleagues before competition sank in.

With bloody marys and cigars in hand, players proceeded to their shot-gun start on Course No. 2, The Ravines. Not only was the weather beautiful and the course challenging, but participants had the opportunity to meet EREF Scholar – and the first recipient of the Carl J. Apicella Scholarship – Tristanne Davis who attends Yale University. Tristanne's research project, "Evolving Role of Business in Solid Waste Management," explores the evolving role of business in solid waste management. "I think Tristanne's research is extremely relevant for where the industry's going and it also shows how the industry is changing," said Carl Apicella, President of American Environmental Group.

EREF Scholar Tristanne Davis with Board Member Ron McCracken

To bring the day's events to a close, EREF hosted its first Poker Tournament, sponsored by Sonrai Systems, where players enjoyed food, drinks and the chance to win a player's seat at the 2016 World Series of Poker – which was snagged by Josh Molnar of Groot Industries.

This year marked EREF's thirteenth Fall Classic, one of the foundation's annual fundraising events that allows for charitable support of the waste industry. "I support EREF because it is the research within our industry. Whether it's through the foundation's internal research program or a scholarship, EREF is always there to make the waste industry more advanced and innovative. I attend the golf tournament every year because it's a great place to network and have a great time with colleagues." said Joe Benco, Vice President of Engineering and Environmental Management at Republic Services and tournament co-sponsor. All proceeds from the EREF Fall Classic and Networking Event help support EREF's mission to fund and direct scientific research and educational initiatives for waste management practices. •

EREF Fall Classic Winners

Tournament First Place
Junior Thompson, John Lamanna, Mike Calleja & Brady Stewart

Tournament Second Place
Peter Reed, Bryan Nichols & Tom Lutes

Closest to the Pin
Frank Buscicchia

Longest Drive Women
Jeanie Dubinski

Longest Drive Men
Matt Edwards

Longest Putt
Chris Morley

Putting Contest
Adam Ryan

50/50 Raffle
David West

Poker Tournament
Josh Molnar

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EREF In the News

In addition to an article in the *Atlantic Monthly* and an honorable mention in *USA Today*, EREF data from its Internal Research Program was recently highlighted in *Forbes*.

The Atlantic

Technology

KICKING THE CAN

The future of trash—and how we'll produce less of it

BY ALANA SEMUELS

When the $20 billion Hudson Yards development is finished on Manhattan's Far West Side in 2024, it will have six skyscrapers, 5,000 apartments, more than 100 stores, and a public school. One thing it will not have is municipal garbage trucks. Related Companies, one of the developers working on the project, plans to install pneumatic tubes that will whisk trash to a sorting area. The system should decrease the amount of garbage that ends up in landfills: residents will be able to drop recyclables and compost into designated chutes right outside their doors. By replacing trucks, the tubes will also cut down on noise and pollution—and, hopefully, on rats.

New York has experimented with pneumatic tubes before—the city's Roosevelt Island has used them for trash since the 1970s—but they may become more common as cities struggle with the acres of trash their residents create.

The average American produces about 130 pounds of trash a month, and an article in the journal *Nature* estimates that global solid-waste generation will triple, to 11 million tons a day, by 2100. Meanwhile, we're running out of space for landfills, especially in Japan and Europe. Here, drawn from interviews with scientists, environmentalists, and sanitation experts, are ideas for how to tackle this looming problem.

1 Putting a Price on Trash

One way to get people to produce less garbage is to charge them for it. So-called pay-as-you-throw programs—in which municipalities bill residents for their garbage—have been around for decades but are becoming more widespread. And they work: since beginning a pay-as-you-throw program in 1993, Worcester, Massachusetts, has seen a 53 percent drop in waste, from 43,000 tons a year to 20,000. "It really does change behavior," says Mark Dancy, the president of WasteZero, a company that runs similar programs in hundreds of municipalities. "Now that [people] are aware that trash has a cost, they begin looking for all the alternatives to putting things in a trash can."

Of course, people will try to cheat by putting their garbage in someone else's can. (Some towns employ inspectors to follow up on reports of illicit dumping; they search trash for identifying information and write tickets.) But technology could combat this, says Bryan Staley, the president of the Environmental Research and Education Foundation, which funds research on waste management. Companies could attach radio-frequency identification (RFID) tags—which cost as little as 7 cents apiece—on trash bags, he says, so that an RFID reader on a truck could reject any bags that don't belong to that household. RFID readers can also reward good behavior—a New Jersey trash-collection company called Sanico uses RFID chips on recycling bins to give people discounts when they recycle.

2 A Single Stream

Americans are pretty bad at composting and recycling: by some estimates, up to three-quarters of the

"But technology could combat this," says Bryan Staley, the president of the **Environmental Research and Education Foundation**, *which funds research on waste management...*

Read the full article at **www.theatlantic.com**

Forbes

"The Environmental Research & Education Foundation (ERERF) unveiled new research verifying that there are nearly 3,500 active recycling facilities in the United States, more than double previous estimates. That brings the total number of waste and recycling operations to 8,828 facilities (the previous estimates total was 4,057). Further, EREF estimated the amount of waste generated in the United States is 128.4 million tons higher than EPA numbers. It represents a 50% difference in tonnage and suggests that the United States generates significantly more waste that is managed by the solid waste industry."

http://www.forbes.com/sites/kateharrison/2015/10/26/waste360-recycling-summits-top-takeaways-for-entrepreneurs/

"In surveys of recycling facilities across the country, the Environmental Research & Education Foundation has found that contamination rates on average rose from 7% in 2007 in 437 facilities to 16% in 2013 in the 97 facilities so far counted."

USA TODAY

http://www.usatoday.com/story/money/2015/08/17/recycling-confusing-but-new-ad-campaign-helps-consumers-sort-out/30288983/

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(Research Grants continued from cover)

wetter than average, but others are not. Elevated temperatures have posed regulatory challenges, and in several cases have resulted in costly operations and management, pressure to initiate uncertain remedial actions, and litigation associated with off-site migration of gases and odors caused by elevated temperatures.

The objectives of this study are to (i) definitively and comprehensively understand and explain why some landfill temperatures become elevated and (ii) to develop and validate a methodology to predict temperatures within landfills, particularly elevated temperature conditions. The project's approach involves applied research in the three integrated areas:

1. **Critical Analysis of Existing Information:** Develop a comprehensive review and analysis of existing information that pertains to heat accumulation in landfills. This review will include literature data, analysis of elevated temperature landfill site characteristics, and a comprehensive review of data from landfills with atypical temperatures.

2. **Mechanism Identification and Model Parameterization:** Define the chemical reactions that contribute to excessive heat accumulation, with a focus on the temperature regime above which biological reactions contribute to heat. Develop a comprehensive knowledge base of the parameters used to describe these reactions as well as the parameters that control heat transport within landfills.

3. **Formulation, Validation, and Calibration of Temperature Prediction Methodology:** Develop a methodology to predict heat accumulation in landfills that is based on thermodynamic principles and accounts for all significant heat sources and sinks. Validate and calibrate the methodology using field data from elevated temperature landfills, and provide examples based on existing elevated temperature landfills that illustrate how the methodology can be used to predict elevated temperatures and/or evaluate remediation strategies.

At the completion of this project, landfill owners and operators will have a practical and validated methodology to predict heat accumulation in landfills. The methodology can then be used to develop practical best management practices that prevent excessive heat generation, and evaluate the feasibility of remediation strategies. The investigators will collaborate with the EREF Project Stakeholder Group (PSG), and other industry experts throughout the study to ensure that the technical approach is informed by field experience. The findings will also be available to EREF and the PSG throughout the study via regularly scheduled webinars and stakeholder meetings as well as annual reports and journal articles.

Design of Waste Transfer Station Concrete Overlays Against Premature Deterioration

Investigators: Mohammad Pour-Ghaz, North Carolina State University
Start Date: Sep 2015
Award Amount: $160,000

The premature deterioration of concrete overlays in waste transfer stations is a major concern for the owners and operators of these facilities. Overlay replacement in these facilities has significant economic impacts including direct costs, operational delays, and planning hurdles. While the overlay deterioration is mainly attributed to the abrasion caused by scraping solid waste, anecdotal evidence suggests that other factors might equally contribute to the deterioration of the overlays. Some of these factors may include contact with acidic leachate from fresh waste, the type and operation of equipment used for handling waste, the amount of waste handled, and the lack of systematic structural design that accounts for concrete material deterioration. If the main contributing factors to deterioration are identified, these overlays can be designed against deterioration, resulting in better long-term performance and predictability, and consequently, reduced life cycle cost for owners and operators. The main objectives of this research are therefore (i) to identify the contributing factors to the premature deterioration of concrete overlays in transfer stations, and (ii) to establish a structural design methodology for the concrete overlay based on the observed degradation mechanism and operational conditions.

Geopolymer-Based Solutions for Coal Combustion Product Solidification and Stabilization

Investigators: Maria Juenger & Lynn Katz, University of Texas at Austin and Gaurav Sant, University of California, Los Angeles
Start Date: Sep 2015
Award Amount: $285,000

Coal burning power plants produced about 115 million tons of CCPs in 2013 in the US, less than 50% of which found beneficial reuse (http://www.acaa-usa.org). Much of the landfilled or ponded material contains trace elements that are highly soluble and present groundwater contamination concerns. One of the goals is stabilizing waste residues using CCPs from the power plants themselves to make geopolymers. The objective of the research is to design and evaluate geopolymer mixtures made with coal combustion products (CCPs) to solidify/stabilize flue gas desulfurization (FGD) residues, water treatment residues (WTRs) and other wastes, particularly those that cannot be beneficially used and which present environmental hazards. Geopolymers are solid materials made by

reacting aluminosiliceous powders with caustic solutions; these present a potentially more stable alternative to solidification/stabilization (S/S) of CCPs with commercially-produced portland cement and can be made almost entirely with wastes produced by power plants themselves.

Methane Oxidation: Field-Scale Test Sections Experiment

Investigators: Tarek Abichou & Jeff Chanton, Florida State University
Start Date: Aug 2015
Award Amount: $70,000

The newly published EPA rules provide an option for site-specific methane oxidation values other the default value of ten (10) percent and can range from 0% to 35% depending on the methane flux and the cover type. Such a flux reflects the conditions at the landfill and the thickness of soil cover over majority of the landfill. However, there are 3 key challenges in these new rules that might make it difficult to actually use the higher methane oxidation values in the range that EPA has provided:

1. The new rule requires that a ZERO oxidation value is to be used for landfills that have a geomembrane (synthetic) cover with less than 12 inches of cover soil for the majority of the landfill area containing waste.

2. A 10% oxidation value is assigned for landfills that do not have a geomembrane with a 12 inches of cover soils, and do not have a soil cover of at least 24 inches for a majority of the landfill area containing waste.

3. Higher oxidation values of 35% can only be used for landfills that have a soil cover of at least 24 inches for a majority of the landfill area containing waste and for which the methane flux rate is less than 10 and grams per square meter per day (g/m2/d), and the higher value of 25% can only be used for landfills that have a soil cover of at least 24 inches for a majority of the landfill area containing waste and for which the methane flux rate is between 10 and 70 grams per square meter per day (g/m2/d).

However, the actual effect of the conditions noted in the EPA rules have not been fully explored. The primary objective of this study to measure methane oxidation under different cover conditions and calibrate a methane oxidation model already developed by the research team. The collected data will also provide additional information on methane oxidation in 6" to 18" soil covers under different or varying methane loading. It will also provide data to quantify the additional methane oxidation by a 12" thick compost biocover placed on a 6" daily cover.

The proposed field study will evaluate methane oxidation capacities on three previously constructed test sections. The three test sections represent a unique opportunity where LFG is being introduced into soil profiles at a controlled rate. The methane loading to the test sections will be controlled to match the recently published EPA rule on methane oxidation as follows:

- Below 10 g/m2/day
- 10 to 70 g/m2/day
- Above 70 g/m2/day

The results from this research will allow for a comparative analysis of the new EPA requirements with actual field data. •

EREF Implements Pre-Proposal Process

EREF is the only private, grant making institution with a national and international scope whose sole mission is to support solid waste research and education initiatives. EREF's research grants program is led by its Research Council, a body of volunteers consisting of technical experts in industry, academia and consulting. The work of the Council is guided by a long range strategic plan with the goal to achieve greater sustainability, good environmental stewardship, higher process efficiency and increased knowledge. Council recommended projects are then reviewed by EREF's Board of Director's Projects Committee for a final review and funding allocation.

Pre-proposals are now REQUIRED prior to submitting a full proposal. All pre-proposals must adhere to the criteria noted and be submitted by the established deadlines. Pre-proposals submitted in response to this RFP that do not fit within the topic areas noted will not be reviewed. The next pre-proposal deadline is January 6, 2016. Visit **www.erefdn.org/grants/proposal** for more information. •