WORKING TOGETHER TO ACHIEVE ECONOMIC AND ENVIRONMENTAL RESULTS

POLLUTION PREVENTION SERVICES

2025 INTERN PROGRAM CASE SUMMARIES

pollution prevention services

www.iowap2services.com

CASE SUMMARIES WRITTEN BY
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DIRECTOR'S NOTE

Over the years, Iowa businesses have consistently demonstrated remarkable resilience, growing stronger through various challenges. A crucial component of this resilience is their focus on continuous improvement and efficiency. Among the most effective strategies for achieving this is source reduction, which targets waste and inefficiency at the earliest stages of a process. Through source reduction, companies can pinpoint key opportunities to optimize resource use and increase profitability. This proactive approach delivers a powerful competitive advantage, turning a business' capacity for efficiency into a source of enduring strength, sustainability, and financial gain.

The Pollution Prevention (P2) Intern Program offers Iowa businesses a valuable tool in targeting source reduction opportunities. By collaborating on a project with the program, businesses gain access to the creativity and problem-solving skills of top engineering students. While working at their host companies the interns compile data, research solutions, quantify impacts, and make recommendations in a technical final report on their focus project. Their fresh perspectives and source reduction training can reveal new efficiencies for a business' process operations, leading to impactful projects that improve profitability and contribute to a healthier environment for Iowa.

Since 2001, the P2 Intern Program has partnered with Iowa businesses and organizations to conserve and protect our natural resources by identifying and implementing source reduction solutions. Participating Iowa companies have reported more than $122.5 million in savings after implementing their interns' recommendations. These achievements are illustrated in the charts below.

I commend the participating companies, the outstanding interns, and the P2 Services team for their commitment to improving the environment and quality of life in Iowa.

- Kayla Lyon
Director, Iowa Department of Natural Resources

TOTAL IMPLEMENTED SAVINGS 2001–2025

POLLUTION/WASTE REDUCTION & COST SAVINGS FROM IMPLEMENTED INTERN PROJECTS

CATEGORY	REDUCTION	UNITS	COST SAVINGS
WATER CONSERVATION	6,500,434,107	gallons	$21,447,897
SPECIAL WASTE	76,257	tons	$2,256,529
SOLID WASTE	210,506	tons	$17,954,260
HAZARDOUS WASTE	10,493	tons	$18,960,934
MERCURY ABATED	42,817	grams	
ENERGY	518,438,091 4,462,265 26,928,361	kWh *MMBtu therms	$29,982,044 – $17,305,274
OTHER			$14,614,762
			TOTAL: $122,521,700

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

2001–2025 GREENHOUSE GASES & CONVENTIONAL AIR POLLUTANTS FROM IMPLEMENTED PROJECTS

CONVENTIONAL AIR POLLUTANTS DIVERTED IN METRIC TONS

NH_3	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO
12.516	698.565	117.763	77.056	1,262.15	143.265	410.024

GREENHOUSE GASES DIVERTED IN METRIC TONS

CO_2	CH_4	N_20	CFC	$MTCO_2e$
321,864.646	78,821.399	4,450.601	2,211.416	430,020.151

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

EXECUTIVE SUMMARY

The Department of Natural Resources (DNR) collaborated with five upper-level engineering students through the 2025 Pollution Prevention (P2) Intern program to help companies achieve their environmental goals. This initiative fosters a unique partnership among academia, business, and government, generating significant environmental and economic benefits. The interns worked closely with P2 advisors to address key areas such as water and energy reductions, water treatment optimization, and process efficiency. Their recommendations have the potential to save participating companies more than $1.2 million annually, with projected first-year savings of approximately $543,052 from implemented projects.

All 2025 intern host companies have previously partnered with the program over the last decade. These established partners rely on the program to identify high-caliber interns who serve as a critical engineering resource, assisting companies in pinpointing source reduction solutions and cost-saving process efficiencies.

Case summaries are also included for 28 week co-op projects completed in 2024 and 2025 at Ajinomoto Health & Nutrition North America, Inc., focusing on process improvements in energy and water efficiency. These extended P2 projects allowed for comprehensive research and system evaluation under various conditions, resulting in deeper insights and more impactful recommendations. The extended timeframe enables interns to thoroughly assess the effects of process changes and make necessary adjustments.

The intern program is an extension of DNR's P2 Services, which provides confidential, technical assistance to Iowa businesses. This initiative not only provides companies with innovative solutions and fresh perspectives from the interns; it also offers students invaluable real-world engineering experience. The successful outcomes from the 2025 projects demonstrate the effectiveness of collaborative efforts between companies, students, and the DNR in achieving meaningful environmental improvements.

2025 ENVIRONMENTAL SAVINGS

ACTUAL POLLUTION/WASTE REDUCTION AND COST SAVINGS FROM IMPLEMENTED INTERN PROJECTS

CATEGORY	REDUCTION	UNITS	COST SAVINGS
WATER CONSERVATION	72,738,000	gallons	$236,620
SOLID WASTE	480	tons	$542,630
ENERGY	5,292,704 18,064 0	kWh *MMBtu therms	$305,423 – $0
OTHER			$0
			TOTAL: $1,084,673

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

NOTE:

- Air emissions and greenhouse gases shown on these pages 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, Version 16, available at: https://www.epa.gov/waste-reduction-model.
- Life cycle air emissions and greenhouse gas estimates for all sectors except solid waste are calculated using Carnegie Mellon University Green Design Institute (2022) Economic Input-Output Life Cycle Assessment (EIO-LCA), US 2002 (428 sectors) Producer model.

TOTAL REPORTED FROM 2025 PROJECTS THROUGH AUGUST

CONVENTIONAL AIR POLLUTANTS DIVERTED IN METRIC TONS

NH_3	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO
12.516	698.565	117.763	77.056	1,262.15	143.265	410.024

GREENHOUSE GASES DIVERTED IN METRIC TONS

CO_2	CH_4	N_20	CFC	$MTCO_2e$
321,864.646	78,821.399	4,450.601	2,211.416	430,020.151

WHAT IS POLLUTION PREVENTION (P2)?

Pollution Prevention (P2) was created by Congress in 1990. The P2 Act focused public attention on reducing the amount of pollution in the air, water, and soil. Government implemented policies to effect change. Business, industry, and individuals started making cost-effective changes in production, operations, raw material use, and waste management to reduce the pollution being generated and become better stewards of their environment.

P2 is the reduction or elimination of wastes at the source (source reduction) or beginning of a process, instead of at the end-of-the-pipe or stack. When employing P2, the entire process is examined to identify how and where waste is generated and find ways to use resources more efficiently. Reducing the generation or use of hazardous materials is a key component of P2 methodologies.

Seven P2 strategies that categorize most improvements include:

- Input substitution
- Equipment modifications
- Process modifications
- Product reformulation
- Raw material use & handling
- Material tracking & inventory control
- Improved housekeeping & maintenance

Using one or more P2 strategies to implement environmental improvement projects almost always saves a company money in reduced utility or operating costs. The projects in this document provide examples of how quickly savings can add up when prioritizing stewardship of resources.

YOUR COMPANY IS ELIGIBLE TO WORK WITH POLLUTION PREVENTION SERVICES IF:

1) You are a business, industry, institution (e.g. hospital, educational campuses), or governmental agency with 100 or more employees.

2) You employ fewer than 100 people, but meet at least one of the following criteria:

- **Toxic Release Inventory (TRI) reporter**
- **Resource Conservation and Recovery Act (RCRA) Large-Quantity Generator of hazardous waste**
- **Large Utility User (greater than $1 million in energy and water usage and waste disposal annually).**

POLLUTION PREVENTION: COMPANY PROJECT REQUESTS

FOR COMPANIES WISHING TO MAKE A PROJECT REQUEST

Pollution Prevention Services is currently accepting requests for 2026 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 January 16, 2026, to be considered for a 2026 intern placement.

Project requests will be reviewed upon receipt and companies contacted within two weeks for review, clarification, and further development, if needed. 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 2026.

Project request forms are available at www.iowap2interns.com

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

» SUBMIT PROJECT REQUESTS TO: P2SERVICES@DNR.IOWA.GOV

COMPANY TESTIMONIALS

"Our intern provided valuable insights by analyzing our systems and gathering data that will guide future strategic decisions. This program not only allowed us to complete work towards our sustainability goals, but also gave the student real-world experience to prepare them for success after graduation."

– DARREN BLAHA
SR. ENGINEERING MANAGER – INGREDIENTS & SOLUTIONS DIVISION
AJINOMOTO HEALTH & NUTRITION NORTH AMERICA, INC.

"We have had a number of pollution prevention interns over the years and have always been happy with the partnerships! On a college campus, a sustainability related issue often includes multiple departments and the solutions often need a deep dive and time to get to know all of the constituents. These internships are a great solution as opposed to a consultant that may visit campus a few times and fail to understand all of the viewpoints."

– CHRIS BAIR
ENVIRONMENTAL & SAFETY COORDINATOR
GRINNELL COLLEGE

"The P2 Intern Program delivers real, actionable improvements that align with our sustainability mission. It's been a valuable partnership we're proud to continue."

– PAOLA SALINAS
ENVIRONMENTAL MANAGER
JBS SWIFT PORK

IS A P2 INTERNSHIP THE RIGHT OPPORTUNITY FOR YOU?

As an intern in the nationally recognized Pollution Prevention Intern Program, you will work onsite at a company or institution dedicated to protecting the environment and saving money through projects aimed at reducing or eliminating waste and inefficiencies.

WHAT IS POLLUTION PREVENTION?

Pollution Prevention is the act of changing client processes to reduce or eliminate waste and pollutants at the source, minimizing the need for treatment or disposal.

WHO IS ELIGIBLE FOR AN INTERNSHIP?

Upper-level undergraduate students and graduate program candidates are eligible. Selected applicants will be matched to a project based on academic performance, relevant experience, and technical skills. Up to 15 internships will be funded in 2026.

HOW DO PROJECTS WORK?

Interns report to a company supervisor who provides onsite resources and garners management support. They also report to a P2 program advisor who provides technical support. The intern will assess a process, research options, evaluate feasibility, and develop cost comparisons for their assigned project. Interns will also initiate implementation of their recommendations at their host company. Deliverables include a final report documenting results, a case summary of the project, and a presentation to host company management.

WHAT SUPPORT WILL I HAVE?

Internships will begin on May 18th with a week of training. Interns will learn how to complete an assessment and identify inefficiencies, how to apply P2 methodologies to improve performance and reduce waste, and how to quantify economic and environmental savings. Interns serve as project managers at their host companies and receive technical support from Iowa Department of Natural Resources' Pollution Prevention Services engineers.

BACKGROUND

Pollution Prevention Services is a team of DNR experts offering non-regulatory environmental technical assistance to business and industry, institutions, and government agencies. The internship program matches host companies with students, refines project goals, helps to generate ideas, and keeps projects focused on pollution prevention.

"We've taken advantage of the professionalism and passion of the P2 staff and interns for eight years, which demonstrates how much they bring to us each year. All of these interns have delivered the same quality investigative work and real-world recommendations. We're already looking forward to next year's partnership."

– CHARLES HEISEL
CORPORATE ENVIRONMENTAL MANAGER
JBS SWIFT PORK

2025 POLLUTION PREVENTION INTERNS

AUSTIN LEE, GRINNELL COLLEGE:

I felt very rewarded by the people onsite who recognized my work during my P2 internship. The continuous support, both onsite and from the DNR, ensured I always had the necessary tools to get the work done. This internship provided valuable insight into the industry and the daily aspects of this type of work. The professional connections I made throughout this experience have also been extremely beneficial.

ZACHARY DIXON, JBS USA, LLC:

The P2 internship offers a unique opportunity to complete a truly meaningful project that can significantly impact the host company. While the task may seem overwhelming at first, you are given the time, tools, and necessary resources to complete the given project. This internship experience has been incredibly valuable, providing professional work experience that I believe will lead to excellent future opportunities.

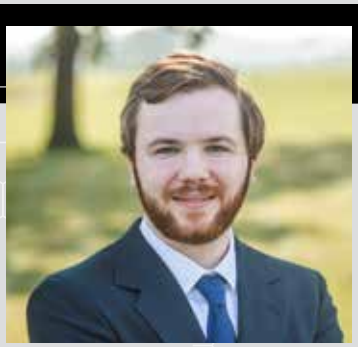
TYLER CASEY, JBS SWIFT PORK:

My P2 internship allowed me to shadow multiple professionals and focus on various aspects of engineering. This experience significantly expanded my engineering knowledge while also benefiting the host company and the environment.

MICHAEL MAGGIO, KEMIN INDUSTRIES:

During my internship, I was given information to understand the problem, develop a solution, and then identify the necessary steps for implementing a change.

NOT PICTURED:
AMAN CHAUDHARY,
AJINOMOTO HEALTH & NUTRITION NORTH AMERICA, INC.:
My P2 internship allowed me to acquire real-life experiences in P2 and embrace P2 practices in a professional engineering work environment. Interns get to learn more about environmental problems and be a part of projects that create a benefit not just for their host company but also for society and the world.



SHANE KELSEY

SCHOOL: Iowa State University
MAJOR: Chemical Engineering

AJINOMOTO HEALTH & NUTRITION NORTH AMERICA, INC.

EDDYVILLE

2024 28-WEEK CO-OP PROJECT

COMPANY PROFILE:

Ajinomoto Health & Nutrition North America, Inc. (Ajinomoto), founded in 1909, is a Japanese-based food and amino acid producer with more than 34,000 employees worldwide and annual sales exceeding ten billion dollars. Dedicated to its mission to improve the health of humankind, Ajinomoto produces high quality products to resolve food and health issues globally. Ajinomoto is the world's largest producer of monosodium glutamate (MSG), a flavor enhancer that is naturally present in many foods. The location in Eddyville, Iowa, focuses on the production of MSG as well as amino acids for farm animal consumption, including lysine, threonine, and tryptophan.

PROJECT BACKGROUND

The objective of the 28-week co-op is to analyze the water chiller system at the Heartland plant and find points of inefficiency, research potential solutions and recommend further action. Namely the intern focused on the buildup of scale within the chillers that is caused by the hard water that is used in the system which contributes to system inefficiencies. This extends to also increasing the capacity of the chiller system. The first half of the project was spent establishing a baseline while the second half was used for researching solutions along with creating an action plan for the aforementioned solutions.

INCENTIVES TO CHANGE

Ajinomoto has been committed to sustainability and the reduction of greenhouse gasses. Ajinomoto has stated the goal of reducing their environmental impact 50% by 2030. Locally, the company strives to be a productive and responsible neighbor, contributing to a healthy community. From an environmental perspective, this project aims to substantially reduce the water usage by the cooling towers, which will decrease the stress placed on the deep well that Ajinomoto draws from. This would also result in a decrease in electric costs, as the chillers would be using less power and running more efficiently reducing GHG emissions and reducing overall site water consumption.

RESULTS

Cold Lime Softening (CLS) System

The primary source of inefficiency in the water chiller system is from the minerals that have been able to build up on the inside of the copper pipes. These minerals act as an insulator that inhibits heat transfer. To address this problem the intern recommended the use of a CLS system that will remove the minerals before they reach the pipes. Once the tubes are clean, this will help maintain the highest amount of heat transfer and reduce the amount of power drawn by each of the chillers. It also saves a significant amount of money on water treatment chemicals as Ajinomoto must extensively treat the water before it reaches the rest of the plant.

Control and Monitoring System

Throughout the 28 weeks it became apparent that there is very little data tracked in the utility building. Because of this, it would be difficult to see the effect that the recommendations would have on the system and it would be more difficult to fine tune the changes. With this in mind, the intern recommends the implementation of a control and monitoring system that would not only allow Ajinomoto to see in real time the status of the water chillers but also make small changes to how the entire system operates. Another benefit is that the water chillers could automatically adjust themselves and talk to each other. There has been a vendor contacted and a quote has been acquired, with the next step being the implementation of the system onto each of the water chillers.

Tube Cleaning

In discussing this project, the intern found that there was an in-house tube cleaning brush that had previously been used to maintain the water chillers. However, this was discontinued at some point. For the CLS system to have the greatest impact the intern recommends that each of the water chillers be cleaned regularly. This would increase efficiency in each of the chillers and decrease the amount of power needed. This is also the project that would have the quickest results as once they are cleaned there will be an instant increase in heat transfer. The next step is to rotate the chillers out of service and clean them one by one.

Increased Flow to Chillers

When establishing the baseline, the intern discovered that there was a disconnect between the tower water flow rate and where the manufacturer's representative says it should be. This was then cross referenced with design documentation provided by the chiller manufacturer and discovered to be true. The effect this has on the system is that it reduces the amount of heat that can be transferred out of the chilled water. Because of this, Ajinomoto has been renting water chillers for six months out of the year to make up the difference. The intern checked pipe and pump sizes and found that they were sized correctly. Thus, the only other reason could be a restriction caused by a valve that is partially closed. The specific valve proved difficult to find as they are largely out of view. The intern therefore recommends that the site investigate to determine if there is a partially closed valve.

ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
COLD LIME SOFTENING (CLS) SYSTEM	$357,157	72,270,000 GAL	IN PROGRESS
CONTROL AND MONITORING SYSTEM	$185,244*	TBD	RECOMMENDED
TUBE CLEANING	$185,244	$2,646,352 kWh	IN PROGRESS
INCREASED FLOW TO CHILLERS	TBD	TBD	RECOMMENDED

**The cost savings are associated with proper operation based on the ability to monitor and control the process based on a new control and monitoring system. The cost savings for the control and monitoring system are already included in the tube cleaning.*

AMAN CHAUDHARY
SCHOOL: Augustana College
MAJOR: Mechanical Engineering

AJINOMOTO HEALTH & NUTRITION NORTH AMERICA, INC.

EDDYVILLE

2025 28-WEEK CO-OP PROJECT

COMPANY PROFILE:

Ajinomoto Health & Nutrition North America, Inc. (Ajinomoto), founded in 1909, is a Japanese-based food and amino acid producer with more than 34,000 employees worldwide and annual sales exceeding ten billion dollars. Dedicated to its mission to improve the health of humankind, Ajinomoto produces high quality products to resolve food and health issues globally. Ajinomoto is the world's largest producer of monosodium glutamate (MSG), a flavor enhancer that is naturally present in many foods. The location in Eddyville, Iowa, focuses on the production of MSG as well as amino acids for farm animal consumption, including lysine, threonine, and tryptophan.

PROJECT BACKGROUND

One of Ajinomoto's business commitments is to reduce impacts on the environment through energy and greenhouse gas (GHG) reduction sustainability projects. The objective of this 28-week co-op is to evaluate specific manufacturing unit operations to determine if improvements in energy efficiency and water usage can be realized. Several specific unit operations are under investigation, primarily focusing on process heat exchangers, flash steam vent condensers, and forced circulation evaporators. The intern began by assessing current operating parameters and then devised strategies to create or restore sustainable energy and water usage.

INCENTIVES TO CHANGE

Energy prices continue to rise. Water scarcity is a real risk to both business and the environment. Additionally, Ajinomoto has a commitment to reduce GHG emissions by 50 percent by 2030. All these serve as strong incentives to fully explore energy and water recovery opportunities. Additionally, stable, and safe operation are the top priority for Ajinomoto. Effective and efficient unit operations are inherently more dependable. These projects can directly reduce GHG emissions, cut water and energy use, and facilitate long-term cost-savings and improve reliability.

RESULTS

An in-depth energy assessment was conducted on specific unit operations by reviewing current performance against design basis. A detailed investigation of historical and current operational data was conducted using several methods, such as the plant data historian system, as well as manual field readings, reviewing process and instrumentation diagrams (P&ID), original equipment drawings and specifications, and communication with the specific equipment vendor representatives. This investigation often would result in identifying lost efficiency due to bypassed energy or water recovery equipment due to fouling. It also led to realizing underutilized equipment either by mis-operation or mis-design against current operation conditions. It was based on these findings that the following recommendations have been identified as part of the intern's work:

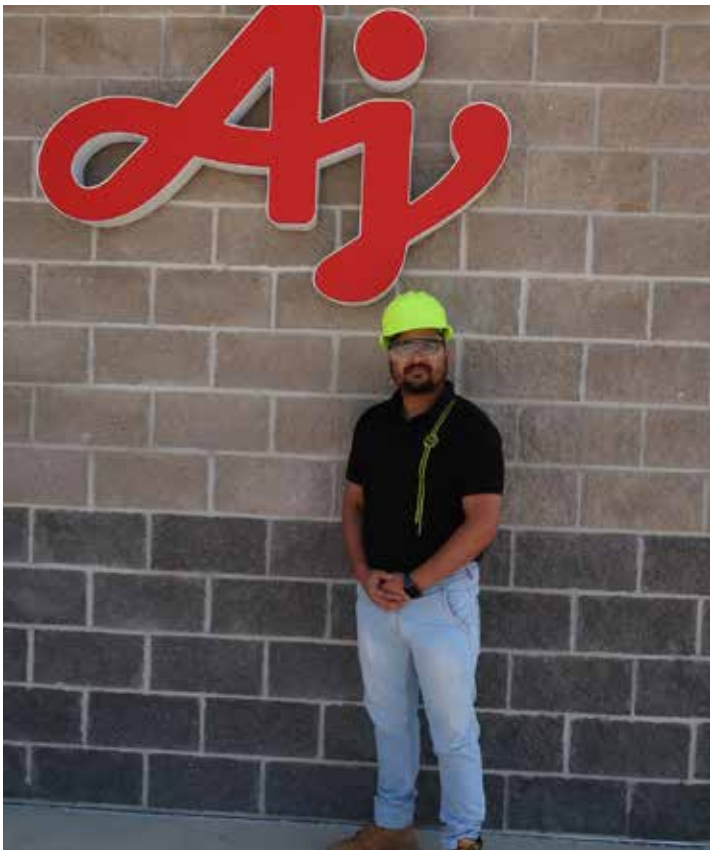
Recover Energy Using Wastewater Heat Exchanger

In the past, the facility idled a heat recovery heat exchanger due to operational challenges, primarily heat exchanger (HX) fouling. A thorough analysis was made of current data and site operation, and an investigation of why the unit was taken offline in the past. It was determined that consistent plugging of the heat exchanger was the primary reason the equipment was bypassed, along with lack of site awareness of the unit operations contribution to overall energy savings.

By putting the idle heat exchanger back into service, there is projected to be a significant reduction in the usage of steam as the unit will be recovering up to 30,000 Btu of heat per hour that is currently being lost and sent to wastewater. To address the operational challenges, new plate packs with wider gaps for passing solids are being considered. The anticipated savings of this change is more than $90,000 per year, and a simple payback is estimated to be 3-4 months. The next step will be to submit a testing plan to the manufacturing plant production team to perform a commercial plant test for this redesign. Additionally, the intern will determine how to maintain the tracking of energy performance to make the value contribution to the business visible for all stakeholders.

Maximize the Flash Steam Condenser Performance

The manufacturing plant's steam condensate recovery system was realized to be wasting a significant amount of energy due to flash steam generation and venting to the atmosphere. An investigation of the system revealed the HX used to capture this excess flash steam energy was not performing as designed. Several candidates for root cause have been identified, including steam trap failure, heat exchanger fouling, and excess flash steam loading as the primary candidates. Optimizing this steam heat recovery system will recover more of the available latent heat and condensate water, which can be utilized in preheating the incoming boiler makeup water and reducing the



natural gas usage, and overall utility expenses. The next step is to perform root-cause investigations into why these steam system conditions exist during the annual plant outage, and then take corrective actions, which could include things like cleaning, trap repairs, or adjustment of the process controls.

Improve Vapor-to-Steam Ratio Monitoring and Control

Ajinomoto uses several steam and water energy intensive unit operations in their evaporation processes. One of the efficiency performance metrics is vapor-to-steam ratio, which is an indicator of the efficiency of the evaporator's utilization of steam heat energy. The target of this project is to promote higher awareness and utilization of this asset's health metric. Higher vapor-to-steam ratio indicates more efficient water removal and lower energy usage and cost. The project began with reviewing the original equipment design data & evaluating past calculation methods. The intern identified any missing data or updated calculations necessary for accurate real-time monitoring.

The next step of this project will be creation of live dashboards that will enable stakeholders to monitor the vapor-to-steam ratio, as well as the energy and GHG impacts of this equipment. This will allow stakeholders to understand performance in real-time and adjust for maximum efficiency. It also will make this data more visible in the decision-making process to maximize efficiency, aligning with Ajinomoto's sustainability objectives.

AUSTIN LEE
SCHOOL: University of Wisconsin - Platteville
MAJOR: Mechanical Engineering

GRINNELL COLLEGE

COMPANY PROFILE:

Grinnell College is a liberal arts college located in Grinnell, Iowa, and hosts around 1,750 students and employs roughly 550 employees. The college offers 28 major degree programs with 17 concentrations. Common fields of study include social sciences, biology, and computer sciences. The main campus includes 120 acres and 63 buildings, 20 of which are residence halls. Grinnell College actively practices sustainability through LEED certified building construction, rainwater collection, and renewable energy usage.

PROJECT BACKGROUND

Grinnell College's dining service is proactive about collecting food waste from various sources such as kitchen preparations and post-consumer leftovers. The intern focused on exploring options to more efficiently collect data and document sources of food waste to guide future waste reduction projects. Disposal alternatives were also investigated to mitigate odor production.

The college's energy consumption fluctuates throughout the day resulting in high peak demand charges. The intern was tasked with finding opportunities to reduce the peak demand such as load shifting, efficiency updates, and dynamic building controls.

INCENTIVES TO CHANGE

The college created a sustainability plan in 2018 that outlined steps to move towards carbon neutrality by 2040. Recent projects such as adding a solar field and geothermal installations have made progress towards their goal.

Grinnell prioritizes landfill diversion through recycling and composting. Increasing allergy-free alternatives and more dining options have gradually increased food waste production. For this reason, continuing to meet their landfill diversion goals necessitates source reduction and an update to the current food waste collection system.

Recent billing structure changes have also incentivized Grinnell to reduce their peak demand for energy. Opportunities that reduce peak use have the appeal of both decreasing peak demand charges as well as overall energy consumption.

RESULTS

Food Waste Characterization Study

Food waste characterization studies are used to better understand the food waste production on campus and guide future waste reduction projects. However, the quantity of food waste data being collected was limiting waste reduction projects. Investing time into designing and conducting a thorough food waste characterization study will provide the information needed to evaluate source reduction opportunities.

Two types of food waste studies were designed to measure the waste produced across Grinnell's campus and document the contributing sources. The first food waste study considers all food waste streams across the campus to identify major contributors. This introduces measurements from sources that have not been tracked before. The second study evaluates

specific meals and is designed to be implemented regularly for continual improvement on campus. This allows the dining services to assess preparation processes, meal options, and student behavior. Data collection forms for each of the food waste studies were created by the intern. A dining manager will need to organize data collection and train employees on how to use the forms for successful implementation.

Sanitary Sewer Disposal

The campus currently collects food waste in a compacting container for weekly transportation to an industrial composter. Immediate disposal is an approach to eliminate odor production from food waste. A kitchen sink disposal system could be an effective alternative to reduce the volume of food waste and minimize transportation. Utilizing the sanitary sewer to transport food waste to the wastewater treatment plant combines the convenience of immediate disposal with the stewardship of aerobic digestion at the plant. This system streamlines the kitchen's process to increase reliability, reduce the labor involved for employees, and reduce operating expenses. Grinnell College will need to obtain an updated quote from a contractor for the installation of the sink disposal and plumbing.

Update Lighting to LED

LED updates are a straightforward way to increase the efficiency of building lighting. Three large gym spaces

currently utilize high bay, metal halide HID lamps. These spaces are open for various hours throughout the week, and the lights remain on during open hours. LEDs provide the value of reduced electrical consumption and greater control to quickly modulate brightness. This update was previously recommended by another intern; however, the technology was unproven at the time. LEDs have since become a staple in building lighting and have set the efficiency standard. A quote has been received from a contractor and installation is ready to begin upon approval.

Building Temperature Setback

The high-variable chiller load was determined to be a key contributor to the peak demand set point. Grinnell College's solar energy production aligns with the total energy consumption on campus; therefore, the daily peak often occurs sometime between 5:00 p.m. and 8:00 p.m. A building temperature control plan was developed to incorporate setbacks during this three-hour period to counter the peak demand. It strikes a balance between source reduction while maintaining comfort for the people on campus. Once the temperature ranges are approved, building control technicians on campus can adjust the temperature settings.

ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
FOOD WASTE CHARACTERIZATION STUDY	$6 PER $1 INVESTMENT	Reduced Food Waste and Operating Costs	RECOMMENDED
SANITARY SEWER DISPOSAL	$13,150	Reduced Operating Costs	RECOMMENDED
UPDATE LIGHTING TO LED	$21,248	194,106 kWh 506 kW	RECOMMENDED
BUILDING TEMPERATURE SETBACK	$8,655	17,616 kWh 388 kW	RECOMMENDED

TYLER CASEY

SCHOOL: St. Ambrose University
MAJOR: Mechanical Engineering and Mathematics

JBS SWIFT PORK

COMPANY PROFILE:

JBS is a Brazilian multinational company created in 1953, with more than 400 facilities spanning twenty different countries. JBS is the world's largest protein producer, with its subsidiary, JBS USA, being a leading producer of beef, pork, and poultry. The company operates five pork processing plants in the Midwest, including the one in Ottumwa, IA. The plant produces both pork and bacon, processing more than 21,000 hogs per day and employing more than 2,500 people.

PROJECT BACKGROUND

The primary project focus was to identify opportunities for solid waste reduction within the plant, with a priority placed on source reduction solutions for cardboard and plastic waste. Electricity use in the wastewater treatment plant was also analyzed, in order to develop cost effective energy efficiency solutions. Detailed baseline assessments were established for both projects and strategies for ongoing data collection were developed as part of the project deliverables.

INCENTIVES TO CHANGE

As the largest protein producer in the world, JBS is committed to sustainability within their own operations as well as the greater food production system. Due to the Ottumwa plant's sizable production operations, a reduction in the amount of solid waste generated and electricity used will generate a meaningful impact on their environmental footprint and carbon emissions, while reducing their overall consumption of natural resources.

RESULTS

Improved Waste Metrics

While overall landfill and recycling weight totals are tracked separately, having a more detailed breakdown of waste materials generated will allow for more targeted source reduction strategies. Three different tracking sheets were developed to track defective or damaged cardboard, plastics, and waste by department. The sheets will be piloted in designated departments and then their use expanded to other departments.

Optimize Placement of Pallet Rollers

Pallets of flat product box bundles are transported via sloped pallet rollers. The slope of one roller section is steep and pallets forcefully hit the stops at the bottom. This can cause the box stacks to either spill to the floor and be discarded, or misalign, which increases the potential for equipment jams. Reducing the rollers' slope will slow down the pallets and avoid cardboard losses. Maintenance will schedule a time to perform the approved modifications.

Case Erector Equipment Modifications

Case erectors are machines that assemble product boxes. They can jam easily if a box doesn't align properly when being discharged, resulting in damaged, unusable boxes. Adding a metal funnel to better guide boxes when discharged will prevent jams and reduce cardboard loss. Maintenance will install the funnel and adjust based on performance.

Reducing Combo Damage

JBS uses large, octagon-shaped cardboard containers called combos to transport bulk product. Combos are delivered in flat, banded bundles which are transported by forklifts. Any contamination or forklift damage causes combos to be rendered unusable. A multi-pronged solution to minimize losses includes the use of cardboard sheets and spacers between bundles to create better protection from forklift forks. Combo stacks will also only be stored two bundles high to improve the accuracy of forklift access. After operational changes are implemented, outcomes will be monitored by JBS staff.

Utilize In-House Product Bags

JBS purchases two types of plastic product bags for individual finished products. Each has design drawbacks that can lead to packaging rework and wasted bags. By

switching to an in-house bagging machine and making their own bags, JBS will have more control over the plastic feedstock and bag sizes, allowing for better product fit, less waste, and less rework. Further research will identify the optimal machine and bag thickness before installation.

Optimize Product Bag Size

In certain departments JBS creates custom product bags. Since bags can be sized to the product, less waste is generated. However, there is often not enough time to adjust bag sizes between product runs so a longer bag size is frequently used for all products. If employees pre-produce smaller bags during down time, bags and product sizes can be better matched, reducing excess plastic use. Employees will be trained on the new procedure before implementation.

Improved Collection Containers

An inventory of the production floor indicates there are not enough collection containers to capture recyclable cardboard and plastic. Additionally, employees sometimes use combos for waste collection out of convenience, which then must be landfilled with their contents. Expanding the number of permanent collection solutions for both solid waste and recyclables will create uniform practices and reduce unnecessary waste. After employee training, new containers will be acquired and implemented facility-wide.

Combos Redesign

Cardboard combos are designed to withstand heavy bulk product transport. Redesigning the current combo to use less cardboard, while retaining its current durability and performance, could lead to reduced cardboard generation. The redesigned combo will be tested in various internal production applications before next steps are determined.

Replace Wastewater Blowers

In the wastewater treatment plant, five air blowers are used to provide aeration to the aeration basin. They are manually controlled based on the measured levels of dissolved oxygen (DO) present. Replacing these with variable speed drive (VSD) blowers that are automated to respond to DO sensor readings will optimize blower run speeds, making the process more energy and labor efficient. After all system quotes are collected, JBS can submit for budget approval.

ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
IMPROVED WASTE METRICS	$8,240	120.4 tons mixed recyclables	IN PROGRESS
OPTIMIZE PLACEMENT OF PALLET ROLLERS	$14,085	5.3 tons cardboard	IN PROGRESS
CASE ERECTOR EQUIPMENT MODIFICATIONS	$15,301	11.4 tons cardboard	RECOMMENDED
REDUCING COMBO DAMAGE	$101,636	76 tons cardboard	IN PROGRESS
UTILIZE IN-HOUSE PRODUCT BAGS	$184,491	3.3 tons plastic	MORE RESEARCH NEEDED
OPTIMIZE PRODUCT BAG SIZE	$4,091	2.2 tons plastic	IN PROGRESS
IMPROVED COLLECTION CONTAINERS	$97,778	51 tons cardboard	IN PROGRESS
COMBOS REDESIGN	$316,800	225.7 tons cardboard	IN PROGRESS
REPLACE WASTEWATER BLOWERS	$114,913	1,531,237 kWh	RECOMMENDED

ZACH DIXON
SCHOOL: Iowa State University
MAJOR: Chemical Engineering

JBS USA, LLC

MARSHALLTOWN

COMPANY PROFILE:

JBS USA, LLC in Marshalltown, Iowa, is part of JBS USA, a leading American food company and a subsidiary of the global protein giant JBS S.A., headquartered in Brazil. The Marshalltown plant is a pork processing facility, distribution center, and warehouse that delivers pork products to brands such as Swift® and La Herencia™. It runs 24/7 on three shifts: two production and one sanitation. It employs more than 2,400 team members and processes more than 5 million hogs annually.

PROJECT BACKGROUND

Pork processing is a water-intensive process. JBS requested a P2 intern to identify opportunities for water optimization and reduction in their process operations. The project focused on analyzing opportunities to reduce water usage, improve process efficiencies, and reuse water. First, the intern completed a comprehensive baseline for the large water users in the plant to determine flow rates and opportunities for optimization. Next, the intern ran a cost analysis on the procurement and treatment of water as it entered and exited the plant. Finally, the intern analyzed opportunities and made recommendations with favorable financial paybacks.

INCENTIVES TO CHANGE

JBS is striving to set the food industry standard for profitable and sustainable food production for a growing planet. Efficient water use is a key pillar of their sustainability plan. They have established a corporate goal of reducing water usage by 30 percent by 2030, as compared to each JBS plant's 2019 baseline. Additionally, the Marshalltown plant seeks to minimize their tracked water metric of gallons of water used per hog processed. The value of reducing water usage also lies in the high costs associated with water use and treatment.

Reducing water consumption will conserve water resources, lower energy demands, and ultimately reduce the plant's environmental footprint.

RESULTS

Bone Crusher Cooling Water Reduction

The ham boning line sends hams to a bone crusher, which breaks the bones into smaller pieces before a second machine separates the meat from the bones. Both machines require water to cool their oil tanks, which is done via a water line that uses a T-valve to supply separate cooling lines to each. The valve on the main line is always fully open to ensure both units receive sufficient water, but the resulting supply to each machine exceeds their needed individual flow rates. Replacing the current T-valve cooling flow feed with a single hose line that can cool both pieces of equipment will allow for better optimization of cooling water usage. The second piece of equipment requires more cooling water than the first, so the flow can be set to meet its higher requirements. The water temperature will be sufficient to successfully cool both pieces. Installation of a flow control valve will ensure the optimal flow rate is not exceeded. Internal maintenance staff will be able to implement this change upon management approval.

Singer Cooling Line Modifications

During production the hogs are carried on a rail system and pass through singers that remove surface contaminants and any remaining hair before processing. Due to the high temperatures above the singers, there are tanks above the rails that supply a constant flow of cooling water to prevent the metal from deforming. However, with the supply tank resting above the rail, the cooling process is not as effective as possible, resulting in excess water being required. It is recommended that the current system be replaced with an I-beam, air blowers, shields, and a single water line. An I-beam will allow the cooling water

line to run directly on the rail itself, providing more direct cooling. Furthermore, shields on the open ends of each singer would prevent heat losses, and three blowers would cool each shield as well as the I-beam. The cooling effect of air would also reduce the demand for cooling water, thus reducing water consumption. After management approval, contractors can be hired to remove the current water tank structure and replace it with the suggested equipment and supplies.

Non-Production Water Shutoff

The singers have a cooling line where water constantly flows, also feeding a rinse cabinet downstream. During non-production times, both units are typically left running, consuming excess water. Assigning specific workers the responsibility of shutting down water flow before leaving the area during these times will provide better flow control. Further, assigning specific supervisors the task of verifying the water has been shut off will ensure accountability to the new process. Ultimately, this implementation affords the plant significant water savings while granting immediate financial payback.

Additional Water Submetering

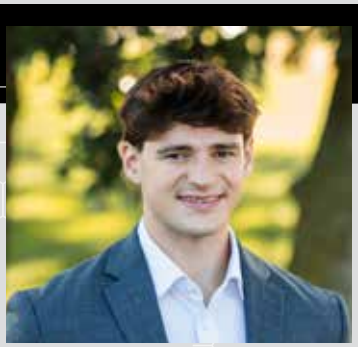
Within each department of the plant, real-time flow meters

measure flow rate and consumption, enabling operators and managers to monitor and adjust water usage throughout the facility. Investing in water submetering is crucial for optimizing water use, as it allows facilities to track and record process-specific data over time, helping to identify issues like leaks or unnecessary waste. Several widely cited studies highlight that submetering can yield up to 5 percent of utility savings for a facility. This data can guide management, operational, and investment decisions regarding plant areas where utility use is metered. Strategically implementing these water flow meters provides management oversight and promotes water conservation.

Given these benefits, it is recommended that additional water submetering be implemented in specific areas of the plant including the scald tank, the wash cabinet, pan table sprays, and the singer cooling line. Upon approval, JBS can work with their existing metering vendor to purchase and install the additional units.

ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
BONE CRUSHER COOLING WATER REDUCTION	$40,009	4,909,086 gallons	RECOMMENDED
SINGER COOLING LINE MODIFICATIONS	$21,024	8,406,972 gallons	RECOMMENDED
NON-PRODUCTION WATER SHUTOFF	$43,987	8,625,043 gallons	RECOMMENDED
ADDITIONAL WATER SUBMETERING	$1,862	433,112 gallons	RECOMMENDED



MICHAEL MAGGIO

SCHOOL: The University of Iowa
MAJOR: Chemical Engineering

KEMIN INDUSTRIES

DES MOINES

COMPANY PROFILE:

Kemin Industries is a global ingredient manufacturer headquartered in Des Moines, Iowa, serving the human and animal nutrition, food technologies, crop technologies, and textile industries. Founded in 1961, the company has grown into a bioscience powerhouse with more than 15 manufacturing facilities and a presence in more than 90 countries. Kemin produces more than 500 specialty ingredients and impacts an estimated four billion people daily. Known for its scientific innovation and commitment to sustainability, Kemin is investing heavily in research and environmental initiatives, with a goal to sustainably improve the quality of life for 80 percent of the world's population by 2042.

PROJECT BACKGROUND

Kemin's Des Moines campus, specifically Building #3, was the focus of this internship due to its high-water consumption and wastewater generation. The project aimed to identify opportunities for reducing water use, improving wastewater treatment efficiency, and repurposing water streams. Primary systems studied included the Clean-In-Place (CIP) system used in Slendesta production, the reverse osmosis water purification system, and the wastewater stream generated during Lutein and Zeaxanthin extraction. The intern was responsible for mapping utility baselines, identifying inefficiencies, conducting cost and environmental impact analyses, and developing recommendations that aligned with Kemin's operational and sustainability goals.

INCENTIVES TO CHANGE

Kemin's primary incentives for environmental improvement stem from both internal and external drivers. Internally, the company has pledged to reach net-zero greenhouse gas emissions by 2050. Operational inefficiencies, particularly in water use and off-site wastewater treatment, presented opportunities for cost savings and sustainability alignment. Externally, regulatory compliance and evolving customer expectations around environmental responsibility are compelling action. Rising utility costs, transportation-related emissions, and increased scrutiny from clients in the nutrition and health industries made this project a high priority. These factors combined to support investment in practical and scalable pollution prevention strategies across Building #3.

RESULTS

Clean-In-Place (CIP) Optimization

The first recommendation focuses on optimizing the CIP system used to clean equipment in the production of Slendesta. This automated system runs multi-step sequences—

including rinses, caustic and acid washes, and sanitizing stages—to ensure proper sanitation between production batches. Each sequence contains 40 to 70 steps and uses large volumes of city water, especially during rinse stages. Because the system was recently installed and initially programmed under tight time constraints, it is likely the needed duration and flow rate of many steps was overestimated.

To reduce water usage, each step was documented then particular steps were identified that could be shortened or modified. For example, in one of the sequences, unnecessary flow was occurring during drain steps. Fixing this error saved 240 gallons per cleaning cycle. Since Slendesta is produced multiple times per week, this single correction yields an annual water savings of approximately 28,800 gallons. Because the changes required no capital investment, Kemin immediately benefitted from not purchasing the excess water. Additional rinse time reductions are under evaluation using a simple operator log which tracks whether each modified sequence passes post-cleaning swab tests. This low-cost, iterative approach allows the CIP system to maintain cleaning effectiveness while reducing water usage over time.

Treating Wastewater with a Dissolved Air Flotation (DAF) System

The second recommendation is the installation of a DAF system to treat wastewater from Lutein (Lu) and Zeaxanthin (Ze) production on-site. Currently, all wastewater from these processes is adjusted for temperature and pH, then hauled off-site to the Des Moines Wastewater Reclamation Authority (DMWRA) for treatment. This method costs Kemin a considerable amount of money, considering treatment fees, fuel costs, and monthly service charges. A DAF system would allow Kemin to process this wastewater on-site by removing suspended solids and plant pigments that prevent the water from being discharged to the sanitary sewer. DAF systems use coagulation, flocculation, and air bubbles to float contaminants to the surface for removal as sludge. The clarified water can then be safely discharged to a sanitary drain.

This solution is well suited to the Lu/Ze wastewater, which contains organic residues and pigments from marigold

extracts. While Kemin previously used a Bubble Accelerated Flotation (BAF) system, it was decommissioned due to chemical-related maintenance issues. Today's DAF systems use more stable chemistries and improved automation, making them a more reliable option. Preliminary estimates suggest that the DAF system would reduce off-site treatment needs by 80 percent, and reduce the cost of annual treatment by nearly two-thirds. Accounting for electricity use and chemical costs, the system would still yield substantial annual savings. To reduce risk, Kemin plans to rent the unit for two months with a portion of the rental cost being applied toward purchase. The DAF system will still generate sludge requiring off-site treatment, but this volume is significantly smaller, enabling monthly rather than daily hauls. The result is a major reduction in transportation-related fuel consumption, carbon emissions, and disposal costs.

Together, these two recommendations provide a powerful combination of cost savings and environmental impact reduction. The CIP optimization is a no-cost solution that immediately reduces city water consumption, while the DAF system offers a long-term strategy to minimize wastewater treatment costs and emissions. Both projects directly support Kemin's environmental goals and long-term sustainability commitments.

ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
CLEAN-IN-PLACE OPTIMIZATION	$422	468,000 gallons	IN PROGRESS
TREATING WASTEWATER WITH A DISSOLVED AIR FLOTATION (DAF) SYSTEM	$290,435	16,000 tons CO2	RECOMMENDED

POLLUTION PREVENTION: STUDENT APPLICATIONS

STUDENTS! Join the P2 Intern Program in 2026!

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

- ☐ Application Form
- ☐ Résumé
- ☐ Unofficial copy of transcripts
- ☐ List of Fall 2025 and Spring 2026 classes
- ☐ Cover Letter (optional)

Selection of 2026 interns will begin in January and continue into the spring until project assignments are finalized.

Pollution Prevention Services is offering internships for 12-weeks (May 18-August 7) or co-ops for 28-weeks (May 18-November 27) in 2026.

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

Application forms are available online at: CyHire, Handshake, or www.iowap2interns.com

The Iowa Department of Natural Resources is an EEO/AA Employer

» SUBMIT APPLICATIONS TO:

Online through CyHire or Handshake

P2Services@dnr.iowa.gov

(515) 322-9815

POLLUTION PREVENTION SERVICES SERVES IOWA COMPANIES

Since 1990, hundreds of Iowa businesses, industries, institutions and governmental agencies have saved money, improved operational efficiency, and become environmental leaders by working with DNR's Pollution Prevention (P2) Services.

Our team of technical engineers provide no-cost, confidential, non-regulatory assistance to facility operators. Opportunities are identified that can improve your company or organization's bottom line while making positive environmental impacts.

Our services include:

ASSESSMENTS

OPPORTUNITY ASSESSMENT: Site visits identify potential areas for pollution prevention.

FOCUSED ASSESSMENT: In-depth analysis of a single process or media within a facility.

THERMOGRAPHIC ASSESSMENT: Infrared cameras spot inefficiencies in structures and systems.

Our team provides a detailed report on waste reduction and pollution prevention strategies, support for implementation, and help in applying for EPA recognition programs. Areas of focus include energy efficiency, solid and hazardous waste reduction, and water conservation.

TECHNICAL SUPPORT AND RESOURCES

P2 RESOURCE LIBRARY: Access a digital library of best practices and new technologies.

TECHNICAL ASSISTANCE: Get answers to your queries in-person, over the phone, or by email.

EQUIPMENT LOAN PROGRAM: Pollution Prevention Services has several pieces of monitoring equipment that are available to companies to assist in data collection to further their pollution prevention initiatives. For more information, visit www.iowap2services.com.

PURE: Our online training modules show how to apply P2 to various process systems.

P2 INTERN PROGRAM

We hire engineering students to conduct assessments and research solutions. They establish usage baselines and quantify benefits of system improvements. Our intern program has facilitated more than $122.2 million in savings for companies looking to meet environmental goals while providing valuable experience for students.

ENVIRONMENTAL MANAGEMENT SYSTEM (EMS) SUPPORT

An EMS offers a structured way to manage environmental responsibilities. Our confidential, technical assistance helps with EMS development and continuous improvement.

WORKSHOPS

Our workshops and webinars facilitate the sharing of best management practices and new technologies, focusing on topics like water conservation, energy efficiency, and waste management. They provide critical insights to lower costs and reduce environmental footprints.

2025 PROJECT INDEX

POLLUTION PREVENTION INTERN PROGRAM

BOILER EFFICIENCY/STEAM SYSTEM

- Ajinomoto Health & Nutrition North America, Inc. (2025)

ENERGY REDUCTION

- Ajinomoto Health & Nutrition North America, Inc. (2024)
- Ajinomoto Health & Nutrition North America, Inc. (2025)
- Grinnell College
- JBS Swift Pork

HVAC EFFICIENCY

- Grinnell College

LIGHTING

- Grinnell College

ORGANIC WASTE MANAGEMENT

- Grinnell College

PROCESS IMPROVEMENT

- Ajinomoto Health & Nutrition North America, Inc. (2024)
- Grinnell College
- JBS Swift Pork
- JBS USA, LLC
- Kemin Industries

SOLID WASTE MANAGEMENT

- JBS Swift Pork

WASTEWATER

- JBS Swift Pork
- Kemin Industries

WATER USE REDUCTION

- Ajinomoto Health & Nutrition North America, Inc. (2024)
- Grinnell College
- JBS USA, LLC

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