WORKING TOGETHER TO ACHIEVE ECONOMIC AND ENVIRONMENTAL RESULTS

POLLUTION PREVENTION

INTERN PROGRAM CASE SUMMARIES

2018

STUDENT PERSPECTIVES:

"I was able to come up with ideas, flesh them out, and turn them into environmental and economic savings for the company."

— Badrinath Balasubramaniam, Iowa State University

"I will be able to apply the skills and knowledge I have gained over the course of this internship in multiple engineering fields throughout my career."

— Jonathan Jerke, Iowa State University

"It was a rewarding experience to be able to quantify the impact I was making at my host company and for the environment. "

— Tom Alleven, Iowa State University

COMPANY TESTIMONIALS:

"Our intern got an outstanding amount of work done. He did a great job of opening doors to outside resources and starting conversations that we didn't have time to do. This will be key in fostering our ability to move forward, implement change and reap the benefits of lowering our operating costs."

— Aaron Long, Monogram Prepared Meats

"The P2 Intern Program is a valuable way for some of Iowa's brightest engineering students to gain exposure to our company, demonstrate their skills and develop innovative solutions for challenging environmental projects. We have been impressed with the caliber of students, and the projects at our facility have resulted in improved environmental performance and economic savings. We are proud to support the local community and area students interested in growing their career in the fields of engineering and environmental protection. "

— Charles Heisel, JBS USA

www.iowap2services.com

CASE SUMMARIES WRITTEN BY
2018 P2 Interns

PROGRAM TEAM
Jeff Fiagle
Callie Kirkegaard
Danielle Roseland
Jennifer Reutzel Vaughan

EDITING & DESIGN
Cooper Smith & Company

CONTRIBUTING PHOTOGRAPHERS
Amie Davidson
Danielle Roseland

FABA SECTION SUPERVISOR
Jennifer Wright

LAND QUALITY BUREAU CHIEF
Alex Moon

ENVIRONMENTAL SERVICES DIVISION ADMINISTRATOR
William A. Ehm

IOWA DNR ACTING DIRECTOR
Bruce Trautman

Iowa Department of Natural Resources
502 East 9th Street
Des Moines, Iowa 50319-0034
Phone: 515.725.8353

CONTENTS

2 **DIRECTOR'S NOTE**
3 **2018 EXECUTIVE SUMMARY**

	COMPANY	INTERN
4	**CAMBREX**	Andrew Nurse
6	**HACH COMPANY**	Dillon Johnson
8	**IOWA FERTILIZER COMPANY**	Adam Weis
10	**JBS USA, LLC.**	Badrinath Balasubramaniam
12	**JBS USA**	Jonathan Jerke
14	**MONOGRAM PREPARED MEATS**	Kenneth Prell
16	**SMITHFIELD MASON CITY**	Sarah Jacobson
18	**SMITHFIELD FOODS, INC.**	Cole Carpenter
20	**STANLEY ENGINEERED FASTENING**	Tom Alleven
22	**WOODWARD RESOURCE CENTER**	Clay Hugan
24	**WOODWARD RESOURCE CENTER 24-WEEK**	Ethan Moran
26	**ZOETIS**	Jacob Koke

28 **PROJECT INDEX**

PRINTED WITH SOY INK
PRINTED ON RECYCLED PAPER

DIRECTOR'S NOTE

To maintain a competitive edge in today's economy, companies must constantly evaluate ways to improve practices and increase efficiency in their operations. Iowa companies partnering with the DNR's Pollution Prevention Intern Program are demonstrating that improved environmental performance can provide significant cost savings in addition to many hidden benefits including lower utility costs, risk reduction, increased productivity, less material waste, leaner processes, and extended equipment life.

Whether a company has implemented a formal environmental program or they have an onsite team tasked with seeking improvement opportunities, continuous improvement is a key component to staying on track with environmental performance. Companies are often aware of where their greatest areas of opportunity are found but they lack the time or resources to delve into the process or system. The Pollution Prevention Intern Program pairs the company with an upper level engineering student to focus full-time on their project. Interns apply their technical and analytical skills to compile data, research solutions and quantify impacts of their recommendations. At the end of the internship, companies are left with a comprehensive final report and a depth of information to make informed environmental decisions.

Occasionally, interns are able to initiate implementation of a project while onsite. For example, an intern may write work orders or implement a repair schedule to correct leaks in a compressed air system. Most of the recommendations, however, require the investment of more time or resources after the intern has presented their report to garner materials, schedule contractors or initiate a major process change.
Some improvements may need to be scheduled during a production break to be implemented, others may require revamping of a set process, modification of a contract, or budgeting of capital expenditures. Whether implementation was started prior the end of the project or will be continued over the next year or two, every participating company realizes the immediate benefit of the information provided by their intern and documentation to make informed decisions and drive implementation.

I commend the host companies of the 2018 Pollution Prevention Intern Program for their perseverance in the pursuit of environmental excellence and the interns for their dedication to their host company's environmental objectives. As you read through the case studies in the following pages, I hope you are inspired by the innovative solutions and commitment of these partners to improve Iowa's environment and help ensure a legacy for future generations.

BRUCE TRAUTMAN, Acting Director
Iowa Department of Natural Resources

TOTAL IMPLEMENTED SAVINGS 2001–2018

POLLUTION/WASTE REDUCTION & COST SAVINGS FROM IMPLEMENTED INTERN PROJECTS

CATEGORY	REDUCTION	UNITS	COST SAVINGS
WATER CONSERVATION	4,903,711,381	gallons	$10,319,357
SPECIAL WASTE	75,681	tons	$943,275
SOLID WASTE	163,139	tons	$16,108,733
HAZARDOUS WASTE	8,646	tons	$15,347,726
MERCURY ABATED	42,817	grams	
ENERGY	392,799,059 2,497,806 11,571,829	kWh *MMBtu therms	$22,246,220 $8,484,685
OTHER			$14,338,503
			TOTAL: $87,788,499

*MMBtus are calculated from kWh and therms for special reporting only. All dollars and actual energy saved are reported under therms and kWh.

2001–2018 GREENHOUSE GASES & CONVENTIONAL AIR POLLUTANTS FROM IMPLEMENTED PROJECTS

CONVENTIONAL AIR POLLUTANTS DIVERTED IN METRIC TONS							GREENHOUSE GASES DIVERTED IN METRIC TONS				
NH_3	NO_X	PM_{10}	$PM_{2.5}$	SO_2	CO	VOC	CO_2	CH_4	N_20	CFC	$MTCO_2e$
6.60	498.29	81.81	54.62	901.75	270.26	81.12	227,587.10	55,179.83	2,826.21	1,554.63	257,792.66

2018 EXECUTIVE SUMMARY

Eleven upper-level engineering students from Iowa colleges and universities served as interns with the 2018 Iowa Pollution Prevention Intern Program. The intern program is an extension of DNR's Pollution Prevention Services, a non-regulatory program that offers confidential technical assistance to Iowa businesses and industries. Interns are placed at host facilities to analyze the company's waste streams and to research and recommend process improvements that will lower operating costs while reducing negative environmental impacts.

The interns worked full-time for eleven weeks from the end of May into August, exploring and implementing projects that dramatically reduced water and energy use, solid and hazardous waste, improved system or process flow, and curtailed air emissions, and greenhouse gases. Each project is unique as every company environment is different and contributes to the considerations of the project. Several non-traditional projects were tackled this year, such as exploring the effects of power quality on process operations, an alternative energy system, and a composting project.

Implemented projects will save participating companies and institutions more than 1.65 million dollars annually. The interns also conducted analyses and provided background information for future pollution prevention opportunities. These recommended projects could save companies an additional $2.35 million per year.

The program continues to offer both 12-week and 24-week project opportunities. The Woodward Resource Center 2017 project highlighted in the following pages represents the results of a 24-week steam system project completed in November of 2017. Implementation of this major project is nearing completion and will position the facility to reap the benefits of an efficiently operating system.

A 24-week internship offers benefits to both companies and students. Additional time on site allows interns to conduct more in-depth research, collect data over time and evaluate systems through varying conditions. These extended internships also allow more opportunity for the intern to implement the projects they have recommended. Recognizing a 24-week internship is not feasible for all companies or interns; it has proven to be a viable option for addressing larger projects. The host company benefits by having continuous oversight of initial stages of the implementation process, while the intern gains valuable hands-on experience and may be able to see the project through to fruition.
The 2018 case summaries highlighted in the following pages continue to illustrate that investing in environmental stewardship and sustainability help companies maintain their competitive edge in today's global economy.

*MMBtus are calculated from kWh and therms for special reporting only. All dollars and actual energy saved are reported under therms and kWh.

2018 ENVIRONMENTAL SAVINGS

ACTUAL POLLUTION/WASTE REDUCTION & COST SAVINGS FROM INTERN PROJECTS

CATEGORY	REDUCTION	UNITS	COST SAVINGS
WATER	45,434,242	gallons	$345,373
SOLID WASTE	17	tons	$53,874
ENERGY	323,760 77,405 763,005	kWh **MMBtu therms	$17,644 $943,958
AVOIDED TRANSPORTATION			$286,500
OTHER - ONE TIME			$7,200
			TOTAL: $1,654,549

2018 GREENHOUSE GASES & CONVENTIONAL AIR POLLUTANTS

CONVENTIONAL AIR POLLUTANTS DIVERTED IN METRIC TONS

NH_3	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC
0.175	5.451	1.247	0.374	3.198	2.029

2018 GREENHOUSE GASES DIVERTED IN METRIC TONS

CO_2	CH_4	N_20	CFC	$MTCO_2e$
1321.750	463.034	33.957	8.112	1,882.282

NOTE:

> Air emissions and greenhouse gases shown are Life Cycle estimates and include external activities such as purchasing utilities. Totals do not solely represent emissions generated at the plant sites.

> Greenhouse gas estimates for solid waste reduction projects are derived from U.S. EPA, Waste Reduction Model (WARM), Version 14, available at: http://www.epa.gov/warm

> Life cycle air emissions and greenhouse gas estimates for all sectors except solid waste are calculated using Carnegie Mellon University Green Design Institute, Economic Input-Output Life Cycle Assessment (EIO-LCA), US 2002 Industry Benchmark model [Internet], available from: http://www.eiolca.net

CAMBREX

CHARLES CITY

ANDREW NURSE
MECHANICAL ENGINEERING
IOWA STATE UNIVERSITY

COMPANY PROFILE
Cambrex, founded in 1981, is a global manufacturer of small molecule innovator and generic Active Pharmaceutical Ingredients (APIs). The company has a presence in seven locations globally and is one of the leading API producers in the market. With an accelerated demand in the market, Cambrex continues to use their technologies and expertise to meet the customers' needs for small molecule therapeutics. The plant in Charles City, Iowa, is home to approximately 350 employees.

PROJECT BACKGROUND
The focus of the 2018 Pollution Prevention Intern project was to assess the facility's steam operations and identify improvements to the overall operating efficiency of the plant. The intern conducted an audit of the steam system to identify inefficiencies in piping, steam traps, and condensate return lines. The intern analyzed the trends, gathered and interpreted data, and evaluated solutions for reducing steam usage. The intern also analyzed the boiler operations and assessed opportunities to improve boiler efficiency.

INCENTIVES TO CHANGE
Continuous improvement is a key component in Cambrex's strong commitment to achieve environmental excellence in all their facilities. Steam is widely used in production processes at the Charles City facility to optimize chemical reaction conditions. Utilizing steam for energy transfer enables a quality and cost-efficient heating application to take place. There are significant economic benefits of having a proper and efficient steam plant in operation. Exploring opportunities to optimize the efficiency of the current steam system has the potential to reduce operating costs, keep production running smoothly, and improve environmental performance.

RESULTS
Plant Steam System Survey: Using an infrared camera and an ultrasonic leak detector, the intern conducted an audit of the steam system to identify areas of steam loss. Opportunities to improve the efficiency of the steam system included correcting oversized pipes, failed steam traps, and improperly operating condensate return stations. The audit, along with test results, showed that 8 percent of the steam traps had failed. Work orders were submitted to repair or replace these steam traps to reduce losses of water, energy, and treatment chemicals.

Steam Trap Preventative Maintenance Program: Implementing a preventative maintenance program for the steam system would proactively reduce resource losses and costs. An annual steam trap functionality and leak detection audit would identify failed traps so that repairs could be scheduled in a timely manner. Annual analysis of steam trap failure based on location or associated processes could provide insight into trends and help to identify these failures at their earliest stage. It is anticipated that the preventative maintenance program will be implemented within 6-12 months to sustain repairs made based on the findings of the initial plant steam system survey.

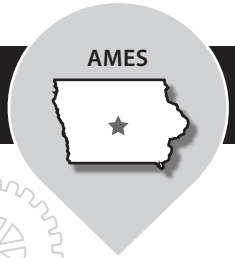
Pipe Insulation: Steam pipes without insulation allow for heat to escape into the atmosphere. The boilers then have to compensate for these energy losses to maintain sufficient heating for all applications. A map was created to show the location of uninsulated pipes, and a contractor was hired to install Velcro insulation. Maintenance workers can now open up the insulation to work on pipes and then conveniently reattach it once they are finished. Maintaining the pipe insulation will reduce the load on the boilers and help the steam system operate more efficiently.

Boiler Operations: Because steam is critical to the production processes at Cambrex, two boilers are kept running at all times to avoid costly interruptions. In the summer the boilers operate at their lowest capacity, yet still provide more steam than the plant requires. To avoid pressure building up in the main steam line, a valve to atmosphere is

opened to release excess steam. Installing and staging two new boilers with a lower capacity could reduce the need for venting steam. This would result in savings in make-up water, energy, and treatment chemicals. More research is needed to further evaluate the impacts, particularly on production, and the feasibility of this recommendation during different seasons and operating conditions.

PROJECT	ANNUAL COST SAVINGS	ENVIRONMENTAL RESULTS	STATUS
PLANT STEAM SYSTEM SURVEY	$16,069	1,888,446 gallons of water 2,065 gallons of HCl 1,475 gallons of NaOH 16,166 therms	IN PROGRESS
STEAM TRAP PREVENTATIVE MAINTENANCE PROGRAM	$4,527	840,477 gallons of water 919 gallons of HCl 657 gallons of NaOH 7,195 therms	RECOMMENDED
PIPE INSULATION	$3,420	11,595 therms	IN PROGRESS
BOILER OPERATIONS	$9,243	241,930 gallons 340 gallons of HCl 189 gallons of NaOH 26,668 therms	FURTHER RESEARCH RECOMMENDED

HACH COMPANY



DILLON JOHNSON
INDUSTRIAL ENGINEERING
IOWA STATE UNIVERSITY

COMPANY PROFILE
Hach Company is an organization known for the manufacture and distribution of instruments and reagents used for water analysis. Hach Company has been a global leader in manufacturing and distributing water analysis products since it was founded by Clifford and Kathryn Hach in Ames, Iowa. The company creates products that are marketed globally and serves any industry where water analysis is required. The Hach facility in Ames employs approximately 550 people and manufactures and distributes more than 100 liquid and powder reagents used for water analysis processes.

PROJECT BACKGROUND
The Hach facility in Ames houses a multitude of operations where substantial amounts of paper are used for tracking, signaling material handlers, and labeling raw materials and goods in various states of production. The environmental, health and safety (EHS) team at Hach observed a significant amount of paper waste resulting from these operations and sought the help of DNR's Pollution Prevention Services. The P2 intern was tasked with pinpointing the primary sources of printed material, quantifying the waste generated, formulating methods to reduce paper printing, and streamlining the process flow. The intern quantified three major sources of paper waste and explored recommendations to improve these processes and reduce Hach's environmental footprint.

INCENTIVES TO CHANGE
Hach is an ISO 14001 certified company that places a high priority on achieving environmental goals. The EHS team at Hach continuously seeks opportunities to improve the company's environmental performance. Multiple processes at the Ames facility generate a large amount of paper waste. These processes also harbor inefficiencies related to this waste. If the amount of paper produced throughout these processes is reduced or eliminated, a more efficient, streamlined process is attainable, along with significant cost savings.

RESULTS
Computerized Tablet System: In the warehouse of the Ames facility, pull sheets are printed to inform associates (pickers) what inventory is required to fulfill customer orders. Each pull sheet represents one customer order. Once a pull sheet is printed, the picker collects the order inventory from the warehouse and stages the picked order for packing to be shipped out. Pull sheet printing results in approximately 1,700 sheets of paper printed each day. Additionally, operators spend a significant amount of time printing individual pull sheets.

A computerized tablet system could streamline the picking process and eliminate a significant amount of excess labor and printing. With this automated system, pull sheets would be sent electronically to the pickers, which would increase the process efficiency and productivity. Automating the picking process in the warehouse would reduce purchasing and disposal costs for the paper, decrease wear and maintenance on the printers, and improve environmental performance.

Implementation of an automated picking system would require the purchase of peripheral equipment. Along with the financial budgeting, Hach's IT staff will need to be involved with transitioning to the new system; interfacing with existing applications and providing training and support for staff who would be using the new electronic process.

SDS PDF Distribution: Customer orders that have been picked are subsequently organized and packaged in preparation for shipment. Along with the customer order itself, safety data sheets (SDS) are also included in all shipments. The SDS is necessary to inform customers of all chemicals and hazards associated with the products they have ordered. These SDS consist of a minimum of four to five pages each and are manually printed by the associates packaging these orders (packers). On an average day, this amounts to approximately 4,000 sheets of printed SDS. Physical printing of SDS for each order results in a high amount of paper use and operator time dedicated to this task.

OSHA standards state that SDS for chemicals must be provided to customers, either electronically or in paper format, the first time a customer receives that chemical. It must also be provided on a repeat shipment anytime an SDS has been updated. To maintain strict compliance with OSHA standards while also seeking to eliminate any inherent process waste, the most feasible solution would be to develop a new computer program that electronically sends customers an email with their SDS in PDF format when the packer electronically scans each product for inclusion in their order shipment. This type of system would significantly reduce paper waste and printing time and costs, and increase the potential number of shipments that packers can prepare for shipping on a given shift. To move forward, Hach will need to allocate funds and IT resources to development and integration of the new computer application, along with any pilot testing, customer reviews and employee training that would be necessary. This project is currently ongoing and will be conducted together with the European Hach facilities.

Move Ticket Labeling: At the Hach Ames facility, paper signs called move tickets are attached to products and packages that need to be moved to a different area of the facility. Move tickets consist of one sheet of printer paper and are designed to let material handlers know that a product or package needs to be transferred to a specific location in the plant. Material handlers manually enter data and location information into a computer, print the move ticket and physically tape the paper ticket to the product. This process requires a sizeable amount of paper, tape, and labor. Transfer errors may occur if the move ticket is not fully secured to the project.

To reduce the solid waste and the occurrence of transfer errors, the move tickets could be printed on small, colored, self-adhesive labels rather than full size printer paper. Label printers are available in each area where move ticket printing takes place. The initial investment would simply be the labels, time required for programming changes and material handler training.

PROJECT	ANNUAL COST SAVINGS	ENVIRONMENTAL RESULTS	STATUS
COMPUTERIZED TABLET SYSTEM	$36,739	12 tons paper	RECOMMENDED
MSDS PDF DISTRIBUTION	$94,491	19.2 tons paper	RECOMMENDED
MOVE TICKET LABELING	$10,824	0.54 tons paper	RECOMMENDED

IOWA FERTILIZER COMPANY

ADAM WEIS
CHEMICAL ENGINEERING
THE UNIVERSITY OF IOWA

COMPANY PROFILE
Iowa Fertilizer Company (IFCo) is a nitrogen fertilizer manufacturing facility that produces anhydrous ammonia, urea (liquid and granulated), urea ammonium nitrate (UAN), and diesel exhaust fluid (DEF). It is the first greenfield nitrogen fertilizer facility built in the United States in more than 30 years. Located in Wever, Iowa, and producing two million metric tons of nitrogen fertilizer annually, Iowa Fertilizer Company produces domestic fertilizer for the highest corn-producing region in the country. More than 230 people are employed full-time at the Wever plant.

PROJECT BACKGROUND
Iowa Fertilizer Company treats approximately 2,000 gallons of sanitary waste per day. A permitted on-site sanitary wastewater treatment plant (WWTP) provides Iowa Fertilizer Company with the ability to treat and discharge its own sanitary waste. The sanitary WWTP uses bacterial nitrification, the conversion of ammonia into nitrate by bacteria, for efficient treatment. Before the sanitary WWTP can discharge treated effluent, proper nitrification must occur. Adam Weis, who served as an intern throughout the summer of 2018, was tasked with optimizing and automating chemical treatment of the current system to ensure sufficient ammonia removal from the sanitary waste stream.

INCENTIVES TO CHANGE
Alkaline chemicals are dosed to the sanitary WWTP to help control pH for proper nitrification. Determining the proper type and amount of alkaline chemical to dose and automating this process would ensure sufficient nitrification occurs. This automation would also improve chemical treatment consistency and reduce the manual labor required by operators to physically add the chemical to the system.

RESULTS
Improved Sanitary Wastewater Treatment: The nitrification process that takes place at the sanitary WWTP produces acidity as a byproduct. These acidic conditions affect the ability of bacteria to continue removing ammonia. The addition of alkaline chemicals is used to counteract the acidity and stabilize pH, ensuring ideal conditions for the bacteria. Iowa Fertilizer Company had been using a combination of sodium bicarbonate and sodium hydroxide to add alkalinity and adjust pH. Daily testing showed that additional dosing was needed and that the previous chemical combination may not be the optimum treatment.

Additional lab tests were subsequently conducted to investigate which chemical best treats the system, and how much should be dosed. Based on the testing, it was concluded that a different alkaline chemical, sodium carbonate, should be used and the quantity should be increased. After implementing these changes, the system saw almost an immediate improvement. Ammonia levels in the sanitary WWTP were reduced. Additionally, sodium carbonate is a considerably safer chemical to use in place of sodium hydroxide, which is a strong base.

Additional monitoring of the sanitary WWTP revealed how Iowa Fertilizer Company can observe the early signs of an increase in ammonia levels or fluctuations in pH and use these observations to make the necessary chemical treatment changes for optimization. These chemical and dosing changes improved the performance of the sanitary WWTP and could save Iowa Fertilizer Company $286,500 per year in supplemental sanitary waste removal costs, along with eliminating the use of 1.2 tons of sodium hydroxide and more than 2,000 gallons of diesel fuel.

Creating a More Efficient Chemical Treatment Process: The next phase of the project consisted of designing an automated chemical injection system to pump sodium carbonate solution into the sanitary WWTP. Currently, operators manually prepare and dose the chemical treatment, which requires extra labor and delivers the chemical in two large doses per day. An automated system helps reduce operator labor and improve dosing consistency. The intern worked with engineering, operations, and other personnel to design an automatic chemical injection system and identify which components to obtain from vendors. The final design includes a mixed tank to prepare the sodium carbonate solution and a pump and piping system to inject sodium carbonate into the sanitary WWTP. This would allow a slow, continuous dose to the system and would deliver the sodium carbonate more consistently, while further reducing potential chemical exposure for the operators.

Additionally, pH sensors will be installed both near the point of injection and towards the end of the sanitary WWTP process. Monitoring the pH towards the end of the system provides a checkpoint for Iowa Fertilizer Company to ensure the sanitary WWTP is working properly, while the sensors near the injection point would be used to automate the pump speed based on the pH of the system. This efficient process provides a more reliable and hands-free method of controlling alkalinity dosing.

While the primary cost savings from the automation project come from reduced operator labor, it would also provide increased reliability for the system and eliminate the need for employees to constantly oversee its operation. The next step for Iowa Fertilizer Company is approval of the automated chemical treatment design and budget proposal, and then funding can be secured for procurement and installation.

PROJECT	ANNUAL COST SAVINGS	ENVIRONMENTAL RESULTS	STATUS
IMPROVED SANITARY WASTEWATER TREATMENT	$286,500	0.09 tons NH_3 2,044 gallons diesel 1.2 tons NaOH	IMPLEMENTED
CREATING A MORE EFFICIENT CHEMICAL TREATMENT PROCESS	$22,000	–	RECOMMENDED

JBS USA, LLC

MARSHALLTOWN

BADRINATH BALASUBRAMANIAM
MECHANICAL ENGINEERING
IOWA STATE UNIVERSITY

COMPANY PROFILE
JBS USA is a food processing company and a subsidiary of JBS S.A, which is a leading processor of beef, pork and lamb in the United States. It is headquartered in Greeley, Colorado, and has multiple facilities in the United States and abroad. They have a total of approximately 235,000 employees, with more than 2,200 working at the Marshalltown, Iowa, pork processing facility. About 21,000 hogs are processed daily and the products are shipped to domestic and international customers in countries including Hong Kong, Japan, Mexico and China.

PROJECT BACKGROUND
JBS Marshalltown produces nearly 600 million pounds of steam annually from three boilers. The plant uses steam in a variety of production systems and has a vast distribution system. The aim of this project is to conduct an assessment of the steam system and end use applications, and optimize the efficiency of steam usage throughout the plant.

INCENTIVES TO CHANGE
The company has a broad set of corporate environmental goals including a 20 percent reduction of natural gas usage and greenhouse gas emission intensity by 2020 as compared to 2015 baselines. They also seek to reduce electricity use by 12 percent and water use intensity by 10 percent. The focus of the 2018 project ties directly into JBS' environmental goals, since recommendations will lead to a reduction in the natural gas and water used by the boilers to produce steam.

RESULTS
Dehair System Improvements: The dehair unit removes hair from the hogs using hot water that is maintained at 140°F by steam. Water from four tanks is sprayed onto the hogs as they move through chambers in the unit. While the first three tanks use hot 140°F water, the fourth tank uses a separate cold water supply as a rinse. The water from all four tanks, including the cold rinse water, is collected in an overflow tank where it is reheated and reused in the same dehair process. Additionally, a second cold water source coming from the singer is also introduced into the overflow tank. Re-routing these two cold water sources to different plant operations, would significantly reduce the amount of steam needed to reheat the remaining overflow water.

One alternate use, the scrubbers, currently use city water as make-up water, so replacing that make-up water with the new cold-water reuse stream would generate additional water savings. Covering and insulating the overflow tank could reduce heat loss and lead to additional steam savings. To implement this project, funding will need to be approved and budgeted, piping will need to be rerouted, and equipment and insulation procured and installed.

Dehair Unit and Hair Room Tank Steam Turn Off: The steam supply to the dehair unit and the hair room tank is left on during the sanitation shift, creating steam demand when it is not needed. Turning off the steam supply during sanitation would generate immediate energy and water savings. Sanitation and production managers will be key to successfully implementing this new procedure change.

Shrink Tunnel Process Improvement: The shrink tunnels heat cold water up to 200°F and spray it onto packaged meat to vacuum seal it. The water is heated using steam injection. It is recommended that the cold water in the shrink tunnels be replaced with a portion of the excess 140°F water that is currently already produced by the facility as a byproduct of their rendering cooker. This generates water savings, water treatment savings and cuts the temperature to which the water must be heated by more than 50 percent, leading to a significant reduction in steam consumption. After allocating funding to this project, piping and plumbing work would be needed to implement the change.

Rendering Cooker Steam Reduction: The rendering cooker receives inedible pieces and scraps from multiple parts of the facility and converts them into dried meat and bone meal. The cooker requires a significant amount of steam to dry out the wet scrap and create a marketable product. The inedible scraps feed into a dual incline auger that empties them into a raw bin prior to being fed into the cooker. The auger has dewatering pans to help remove excess moisture from the scraps prior to the cooker, but these pans are regularly clogged by meat and fat, leading to ineffective dewatering. Hosing down the dewatering pans at specified intervals would lead to a significant reduction of moisture content in the scraps, which would further reduce steam and water use by the cooker. JBS could realize immediate results when this step is added to the rendering process.

Steam Leak Repair: Several steam leaks were identified in various parts of the facility. They cause a loss in steam and also a pressure drop in the line, leading to wasted energy and the possibility of equipment malfunction. It is recommended that the leaks be repaired as soon as possible to maximize savings and reduce the risk of damage to the equipment.

Steam Trap Preventative Maintenance: Steam traps aid in ensuring the efficiency of the steam system. Steam trap management is a vital component for every facility with a steam system. Failed traps cause energy loss and increased costs. It is recommended that JBS contract with an external vendor for bi-monthly steam trap surveys. Although using a vendor would be an ongoing expense, it would lighten the load on the facility's maintenance staff and still net significant cost savings from an efficient running system. The costs of contracting with a vendor were subtracted from the annual savings calculations when evaluating this recommendation. If ongoing funds are approved, the company can contract with an identified vendor and establish a survey schedule.

PROJECT	ANNUAL COST SAVINGS	ENVIRONMENTAL RESULTS	STATUS
DEHAIR SYSTEM IMPROVEMENTS	$114,165	14,282,718 gallons of water 110,520 therms	RECOMMENDED
DEHAIR UNIT AND HAIR ROOM TANK STEAM TURN OFF	$1,144	15,485 gallons of water 2651 therms	RECOMMENDED
SHRINK TUNNEL: PROCESS IMPROVEMENT	$126,607	18,640,659 gallons 89,730 therms	RECOMMENDED
RENDERING COOKER STEAM REDUCTION	$120,755	19,491,481 gallons of water 131,420 therms	RECOMMENDED
STEAM LEAK REPAIR	$11,824	159,988 gallons of water 27,339 therms	RECOMMENDED
STEAM TRAP PREVENTATIVE MAINTENANCE	$76,695	1,372,488 gallons of water 210,855 therms	RECOMMENDED

JBS USA

JONATHAN JERKE
MECHANICAL ENGINEERING
IOWA STATE UNIVERSITY

COMPANY PROFILE
As the second largest food company in the world, JBS USA operates 63 processing facilities and 31 prepared food facilities dedicated to producing, packaging and delivering premium meat and poultry products to consumers around the globe. The JBS USA Pork facility in Ottumwa, Iowa, processes more than 19,000 hogs per production day, employs more than 2,200 team members representing as many as 36 countries, and runs two production shifts as well as a sanitation shift for five to six days a week.

PROJECT BACKGROUND
The JBS USA Ottumwa facility uses a large volume of water for cooling operations in the rendering facility. This process produces heated (140˚F) water that can be used in other production operations. However, the facility produces much more of this heated water than can be used throughout the plant, and the excess must be discharged. JBS USA management would like to reduce the overall water consumption of the plant by 15 gallons per unit harvested, and is targeting the rendering facility's production of 140˚F water in an effort to achieve this goal.

INCENTIVES TO CHANGE
In 2017, the JBS USA Ottumwa facility was recognized by the U.S. Environmental Protection Agency, Region 7 with a Pollution Prevention Award for water conservation efforts and plant-wide improvements. JBS USA Ottumwa intends to carry this momentum forward to bring about additional water conservation projects and achieve more source reduction within the facility. The company also seeks to be an industrial leader of good environmental stewardship for the city of Ottumwa. Water distributed within the city comes from the Des Moines River, and as a discharge site, the JBS USA Ottumwa facility aims to lead by example in pollution prevention efforts.

RESULTS
Air-Cooled Condenser Assist: Condensing operations within the rendering facility produce 140˚F water for the plant as a byproduct of a water-cooled heat exchanger. The heated water becomes a source of cleaning water for sanitation and is used for other plant operations as needed. In the summer months, the JBS USA facility will produce 140˚F water in excess due to high incoming cooling water temperatures to the heat exchanger. After treatment, this excess is discharged from the facility back to the Des Moines River. The addition of an air-cooled condenser assist to allow switching between air-cooled and water-cooled condensing would allow for the JBS USA facility to regulate 140˚F water production and eliminate the excess 140˚F water that is produced. To carry this recommendation forward, JBS USA Ottumwa management must determine if funding is available to support the project and select a vendor to which the project would be contracted.

Rendering Moisture Reduction: The purpose of a rendering facility at any meat processing plant is to turn inedible "waste" products into marketable ones. This is partially accomplished by drying inedible raw material and selling it as dried meat and bone meal. The drying process within the JBS USA Ottumwa rendering facility uses indirect heating via steam to evaporate moisture out of raw material entering the facility's disc dryer. The vapors produced in the drying process are condensed in the water-cooled heat exchanger on the roof

of the rendering building. Any excess moisture present in the raw material entering the dryer will require more steam to evaporate it off, and will create more vapors to condense, leading to increased water consumption. The reduction of this excess moisture in raw material can be accomplished through the installation of dewatering equipment such as screens, and the implementation of behavioral changes on the production floor such as increasing dry pickup efforts prior to power washing. The intern calculated that a 5 percent reduction in excess moisture would be an attainable goal. To implement this recommendation the rendering team at JBS USA Ottumwa must pilot test various dewatering equipment for its effectiveness on eliminating excess moisture. Initial reductions could be achieved with new standard operating procedures for dry-pick up to reduce excess moisture and initiate behavioral changes within the facility.

Flow Meter Installation: The installation of flow meters to sub-meter by department and collect water usage data each shift would allow for management to better understand where large amounts of water are being used, and help pinpoint possible opportunities for source reduction. Conservative use of water data generated by sub-metering could lead to a calculated 3 percent savings in the facility's annual water usage. To move forward with this recommendation management must determine the scope and locations of the meters and budget for the purchase and installation of the monitoring equipment.

Leak Identification and Repair Plan: An extensive water distribution system is required to effectively supply water to each portion of the JBS USA Ottumwa plant. Since its construction in 1976, many additions have been made to the original building and as a result pipe systems in the facility are vast and complex. Keeping track of leaks within such an extensive water distribution system is a challenge. Implementation of a leak identification and repair plan that would re-assign the task of identifying system leaks to team members throughout the plant would ease the work-load of maintenance personnel. This plan would also allow for leaks and their subsequent repair to be identified, tracked and documented in a timely fashion. A robust leak identification and maintenance plan has the potential for a five percent reduction in water consumption within the JBS USA Ottumwa facility. The water conservation team has begun to move forward with this recommendation, beginning to allocate personnel to identify and repair leaks in different departments. To fully develop and implement the suggested plan, standard methods for identification and tagging and a standardized maintenance request form for repairs must be developed, along with formal documentation of their finalized process.

PROJECT	ANNUAL COST SAVINGS	ENVIRONMENTAL RESULTS	STATUS
AIR COOLED CONDENSER ASSIST	$142,648	47,734,661 gallons water 7,150 gallons sodium bisulfite	RECOMMENDED
RENDERING MOISTURE REDUCTION	$173,799	19,414,373 gallons water 229,879 therms	RECOMMENDED
FLOW METER INSTALLATION	$154,064	20,395,091 gallons water	RECOMMENDED
LEAK IDENTIFICATION AND REPAIR PLAN	$256,773	33,991,818 gallons water	IN PROGRESS

MONOGRAM PREPARED MEATS

KENNETH PRELL
ELECTRICAL ENGINEERING
IOWA STATE UNIVERSITY

COMPANY PROFILE
Monogram Prepared Meats (MPM) is a division of Monogram Food Solutions LLC; which was founded in 2004 by CEO Karl Schledwitz and President Wes Jackson. Monogram Food Solutions is headquartered in Tennessee and employs 3,000 people across the Midwest and Eastern United States. The Monogram plant in Harlan, Iowa, was acquired in 2013 and employs 250 people. MPM produces microwaveable bacon and jerky for various clients and the plant processes 800,000 pounds of pork bellies weekly.

PROJECT BACKGROUND
MPM operates several large industrial microwaves to cook bacon and jerky. Power quality issues at the plant have resulted in excessive transformer tube breakdowns and replacements which are expensive and time-consuming. Addressing power quality concerns has been a priority for MPM. Some improvement was seen in 2016 after the installation of line reactors, but tube lifetimes are still below acceptable levels based on manufacturer specifications. To reduce waste and operating expenses, MPM was seeking further opportunities to extend tube lifetimes by improving power quality at the plant.

INCENTIVES TO CHANGE
The high rate of tube replacement is both a financial and material drain on MPM. The tubes are costly and outages require maintenance labor and result in downtime on production lines leading to reduced product output. There are also safety concerns regarding the potential of arc flashes from the transmitter systems. MPM requested an intern from the DNR's Pollution Prevention Intern Program to investigate power quality issues and the potential for system redesign to reduce the impact of power quality and the number of tube replacements.

RESULTS
Surge Suppression: In meeting with another local consultant engineer, the need for plant-wide surge suppression was addressed. Surges are defined as spikes in voltage delivered to a device and are known to cause premature equipment failure. Transmitters are also affected by such events, as these sensitive electronics require a near constant amount of current to flow through them to prevent failures. Surge suppression in depth is considered an industry best practice, and has been recommended to MPM as such. This protective measure operates through the application of several surge protective devices (SPD) placed at critical points along the transmission line; one by the main service entrance, another in several microwave control panels, and the last directly prior to every transmitter. While these SPD's do not prevent surges from occurring, they prevent the negative effect any such surges would cause. Surges can be prevented to some degree and this is the aim of future projects, however a surge suppression system is still considered a best practice as it reduces the effects of any unexpected surges. Furthermore, SPD's prevent the damage caused by lightning during thunderstorms. Next steps for implementation include collecting outstanding vendor quotes and internal project approval.

Improved Pause Feature: During normal plant operation, it often becomes necessary to temporarily halt production. This is usually due to a backlog in packing. Several production lines have implemented a pause feature for their operators to use, but all lines have emergency stop features as is required for safe operation. Emergency stops are frequently used when simply pausing the line would be the more appropriate choice because emergency stops are more convenient to the line workers. Designed for safety, emergency stops shut off power in the span of only a few milliseconds, during which time power is disconnected from transmitters, opening the circuit. Huge quantities of energy are released instantaneously, and a multitude of effects can occur including arc flashes, short circuiting, and power absorption into transmitter supporting structure which can be harmful to people and equipment. Use of line pauses instead of emergency stops should be encouraged in non-emergency situations. Ease of access to pause capabilities can be enhanced through a push button system redesign. Emergency stops should not be made harder to access or use due to safety and ethical concerns. However, inappropriate use could be discouraged through the use of required follow-up reports and mandatory maintenance re-starts. To move forward, control system re-design will need to be contracted following discussions with the control system vendor.

Continued Monitoring/Measurement The work done through this project is the beginning of MPM's effort to continuously improve their transmitter setup. Continued monitoring through two avenues; power quality surveys and infrared thermography surveys will help MPM to understand the cause and effect of power quality at the plant and identify inconsistencies earlier.

Power Logger Survey: The aim for the power quality survey will be to use information gathered from this project as a baseline and over time, a database of example waveforms could be created. Monitoring sensitive loads for concerning waveforms and evaluating waveforms currently not understood will provide indications as to whether various instrumentation is working properly. Priority areas for monitoring have been identified.

Infrared Survey: An infrared survey, could be completed in-house, using tools and personnel supplied by MPM. Here infrared snapshots of sensitive equipment, control panels and circuitry, and power connections would be taken. With data collected from the infrared survey, maintenance staff would be able to pinpoint troubling locations and perform preventative maintenance, and work to correct failing parts or redesign the setup to avoid systemic failures.

MPM possesses the power logger and infrared monitoring equipment needed for conducting these surveys. While maintenance staff is trained and currently uses this equipment, additional training on the capabilities of the equipment for these specific applications would help the staff become proficient in using the equipment and logging and analyzing the data, and proactively effect change.

PROJECT	ANNUAL COST SAVINGS	ENVIRONMENTAL RESULTS	STATUS
SURGE SUPPRESSION	$46,330	0.0334 tons source reduction	RECOMMENDED
IMPROVED PAUSE FEATURE	$100,601	0.072 tons source reduction	RECOMMENDED
CONTINUED MONITORING/MEASUREMENT	$24,390	0.0176 tons source reduction	IN PROGRESS
INFRARED SURVEY	$18,290	0.0176 tons source reduction	RECOMMENDED

SMITHFIELD MASON CITY

SARAH JACOBSON
CHEMICAL ENGINEERING
IOWA STATE UNIVERSITY

COMPANY PROFILE
Founded in 1936, Smithfield Foods is now the world's largest pork processor and hog producer. The food company employs more than 50,000 people worldwide. Common household names such as Eckrich®, Nathan's Famous®, and Healthy Ones® are all core Smithfield brands, making the company the primary producer of packaged pork products in the United States. The Mason City facility produces lunch meat, smoked hams, and cook-in-water deli hams. With 275 employees, it operates two primary shifts and is open approximately 300 days per year.

PROJECT BACKGROUND
The focus of the project was to examine the solid waste streams at Smithfield Mason City and identify areas for improved waste handling and disposal. With cardboard and plastic being the primary types of waste, the project goal was to reduce those streams at the source and expand the current recycling procedures. The improved segregation of recyclables based on both material type and contamination level has the potential to increase recycling practices and economic savings. The primary concern with the project was the contamination of the recyclable material due to food products and dissimilar materials, making reuse and recycling challenging.

INCENTIVES TO CHANGE
One of Smithfield's three core principles is responsibility. At a corporate level, a responsibility to sustainability is part of the company's culture. Eight Smithfield facilities are currently at a zero-waste-to-landfill status, with the Mason City location joining that list in August 2016. When the facility became landfill free, an improved recycling procedure was implemented including a Waste to Energy system. With time, compliance to this recycling procedure declined. Also, the recycling partner has implemented policy changes to the separation requirements and the minimum recyclable contamination level. A lack of communication with them has caused material intended for recycling to be diverted to Waste to Energy. Changes to the current procedure will help increase the recycling of primary waste streams and reduce disposal costs.

RESULTS
HDPE Separation: Smithfield sends many of their recyclable items to a separate facility to be recycled for a rebate. It was noticed that the weights listed on statements from the facility for high-density polyethylene (HDPE), a plastic that receives a high rebate, were very low. The identified issue was cross-contamination of materials. Multiple grades of plastic combined resulted in HDPE being counted as a lower grade of plastic and not receiving the high rebate. It also resulted in some HDPE going to Waste to Energy. Streamlining the separation to collect three specific grades of HDPE would eliminate confusion about what can be recycled, increase the rebate available to Smithfield, and divert recyclable material from Waste to Energy.

Combo Rebate: Large cardboard shipping boxes called combos currently are broken-down and compacted in the two compactors on site. These can be recycled for a rebate, but the recycling company offers a better flat rate for combos that are clean, collapsed, and stacked to be reused in their facility. Approximately half of the combos Smithfield generates are clean and could be recycled in this way, with the other half going to the compactor and receiving a rebate based

on weight. Adjusting the process to include both of these recycling methods would allow clean combos to be reused instead of pulped. There is also a time and safety benefit. Collapsing the combos takes much less time than breaking them down and results in less physical strain on employees. Additionally, combining methods increases Smithfield's annual profit on cardboard.

Plastic Baling: A plastic baler is used onsite to send bales of plastic film to the recycling facility. Currently the majority of the bales are made from excess plastic packaging, which is contaminated due to contact with meat and the preservative used. This leads to contaminated bales, which the recycling company sends to Waste to Energy after the bales reach their facility. Much of the clean plastic film at Smithfield is currently going to Waste to Energy due to miscommunication with the recycling facility. A change in the procedure is recommended to bale the clean plastic only and send the contaminated packaging directly to Smithfield's Waste to Energy compactor. This would result in a rebate on bales, divert clean plastic from Waste to Energy, and save money on disposal fees.

Bag Tail Reductions: The excess plastic on product packaging is known as a bag tail. Long bag tails result in additional plastic waste and tend to clog the equipment designed to collect them. Due to contamination, all waste generated from tails goes to Waste to Energy and cannot be recycled. Reducing the initial length of product bags would reduce the plastic waste created from bag tails. Bag lengths and widths differ with each product packaged and with help from the bag supplier, five products were identified as having the potential for bag-size reductions. The smaller bags would save the company money in both purchasing costs and disposal costs, and would reduce plastic waste at the source. Next steps include further product testing to ensure the recommended smaller bag sizes provide sufficient packaging for Smithfield's products and communication with the bag supplier on necessary size adjustments.

Plastic Cutlery: Smithfield has a full-service kitchen in their cafeteria allowing employees to purchase breakfast or lunch daily. There is plastic cutlery available in the middle of the cafeteria that is used often. It was noticed that cutlery gets consumed very quickly, either by employees buying lunch, employees bringing lunch from home, or sometimes by employees taking extra utensils home. Moving the cutlery into the kitchen and distributing utensils along with purchased meals would reduce the amount of plastic cutlery down to the number of meals sold. Employees bringing breakfast or lunch from home would be encouraged to pack their own flatware, and the option of taking utensils home would be eliminated. This adjustment would reduce purchasing costs of cutlery, disposal costs of plastic, and the amount of plastic going to Waste to Energy annually. To implement, kitchen staff and employees will need to be informed of the new procedures and purchasing orders will need to be adjusted.

PROJECT	ANNUAL COST SAVINGS	ENVIRONMENTAL RESULTS	STATUS
HDPE SEPARATION	$1,805	2.5 tons	IMPLEMENTED
COMBO REBATE	$17,773	6.0 tons	IN PROGRESS
PLASTIC BALING	$3,227	8.0 tons	IN PROGRESS
BAG TAIL REDUCTION	$3,074	0.3 tons	RECOMMENDED
PLASTIC CUTLERY	$1,118	0.3 tons	RECOMMENDED

SMITHFIELD FOODS, INC.

SIOUX CITY

COLE CARPENTER
MECHANICAL ENGINEERING
IOWA STATE UNIVERSITY

COMPANY PROFILE
Founded in 1936 in Smithfield, Virginia, Smithfield Foods, Inc. is a global food company and the world's largest pork processor and hog producer. The company has more than 50 locations on two continents, and more than 54,000 employees. With eight locations in Iowa, Smithfield's Sioux City plant is part of Smithfield's Packaged Meats division and produces BBQ meats and pre-cooked ribs. This facility can produce 270 different products and employs 610 people. Previously owned by Curly's, the plant has continued to grow and produce "Good food. Responsibly.®"

PROJECT BACKGROUND
Smithfield Sioux City is actively exploring ways to improve environmental performance. One focus area for this project is the detection and maintenance of compressed air leaks in the facility. Proper means of detecting and repairing leaks were investigated and implemented. Grease recovery from Smithfield's wastewater treatment pit was also evaluated. Recovery and storage are priorities for this facility, and were the emphasis of the project. Reuse of water from a reverse osmosis (RO) system for plant water purification was also evaluated.

INCENTIVES TO CHANGE
As an ISO 14001 certified facility, Smithfield Sioux City is committed to implementing changes to improve plant efficiency and reduce its environmental footprint. Several environmental incentives drive Smithfield to practice continuous improvement methodologies, such as their goals of 5 percent energy reduction and 10 percent water reduction by 2020, from a 2014 baseline. These goals provided incentive for the compressed air system leak detection survey and exploration of reuse opportunities of the RO water respectively. Improving the grease recovery process could significantly reduce wastewater contamination and disposal costs and provide a potential revenue stream.

RESULTS
Compressed Air Leak Repair: Compressed air is a system commonly utilized by many manufacturing companies and can be quite costly if not maintained properly. An ultrasonic leak detection survey was conducted and several leaks were identified in piping, hoses, machines, and machine connections. These leaks were tagged and are in the process of being repaired. The repair of these leaks will help reduce energy consumption, reduce required equipment maintenance, and extend compressor lifespan.

Leak Detection Maintenance Plan and Standard Operating Procedures: The continual detection and repair of air leaks is crucial for efficient and cost effective operation of compressed air systems. Facilities can often reduce their compressed air usage by 5 to 10 percent of total air generated through routine maintenance such as identifying and fixing compressed air leaks. Standard operating procedures and an on-going maintenance plan were created to address compressed air leaks throughout the plant.

A standard operating procedure was written and a 12-month leak detection inspection plan was developed to facilitate timely detection and repair of leaks in the future. Internal maintenance staff will be responsible for carrying out the leak detection plan and following the standard operating procedure to properly tag, report, and repair leaks found in these areas. This will decrease energy costs, improve machine efficiency, and decrease compressor operation.

Belt Grease-Skimmer: A belt grease-skimmer could provide effective grease removal from the on-site grease pit. A tube skimmer is housed in the grease pit building but is not currently in use. In the past, a grease recycling vendor hauled grease from the pit when the tube skimmer was in use. Due to insufficient grease quantities and a lack of onsite storage options, this service was deemed economically infeasible. The pit is currently pumped out twice weekly to remove solids and grease, which are sent to the landfill.

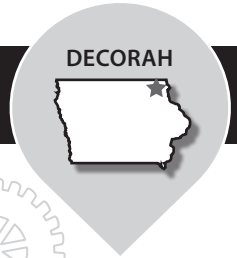
A vertically designed belt grease-skimmer could significantly increase the quantity of recovered grease and make recycling a more cost effective option. With this system, secondary heated storage would not be needed. Additionally, the remaining contents of the pit would require less frequent pumping, which could save labor pumping costs and reduce the volume of waste going to the landfill. Initial discussions are taking place to prepare for implementation.

Reuse of RO Blowdown Water: A variety of different areas were considered when exploring opportunities for reuse of the RO blowdown water. To improve water conservation efforts at the Smithfield Sioux City plant, an RO system was implemented to help purify and filter the water received from the city. An opportunity exists to significantly reduce water usage and associated costs by capturing and reusing the blowdown water from this system. Areas considered for potential reuse of the RO blowdown water were chip burners, sanitation, and rack-washer, which have not proved feasible due to the impurity levels of the blowdown water.

Processes such as forward osmosis have the potential to further purify the RO blowdown water to an acceptable quality for use at the plant. Forward osmosis holds promise, but further research is needed to determine the most efficient and beneficial use for the Sioux City plant.

PROJECT	ANNUAL COST SAVINGS	ENVIRONMENTAL RESULTS	STATUS
COMPRESSED AIR SYSTEM LEAK REPAIR	$13,111	242,820 kWh	IN PROGRESS
MAINTENANCE PLAN AND STANDARD OPERATING PROCEDURES	$4,533	80,940 kWh	IMPLEMENTED
BELT GREASE-SKIMMER	$287,462	990 tons	RECOMMENDED
REUSE OF RO BLOWDOWN WATER	–	2,446,080 gallons	FURTHER RESEARCH NEEDED

STANLEY ENGINEERED FASTENING



TOM ALLEVEN
CHEMICAL ENGINEERING
IOWA STATE UNIVERSITY

COMPANY PROFILE
Stanley Engineered Fastening is a world renowned leader in fastening solutions. Stanley serves diverse industries in automotive, medical, electronic, construction, and defense applications. Stanley Engineered Fastening has more than 5,000 associates around the globe, with facilities in India, China, Spain, Brazil, and United States. With more than 100 years of experience and the most diverse product selection in the world, Stanley Engineered Fastening has become the gold standard in fastener manufacturing.

PROJECT BACKGROUND
When fasteners are produced, a solid hazardous waste is generated as a byproduct of the wastewater treatment process. Stanley Engineered Fastening tasked their P2 intern with finding solutions to reduce the amount of hazardous waste generated at the Decorah facility. To find the optimal solution to reducing the amount of hazardous waste, the intern first generated piping and instrumentation diagrams (P&IDs) of the wastewater process. These P&IDs offered a comprehensive overview of the wastewater process flow throughout the plant. Separately, a newly implemented cleaner in the facility's passivation line was analyzed to determine the most efficient usage concentration.

INCENTIVES TO CHANGE
At the Decorah Stanley facility a large quantity of solid hazardous waste is generated as a natural result of their production process. This waste needs to be transported offsite to a treatment facility more than 150 miles away for proper treatment and disposal. Because of these environmental and economic reasons, Stanley has placed hazardous waste reduction at the forefront of their process improvement priorities. A recent change of cleaning agents used in the passivation line provided another opportunity to improve economic and environmental impacts by fine-tuning the dosing ratio.

RESULTS
Wastewater System Redesign: At the Stanley Engineered Fastening facility, a hazardous solid waste is generated as a byproduct of the wastewater treatment facility. The wastewater treatment facility treats the liquid waste it receives from three major production sources: the passivation line, the electropolish line, and the washers. Of these three lines, only the waste produced in the electropolishing line is classified as hazardous. The other two lines produce non-hazardous waste. However since all three lines mix together prior to treatment and are treated using the same process, all of the resulting solid waste from the wastewater treatment facility must be classified as hazardous.

In addition to exploring source reduction strategies, the intern investigated various separation and elimination processes such as magnetic separation, eddy current separation, and moisture extraction to reduce the volume of hazardous waste generated. Research proved these strategies to be not permissible, insufficient or unreliable to provide a long-term or viable solution.

A wastewater system redesign could provide separation and isolation of the hazardous and non-hazardous solid waste streams. The plant currently runs a clarifier system designed to treat waters and solids, and a batch tank system to treat oils, waters, and solids. These two systems come together before the solids are extracted. The wastewater system was redesigned to isolate the hazardous stream from the non-hazardous stream prior to mixing. With minimal one-time purchases, modifications could be made to create two independent treatment processes, with the clarifier system treating the hazardous material and the batch tank system treating the non-hazardous material. The hazardous solids would no longer come into contact with the non-hazardous solids during or after the treatment process. This recommended solution would reduce the amount of hazardous material generated by 90 percent and could allow Stanley to reduce their EPA hazardous waste generator status from a large quantity generator to a small quantity generator, providing additional regulatory benefits. The next steps for Stanley to implement this recommendation would be to purchase the additional equipment and services needed for implementation.

Passivation Cleaner Reduction: Cleaner is used on the passivation line to remove impurities on the product's surface in preparation for passivation. This cleaner is utilized in a batch process, and an average concentration of 12 percent by volume is currently used. After checking the cleaner's Technical Data Sheet (TDS) and confirming with the manufacturer's lab manager, it was determined that the concentration may be reduced to 5 percent by volume without losing effectiveness. The next step for Stanley to implement this recommendation would be to gradually decrease cleaner concentration from the 12 percent to the 5 percent concentration to verify efficacy.

Piping and Instrumentation Diagram (P&ID) Development: Piping and Instrumentation Diagrams (P&IDs) are commonly used throughout industry to determine corrective process changes. P&IDs of the waste water treatment facility, oil recovery unit, and electropolishing line were fabricated to aid in finding source reduction solutions in the wastewater system redesign project and will provide an on-going resource for maintenance and repair at the facility.

PROJECT	ANNUAL COST SAVINGS	ENVIRONMENTAL RESULTS	STATUS
WASTEWATER SYSTEM REDESIGN	$20,061	63.4 tons of hazardous waste	RECOMMENDED
PASSIVATION CLEANER REDUCTION	$95,550	9,555 gallons	RECOMMENDED
P&ID DEVELOPMENT	$7,200 (one time)	–	IMPLEMENTED

WOODWARD RESOURCE CENTER

WOODWARD

CLAY HUGEN
CHEMICAL ENGINEERING
IOWA STATE UNIVERSITY

COMPANY PROFILE
Woodward Resource Center (WRC) is a state facility operated by the Iowa Department of Human Services. Founded in 1917, WRC has a rich history and has been known by many names and functions. Currently, WRC provides services for approximately 135 individuals as a licensed Intermediate Care Facility. They employ approximately 450 people in this task.

The facility also leases building space to Woodward Academy, a juvenile treatment facility. They operate as a separate entity of WRC and employ 235 staff to provide care and education to approximately 240 students and various staff. Woodward Academy operates 24 hours per day year-round.

PROJECT BACKGROUND
Campus Food Services provide three meals daily to the individuals on campus through a meal delivery system. These meals are regulated by the National School Lunch Program and specifically designed for each individual by a team of three full-time dieticians. They also serve lunch and supper to the Woodward Academy students during weekdays and provide the materials for students to prepare breakfast and weekend meals in dormitory kitchens. Solid waste is generated across campus with recycling processes in place for paper and cardboard.

INCENTIVES TO CHANGE
Woodward Resource Center's goal is to become a more sustainable institution. Waste audits were conducted and it was determined that opportunities exist to reduce food and other solid waste. Through process improvements, implementation of new programs, and expansion of the current the recycling infrastructure, WRC can limit their environmental impact by reducing or diverting waste from the landfill.

RESULTS
Utilization of Forecasting in Menu Planning and Preparation: A common challenge in food service is accurately estimating the volume of food required. Forecasting is the use of historical data to predict future demand. The intern developed an Excel-based tool that can be used to track the amount of food served for each menu item and help calculate preparation amounts. Tracking consumption data will allow WRC to prepare sufficient amounts of food and limit leftovers and waste. Implementation would require each cafeteria to have a printed copy of the spreadsheet for each meal and to record the data. The sheets would then need to be collected and input to build a data base for tracking.

Food Waste Education: Curriculum was developed to guide classroom education on the topic of food waste. Developing an understanding of healthy eating habits and the environmental impact of food waste could help students make conscious decisions during meal times and reduce wasteful behavior. It is important that waste education is implemented with forecasting to reduce the amount prepared if less is taken in line.

Food Donation: Most of the food that has been prepared but not served is landfilled. It is recommended that this nutritionally valuable food be donated, in accordance with the Bill Emerson Good Samaritan Food Donation Act.
A flash cooler and refrigerator storage exists at WRC for safe food handling for the donated product and a local non-profit organization would pick up the food weekly.

Increased Eating Times: It was observed that students have approximately 15 minutes to eat after they sit down for lunch. It is recommended to increase eating times to a minimum of 20 minutes. It may be necessary to change serving processes to speed serving-line flow.

Use of Reusable and Compostable Serving Containers: WRC uses plastic serving containers to speed serving-line flow and control portion sizes. Reusable bowls could eliminate this waste stream and be easily washed and dried in the tray machine after each meal. Fruit and vegetable servings could be pre-dished by the server in reusable bowls to control the serving size. This method could also help with forecasting and would reduce food waste while also reducing this plastic waste stream. Each item replaced would result in diverting approximately 0.62 tons of plastic trash from the landfill annually. This figure is for the 6 oz. side dish, the most commonly used container at the cafeteria. Waste diversion will depend on which bowl is being replaced. When necessary, compostable paper products would be a more environmentally sustainable option. The annual cost savings potential is per item that is converted to a reusable container.

Expansion of the Recycling Program: Cardboard and paper recycling occurs inconsistently on some parts of the Woodward Resource Center campus. Expanding the pickup route for paper recycling campus-wide and including #10 tin cans generated in the food services locations could reduce landfill waste. Additional recycle receptacles would need to be strategically located and facility staff would need to be educated on the new process.

Optimization of Trash Pick-ups: A study showed that many of the dumpsters did not collect a significant amount of trash daily and could be eliminated. Additionally, the pickup frequency could be reduced by half. In addition to saving tipping fees, this change will also reduce fuel usage and in turn, emissions produced by the garbage hauler.

The success of this implementation is dependent on the recycling expansion first being implemented. A new or modified contract with the hauler would need to be implemented to reduce pick-up frequency and the bins would need to be moved to optimize the pick-up efficacy.

Implementation of a Composting Program: Food waste from serving trays could be converted to a valuable soil amendment through composting. The intern researched and identified a composting system and the material handling equipment necessary to accommodate the output of waste at the facility. The finished compost product could be used on campus grounds or bagged and sold at the campus store. It is recommended that an in-vessel composting system be installed on campus. Implementing this recommendation would first require approval and budgeting for the capital expense of the equipment.

Miscellaneous Cafeteria Process Improvements: Measures such as using smaller serving spoons, active employee training, and food waste discussion during meetings could increase efficiency and reduce food waste in the cafeteria.

PROJECT	ANNUAL COST SAVINGS	ENVIRONMENTAL RESULTS	STATUS
FOOD FORECASTING	$3,254	0.5 tons	RECOMMENDED
FOOD WASTE EDUCATION	$6,679	0.25 tons	IN PROGRESS
FOOD DONATION	$416	13 tons	RECOMMENDED
INCREASING EATING TIME	$240	7.5 tons	RECOMMENDED
USE OF REUSABLE SERVING CONTAINERS	$2,918	0.62 tons	RECOMMENDED
EXPANSION OF THE RECYCLING PROGRAM	$3,040	56 tons	RECOMMENDED
OPTIMIZATION OF TRASH PICK-UPS	$13,950	17.28 metric tons CO_2	RECOMMENDED
COMPOSTING PROGRAM	N/A	70.6 tons	RECOMMENDED
MISCELLANEOUS CAFETERIA PROCESS IMPROVEMENTS	$6,679	0.25 tons	RECOMMENDED

WOODWARD RESOURCE CENTER

WOODWARD

ETHAN MORAN
MECHANICAL ENGINEERING
IOWA STATE UNIVERSITY

COMPANY PROFILE

The Woodward Resource Center was established in 1917 and is operated by the Iowa Department of Human Services. The main purpose of the facility is to provide services as a licensed Intermediate Care Facility for the Intellectually Disabled. The mission is to prepare and support individuals to live in a community of their choice. There are currently 132 individuals living on campus being supported by more than 500 employees.

The Woodward Academy, a juvenile treatment facility, leases building space located in the middle of campus. It employs 235 staff to provide clinical services in addition to an education for more than 265 students. Woodward Academy is operated 24 hours per day, 365 days per year.

The Woodward-Granger Community School District also leases building space utilized as a stand-alone special needs public day school based on a state defined consortia model.

PROJECT BACKGROUND

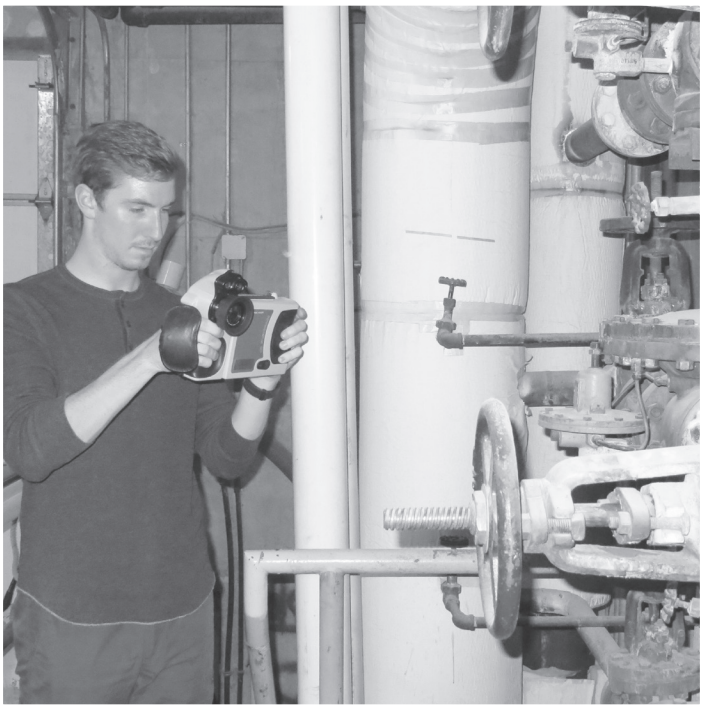
The facility uses a steam heating system for 19 buildings on campus, which includes the Woodward Academy. Two 50-year-old water tube boilers burn natural gas to produce the steam. It is delivered to more than 475,000 square feet of building space through a utility tunnel system that is 8,000 feet long. The steam is used for clothes dryers, kitchen appliances, chillers, and room heating. Woodward Resource Center requested a 24-week intern project through the Iowa Pollution Prevention Intern Program to research opportunities and make recommendations to improve the efficiency of the steam system and reduce energy usage and associated costs.

INCENTIVES TO CHANGE

Since installation, less than 50 percent of the steam infrastructure has been replaced. Over the years, the condition of much of the piping, insulation, and steam traps has deteriorated. This has led to inconsistent heating in employee work spaces. Leaking condensate has also been a concern in the basements of buildings and the utility tunnels. Improving the steam system infrastructure and reducing the amount of heat loss would increase the efficiency of the system, decrease emissions, and result in significant cost savings.

RESULTS

The intern concluded from initial observations that trap and insulation repairs would yield the highest energy-savings opportunities. The intern conducted campus-wide surveys and utilized visual, temperature, and ultrasonic testing to determine the total extent of heat energy being wasted. Data collected during the surveys was compiled into an organized database and included comprehensive information about the locations of traps, trap specifications, and current trap status. Piping insulation status was also documented. It was found that the Resource Center is currently wasting more than 75 percent of the steam they produce due to failed steam traps and poor insulation.



Trap Repair & Replacement: During the audit there were several steam traps identified that had failed and should be replaced to reduce steam loss. This would significantly reduce the amount of steam produced because the steam would be used more effectively instead of being wasted. With less steam generated, the total amount of emissions produced from the boilers would decrease as well.

Insulation Replacement & Installation: Several sections of steam and condensate piping are exposed without insulation or have damaged insulation. Installing new insulation in these areas would reduce heat loss, which allows for the steam heating in buildings to be more effectively utilized. Another benefit is a reduction in steam produced by the boiler. Both the trap and insulation replacement recommendations have similar effects by increasing the efficiency of steam usage, which leads to less fuel and water used.

Trap Maintenance Program: After the initial failed traps are replaced, the facility will need a program to maintain the traps so the failure rate stays relatively low compared to the current failure rate. This will keep the costs and steam loss low for the future. It will also allow the facility to track historical records of trap replacements to identify trends in failures, which will further improve the program. This recommendation is a long term solution compared to the first recommendation.

Insulation Maintenance Program: Similar to the trap program, the facility will need a program to maintain insulation repairs and identify trends for the future as well. This program can be considered the long term solution compared to the second recommendation. The two recommended maintenance programs provide the framework from which Woodward can manage resources to conduct regular audits of the steam system and complete the necessary repairs in a timely manner and on a sustainable schedule.

PROJECT	ANNUAL COST SAVINGS	ENVIRONMENTAL RESULTS	STATUS
TRAP REPAIR & REPLACEMENT	$974, 288	653,053 therms 9,553,978 gal	IN PROGRESS
INSULATION REPLACEMENT & INSTALLATION	$38,781	82,191 therms	IN PROGRESS
TRAP MAINTENANCE PROGRAM	$493,935	353,472 therms 5,156,570 gallons	RECOMMENDED
INSULATION MAINTENANCE PROGRAM	$8,623	18, 920 therms	RECOMMENDED

ZOETIS

CHARLES CITY

JACOB KOKE
MECHANICAL ENGINEERING
THE UNIVERSITY OF IOWA

COMPANY PROFILE
Zoetis is a global company known for its support of the animal health industry. The company is dedicated to delivering quality animal health products including medicines, vaccines and diagnostic products to veterinarians, farmers and pet owners who raise and care for animals. The Charles City, Iowa, facility specializes in poultry, but also produces products for cattle, swine, horses, and companion animals such as dogs and cats. Zoetis' mission statement is "To build on a six-decade history and singular focus on animal health to bring customers quality products, services and a commitment to their businesses."

PROJECT BACKGROUND
The primary goals of this project were to identify potential energy savings for the Research and Administration Building on Zoetis' campus and to complete a feasibility study for renewable energy sources to provide power for the chillers. The Research and Administration Building was built in 1969 and required an assessment to identify opportunities for energy efficiency upgrades. Due to the large number of original windows, it was suspected that significant energy losses were occurring through the building envelope. Zoetis consumes a large quantity of energy to operate production and supporting facilities and is exploring renewable energy sources to help meet sustainability goals.

INCENTIVES TO CHANGE
As a world leader, Zoetis strives to set an example for responsible production practices and environmental sustainability. Energy conservation is one of the main emphasis areas for continuous improvement that will have both environmental and economic benefits. Improving the energy efficiency of the Research and Administration building envelope could reduce the total energy consumed at Zoetis' Charles City facility. Additionally, moving to renewable sources of energy would reduce their reliance on grid energy and improve company sustainability.

RESULTS
Retrofit Windows: An energy audit including an infrared survey was conducted and showed that significant heat transfer is occurring through windows in the Research and Administration building. These windows are wood-framed, single-pane glass windows and are original to the 1968 construction of the building. Windows compose about 60% of the exterior shell of this building and excessive heat transfer between the interior and exterior of the building result in higher heating and cooling requirements to maintain a comfortable temperature for employees. Several window companies were invited to assess and prepare quotes for window upgrades. Upgrading the windows to double pane glass windows filled with argon and metal framing results in an increase of thermal resistance by a factor of 10.

To accomplish this, a four phase program was suggested. The building would be split into four parts based on the room numbers. This helps to break such a large project into manageable segments. Using the room number system will help make it easy to clarify which parts go with which phase. As a result of window upgrades, heating and cooling costs for the Research and Administration Building could be significantly reduced. In addition to economic benefits, Zoetis' employees would enjoy a more comfortable working environment.

Alternative Energy: The Charles City facility consumes a large amount of energy to operate and the majority of power consumption goes to the chillers. A renewable energy system sized for the chillers was explored, but it was found that a larger scale renewable energy system would be a more economical option and would likely be necessary for the project to be a cost effective option at Zoetis. A major constraint that applies to a project this large is that the utility company permits only one megawatt of electricity for net metering. If more than one megawatt is needed then the savings are nearly halved, so appropriately sizing the system is important. Once the amount of energy usage was determined, the intern researched wind and solar technologies, as they typically offer the best return for Iowa companies. Incentives and tax credits available for wind and for solar were compared as well as the price per kilowatt of each. Several vendors were contacted to obtain official bids for the project in order to establish a realistic base line and compare the feasibility of solar versus wind.

There are many different types, sizes, and qualities of solar panels and wind turbines. It was determined from the project analysis that the most cost effective course of action is to pursue a 289 kilowatt solar array energy system to offset energy consumption at select buildings on Zoetis' campus. By beginning implementation of alternative energy to supply select buildings, the project could be scaled up to any system size to offset more of the overall cost of electricity. Starting with the 289 kilowatt system creates a good baseline on price that is large enough to achieve a low dollar per watt of installed power but is still able to be scaled up to help meet Zoetis' energy needs. This scale up is possible with the same payback period up to the point of reaching the net metering cap. To move forward with implementation, a thorough review of project feasibility would need to be completed followed by a budgetary review and pre-planning conversations with the solar firm.

PROJECT	ANNUAL COST SAVINGS	ENVIRONMENTAL RESULTS	STATUS
RETROFIT WINDOWS	$124,314	2,400,000 kWh	RECOMMENDED
ALTERNATIVE ENERGY	$32,333	340,998 kWh	RECOMMENDED

2018 PROJECT INDEX

POLLUTION PREVENTION INTERN PROGRAM

ALTERNATIVE ENERGY

- Zoetis

BOILERS/STEAM

- Cambrex
- JBS USA, LLC - Marshalltown
- Woodward Resource Center 2017 24-week project

BUILDING EFFECIENCY

- Zoetis

CHEMICAL SUBSTITUTION/REDUCTION

- Cambrex
- Iowa Fertilizer Company
- JBS USA - Ottumwa
- Stanley Engineered Fastening
- Woodward Resource Center 2017 24-week project

COMPRESSED AIR

- Smithfield Foods, Inc. - Sioux City

ENERGY REDUCTION

- Cambrex
- JBS USA, LLC - Marshalltown
- JBS USA - Ottumwa
- Smithfield Foods, Inc. - Sioux City
- Woodward Resource Center 2017 24-week project
- Zoetis

PROCESS IMPROVEMENT

- Hach Company
- Iowa Fertilizer Company
- JBS USA, LLC - Marshalltown
- JBS USA - Ottumwa
- Monogram Prepared Meats
- Smithfield Mason City
- Stanley Engineered Fastening
- Woodward Resource Center 2018

SOLID WASTE MANAGEMENT

- Hach Company
- Monogram Prepared Meats
- Smithfield Mason City
- Smithfield Foods, Inc. - Sioux City
- Woodward Resource Center 2018

WASTEWATER

- Iowa Fertilizer Company
- Stanley Engineered Fastening

WATER USE REDUCTION

- Cambrex
- JBS USA, LLC - Marshalltown
- JBS USA - Ottumwa
- Smithfield Foods, Inc. - Sioux City
- Woodward Resource Center 2017 24-week project

» Join the P2 INTERN PROGRAM in 2019!

FOR COMPANIES

Pollution Prevention Services is currently accepting requests for 2019 intern projects. Companies must submit a project request that identifies a focus project and outlines the desired objectives and impacts. Company project requests must be submitted by **December 1, 2018** to be considered for a 2019 intern placement.

Project requests will be reviewed upon receipt and companies contacted within two weeks for review and clarification. Final determination of acceptance will be made within 30 days after project review and clarification of details is completed. Intern assignments for finalized projects will begin in January of 2019.

Please note: Students are not trained in or qualified to assess regulatory compliance issues.

FOR STUDENTS

Graduate and junior or senior-level undergraduate engineering students are encouraged to submit the following documents for consideration:

- Application Form
- Résumé
- Cover Letter
- Unofficial copy of transcripts
- List of Fall 2018 and Spring 2019 classes

Selection of 2019 interns will begin in November and continue into the spring until project assignments are finalized.

Pollution Prevention Services is offering internships for 12-weeks (May 20-August 9) or for 24-weeks (May 20-November 8) in 2019.

Selected applicants will be matched to a project based on academic performance, relative experience and technical skills.

SUBMIT PROJECT REQUESTS & APPLICATIONS TO:

DANIELLE ROSELAND
Iowa Dept. of Natural Resources
Pollution Prevention Intern Program Coordinator
502 East Ninth Street, Des Moines, IA 50319-0034
Phone: (515) 725-8363
Danielle.Dilks@dnr.iowa.gov

STUDENT APPLICATION & BUSINESS REQUEST FORMS ARE AVAILABLE ONLINE AT:

www.iowap2interns.com

Forms may be submitted electronically, faxed or mailed.

THE IOWA DEPARTMENT OF NATURAL RESOURCES IS AN EEO/AA EMPLOYER

GEAR UP & GO GREEN

with the

POLLUTION PREVENTION

INTERN PROGRAM

INTERNSHIPS

MECHANICAL
CHEMICAL
INDUSTRIAL
ENVIRONMENTAL

www.iowaP2interns.com