

SHOWCASE 2024

A hybrid event highlighting
senior design projects and
student achievements

MICHIGAN STATE
UNIVERSITY

Department of Biosystems
and Agricultural Engineering



The Biosystems Engineering (BE) Showcase is a long-standing highlight of the BE calendar. The day consists of three different types of presentations by each project team – poster presentations at Design Day, in-depth design review sessions with our Industry Advisory Board members, and brief public presentations of their overall design results. Showcase brings together the entire BE community – student teams, project clients, our Industry Advisory Board, faculty, other BE students, and friends and family – to get a brief glimpse of the final design reports from these real-world, client-sponsored projects.

Congratulations to all the students for the results of their creative and diligent efforts. Also, special thanks go to Drs. Luke Reese and Sang Jeong for managing senior design and the diversity of projects, as Dr. Jeong joined as a new member of the instructional team this year. Lastly, thanks to all the faculty advisors of the project teams, to the project clients for supporting our program, and to our Industry Advisory Board – whose expert insights, support, and evaluation of the projects are always impactful, in terms of both student learning and our overall program success and continuous improvement process.

Bradley Marks, Ph.D., P.E.

Professor and Department Chair

BE Senior Design is a unique, two-semester experience that prepares students for successful careers solving challenging problems in food, energy, environment and health. In Senior Design, teams of three to five students are paired with real-world clients to work on an actual issue the client is facing. With the help of a BE faculty mentor, these teams work with their client to come up with a solution for the problem using the technical knowledge they've accumulated during their time at MSU. Students also develop skills in teamwork, project management and communication.



The nature of the two-semester structure allows students to take a deeper dive into a project and establish a stronger relationship with their team and client, similar to an industrial co-op. The extended time on the project allows the students to become more knowledgeable about the specific problem and solutions they're working to address. In addition, students experience a more realistic ebb and flow of team and client dynamics that prepare them for the start of their professional career. As an instructor, there's nothing better than seeing your students' hard work come to fruition. It's always exciting when our Senior Design students see their work implemented by clients – and sometimes, receive job offers from them. We're honored to lead this course and eager to share all of the hard work our students have put into their projects over the course of this year.

*Sanghyup Jeong,
Ph.D., P.E.*

Assistant Professor

Luke Reese, Ph.D.
Associate Professor



(L to R) Ryan Heileman, Liliana Valkner, Guy Sloan, & Andrew Hovey

A Networked Geothermal Energy System for Residential and Industrial Consumption: Design and Analysis

Team Consumers Energy

Sponsor: Consumers Energy (project under Non-Disclosure Agreement)

Faculty Advisor: Dr. Chris Saffron

Consumers Energy has sponsored an MSU BE senior design project to explore the feasibility of geothermal energy within Michigan to reach their company goal of net zero greenhouse gas emissions by 2050. The team's final deliverable is a model that shows the economic, environmental, and design requirements for a networked geothermal energy system. The geothermal system will utilize the existing right-of-way to house a piping network that will provide heating and cooling for 32 homes and one industrial facility in Ingham County. Consistent subsurface temperatures of 55°F enable a reversible heat pump to provide heating during winter months and cooling during summer months. Results show a system installment to have a capital cost of \$2.5 million and a levelized cost of energy of \$48/mmBTU. By eliminating the use of natural gas for heating, Consumers Energy's greenhouse gas emissions could be reduced by approximately 80%.



(L to R) Victoria Loomis, Josephine Dukaj, Sydney Richter, & Bilal Sabri

Brine Reduction in Continuous Corned Beef Processing

Team Grobbel

Sponsor: E.W. Grobbel (project under Non-Disclosure Agreement)

Faculty Advisor: Dr. Kirk Dolan

Grobbel desires to reduce purge from 10% to 5% in packaged corned beef products from their Institutional Continuous process line. Purge is the reddish-colored liquid that accumulates at the bottom of packaged meat products. While purge does not affect the meat quality or safety, it has an undesirable perception in the customer's eye. The team's final design extended the system's press conveyor to help remove additional liquid not retained by the product. The team replaced the current vibratory and press conveyor with a 10 ft long conveyor containing (15) 6 in diameter rollers. The modified system will have a one-time capital cost of \$59,000 and will save the company \$60,000 per year in labor. The design reduces purge while maintaining current throughput.



(L to R) Zach Ostoin, Megan Kline, Jack Kujawski, & Ben Adams

Ford Cove Shoreline Stabilization and Restoration

Team R³

Sponsor: GEI

Faculty Advisor: Dr. Pouyan Nejadhashemi

Team R³ worked with GEI Consultants to redesign 2,200 feet of lakeward shoreline of the Ford House Estate on Lake St. Clair. The shoreline is currently hardened with concrete riprap, which provides wave energy protection and mitigates erosion, but also disrupts the ecosystem and destroys nearshore habitat. The team developed a design that includes offshore breakwaters and onshore bioengineering techniques to reduce the cumulative wave energy on the shoreline by 50%. The cost-effective design restores and enhances the habitat for native flora and fauna while stabilizing the shoreline, under the \$3M budget.



(L to R) Carter Monson, Arthur Devota, Skyleer Benczarski, & Nicole Lambert

Regulatory Feed Sampling Process and Ergonomics Improvement

Team S.L.U.D.G.E

Sponsor: Glanbia Nutritionals (project under Non-Disclosure Agreement)

Faculty Advisor: Dr. Wei Liao, PE

Glanbia Nutritionals utilizes an upflow anaerobic sludge blanket (UASB) digester to digest solids into biogas within its wastewater treatment plant, which cleans its water and limits solid waste.

The team has been called on to inspect the digester and perform a mass balance to identify accumulation. The team collected samples over 5 months and then performed statistical analysis on the samples. Based on the results of the mass balance, the team created a management plan for Glanbia to use to maintain the efficiency of their digester.



(L to R) Lillian Bieszke, Xheneta Vitija, Emily Buijink, & Kaily Kao

Medical Device Irrigation System Innovations

Team Stryker

Sponsor: Stryker (project under Non-Disclosure Agreement)

Faculty Advisor: Dr. Ilce Medina Meza

The Sonopet iQ[®] is an ultrasonic aspirator used in spinal and neurological surgeries to resect tissue and bone. Saline is used to cool the device, provide lubrication, and irrigate the surgical site. Currently, there is no system to warn medical personnel that the saline bag is empty. If the saline bag empties during surgery, the device can heat up and potentially damage non-target tissue. To minimize this, a pump revolution counter system was developed to warn hospital personnel when there is ~100 mL of saline remaining. The total amount of saline remaining can be calculated if the volume output per pump rotation is known. A preventative warning system was developed using a single-board microcomputer to demonstrate proof of this concept. The warning system features an audio alert along with an LCD screen pop-up. Testing was also performed for this proof-of-concept prototype to determine the average error of ~6.7%.



(L to R) Christian Loveall, Braden Heimbaugh, Syd Jacobi, & Sydney Thompson

In Vitro Growth Chamber for Imported Chestnut Tissue

Team Chestnut Crew

Sponsor: Nash Nurseries

Faculty Advisor: Dr. Yuzhen Lu & Dr. Dan Guyer

The Chestnut Crew designed a modular system for growing stage II and III in vitro chestnut tissue in shipping containers that Nash Nurseries will use to revitalize the domestic chestnut industry by raising and selling chestnut cuttings imported from Spain. They estimate that growing enough trees to support the current rate of consumption would produce \$40 million in revenue. Fragile in vitro plants must be grown in precise conditions to ensure success. This system uses shelving unit microenvironments to control temperature, humidity, air flow, and lighting within 5% of design values. These parameters are automated to reduce labor requirements. This system aims to reduce startup costs by more than 72% compared to currently available systems and can house 10,000 plants at a time.



(L to R) Vianney Medina-Gonzalez, Jordan Sheely, Erynn Brantley-Ridgeway, & Nathan Schrier

Ergonomic Sampling Tool to Obtain Bulk Feed Samples Safely

Team MDARD

Sponsor: Michigan Department of Agriculture and Rural Development (MDARD)

Faculty Advisor: Dr. Daniel Uyeh & Dr. Tim Harrigan

The Michigan Department of Agriculture and Rural Development (MDARD) oversees feed safety and nutrition. Distribution of these feeds has shifted to bulk deliveries, making MDARD need a new system to collect samples. A tool allowing sampling from the ground and catwalks was developed with ergonomic considerations. The tool consists of a vertical and horizontal portion that meet at a 90° elbow. The vertical portion is made of two identical 4.66 ft long aluminum rods, allowing the tool to reach above trucks from the ground. The horizontal portion holds the sampling cup on the end, which will reach under the hopper to collect feed. A backup camera was mounted on the horizontal portion to give inspectors a view of the sampling cup. The tool uses universal connections between its components which allows the cup to be attached to the horizontal segments for catwalk sampling.



(L to R) Alexis Sawicki, MeiLi Papa, Jensen Tumas, & Matthew DeMartini

Curd Feed Rate Optimization for Improved Cheese Consistency and Operational Efficiency

Team Cheddar Masters

Sponsor: Tillamook (project under Non-Disclosure Agreement)

Faculty Advisor: Dr. Jiyeon Yi and Dr. Bahar Aliakbarian

Tillamook is looking to improve the consistency and quality of cheese at their Boardman, Oregon plant. PH, salt, and moisture are key attributes used to characterize cheese. Maintaining these attributes is essential for product quality. Challenges exist in the Cheddar Master. Curd feed rate variation into the Cheddar Master affects curd bed height, resulting in lower quality cheese and impacting consumer and customer experience. The team designed sequential vat pump over and overlapping vat starts. A stepwise function that governs pump speed and cost analysis for the performance improvements was completed. These improvements result in an estimated 4% throughput increase in cheese curd production per vat, with a return on investment between 3 and 5 years.

The Advisory Board

The purpose of the Industry Advisory Board is to facilitate the exchange of ideas between Board members, faculty, and students of the BE program. Its function is to improve continuously the BE program quality by keeping it current and relevant to industry needs. Regular and adjunct board members also serve as external project evaluators.

Board

Janelle Barnes (Past Chair) ~ Target
Ellen Bornhorst, Ph.D. - PepsiCo
Holly Bowers ~ Consumers Energy
Jessica Bruin ~ Kellanova
Lisa Buchholz ~ Corteva Agriscience
Matt Burttt ~ AbbVie
Shelley Crawford ~ Jiffy
Michelle Crook, PE ~ MDNR
Linnea Crowley (Riddell) - Kellanova
Laura Doud, PE (Chair) ~ MDARD
Cassandra Edwards ~ Tillamook Creamery
Gene Ford ~ Standard Process
Jeremy Hoeh, PE ~ EGGLE
Eric Iversen, PE ~ PEA Group
Kevin Kowalk, PE ~ EA Engineering, Science, and
Technology (MI) PLC
Mitch Miller ~ General Mills-Yoplait
Amber Mostiller - E.W. Grobbel Sons, Inc
Steve Radke ~ John Bean Technologies (JBT)
Rob Yoder ~ BDI, Inc.
Dave Young - Perrigo, Inc

Ex-Officio

Todd Forbush, Techmark, Inc., (ASABE Rep)



If you are interested in sponsoring a BE 485/487 capstone project for the 2024_25 Senior Design teams, please contact Dr. Sanghyup Jeong, PE at jeongsa1@msu.edu or Dr. Luke Reese at reesel@msu.edu.

UNDERGRADUATE SCHOLARSHIPS

Agah Endowed Scholarship

The Agah Endowed Scholarship is awarded to students who look to make a difference as to how the world's food and water supplies are used, restored, and preserved.

F. W. Bakker-Arkema Endowed Scholarship

F.W. Bakker-Arkema was a professor of agricultural engineering at MSU for over 30 years. His scholarship recognizes students that contribute to the cultural and intellectual diversity of biosystems engineering through their leadership experiences.

A.W. Farrall Scholarship

The Farrall Scholarship is the most prestigious undergraduate scholarship awarded by the Department of Biosystems and Agricultural Engineering. It is named in honor of A.W. "Doc" Farrall, who chaired the department from 1945-1964 and helped establish the first agricultural engineering Ph.D. program in the nation. Farrall Scholars excel both academically and professionally, and are leaders in the biosystems engineering community.

DeBoer Family Scholarship

The DeBoer Family Scholarship is awarded to students who excel academically and demonstrate a passion for biosystems engineering

Carleton Scholarship

The Walter M. and Lillie M. Carleton endowed scholarship is awarded to students who excel in Biosystems Engineering. Dr. Walter Carleton was the recipient of the first PhD degree in the U.S. awarded in a standalone Agricultural Engineering department - in 1948 (now the Department of Biosystems and Agricultural Engineering). Dr. Carla Carleton, daughter of Walter and Lillie Carlton, and retired faculty member of the MSU College of Veterinary Medicine, was instrumental in establishing this fund in perpetuity. This is the first year awarding this scholarship.

Clarence and Thelma Hansen Scholarship

The Clarence and Thelma Hansen scholarship is awarded to Michigan natives and U.S. students who have demonstrated academic achievement, leadership, and experience working in agriculture.

George E. and Betty L. Merva Endowed Scholarship

Dr. George Merva was a faculty member in the Department of Biosystems and Agricultural Engineering for 30 years. This endowment, named in his and his wife's honor, recognizes upperclassmen who have demonstrated leadership and academic success.

Mynsberge Experiential Learning Scholarship

See Graduate Scholarships

John and Julianna Merva Endowed Scholarship

Dr. George Merva's father, John, was an immigrant from Slovakia, who, despite receiving no formal schooling and working full time in ore mines, was able to teach himself three languages. In this spirit, the John and Julianna Merva Scholarship is awarded to an undergraduate student who has balanced leadership and academic success, while also working to cover their educational expenses.

Howard F. and Esther L. McColly Scholarship

The Howard F. and Esther L. McColly Scholarship honors Dr. Howard McColly, who served on the faculty of the Department of Agricultural Engineering for more than 21 years, and his wife, Esther. The scholarship is awarded to students who have demonstrated academic achievement, leadership and service to the profession.

Michigan ASABE Section Scholarship

The Michigan Chapter of the American Society of Agricultural and Biological Engineers (ASABE) awards a scholarship to one college freshman and one college sophomore each year. Recipients must be registered as pre-professional members of ASABE.

FRESHMEN SCHOLARSHIPS

Robert J. Gustafson Scholarship

The Gustafson Scholarship is awarded to students with a high academic ability and/or financial need, with a first preference for incoming freshmen students.

Alfred & Mary Murray Scholarship

The Murray Scholarship is awarded to students with a high academic ability and/or financial need with a first preference for incoming freshmen students.

2023-2024 Undergraduate Scholarship Recipients

Agah Endowed Scholarship

Jaclyn Cool

F.W. Bakker-Arkema Endowed Scholarship

Ava Chavez
Alexis Sawicki
Amari Shelby
Xhenta Vitija

W & L Carleton Endowed Scholarship

Jocelyn Cayen

DeBoer Family Scholarship/Fellowship Fund

Janie Cooper
Sebastian Hawkes
Branden Heimbaugh
Syd Jacobi
Meli Papa
Justin Pecora
Mimi Tarter
Kate Wernicke

A.W. Farrall Scholarship

Ben Adams

Clarence & Thelma Hansen Scholarship

Sam Dougherty
Gillian Kuehnle

Howard & Esther McColly Scholarship

Nicholas Bray
Leah Jarmolowicz
Chloe Zaborneykline

George E. and Betty L. Merva Endowed Scholarship

Andrew Hovey

John and Julianna Merva Undergraduate

Sophia Spencer

George A. Mynsberge Experiential Learning Fund for Research

Christian Loveall

Jimmy Butts Memorial Scholarship (ASABE Michigan Section)

Leah Jarmolowicz - Freshman/
Sophomore
Benjamin Adams - Junior/Senior

2023-2024 Freshmen

F.W. Bakker-Arkema Endowed Scholarship

Dominic Lee
Claudia Suarez

Robert J. Gustafson Scholarship

Katie Grundel

Alfred & Mary Murray Scholarship

Joe (JP) Chinavare
Jake Crist
Rylie DuBois
Chase Moore
Carter Ostrowski
Megan Ransler
Kiera Tuttle
Leah Wilson



2023-2024 Graduate Scholarships

Outstanding BE Research Fellowship & Fitch H. Beach Award

The Outstanding BE Research Fellowship & Fitch H. Beach Award is presented to one of the top Ph.D. students in the BE graduate program who has excelled in research productivity, and whose work suggests a high-level of direct impact on society. The recipient represents at the college level against similar nominees from other disciplines in the College of Engineering. Funding is based on placement in the competition at the college level and is funded by the College of Engineering and the BAE Endowment for Graduate Studies.

Most Outstanding BE Graduate Student Fellowship

The Most Outstanding BE Graduate Student Fellowship is awarded to top students in the BE graduate program. It recognizes their recipients' breadth of excellence and direct and indirect contributions to the BAE Department through professional productivity, service to the department and university, and contributions to the extended community. This honor is funded by the BAE Endowment for Graduate Studies, which was from former and current BAE faculty and other donors wishing to support graduate education.

Galen & Ann Brown Scholarship

The Galen & Ann Brown Scholarship supports graduate students working in the engineering domains that can be related or applied to the fruit and/or vegetable industries, a field to which Dr. Galen Brown dedicated his career. This scholarship is funded by the family of Galen and Ann Brown and others who respected and/or worked with Galen.

Katherine & Merle Esmay Scholarship

The Katherine & Merle Esmay Scholarship supports international graduate students with a clear passion and plan to return to their home country to implement their knowledge gained through their MSU BAE degree. It is funded by the family of Merle and Katherine Esmay and others who have the passion to make a difference around the globe, like Merle did.

Mynsberge Experiential Learning Scholarship

Candidates for the Mynsberge Experiential Learning Scholarship must conduct experiential learning research/outreach in water resource recovery, water quality, and/or wastewater treatment. The selected student(s) will work with a BAE faculty member for the experiential learning experience. The award has an expectation that the student presents their experience at a research conference hosted by MSU or a professional society.

M. Kent Taylor Assistantship Fund

The M. Kent Taylor Assistantship Fund supports graduate students in the academic pursuit of alternative, sustainable energy technologies to reduce the carbon load on the atmosphere and oceans.

Graduate Scholarship Recipients

College of Engineering Outstanding BE Graduate Student Fellowship

Carly Gomez

Outstanding BE Research Fellowship & Fitch H. Beach Award

Saad Sharief

Galen & Ann Brown Scholarship

Narindra Randriamiarintosa

Katherine and Merle L. Esmay Fellowship

Babak Dialameh

Mynsberge Experiential Learning Scholarship

Hoda Razavi (working with Dr. Nejadhashemi)

M. Kent Taylor Assistantship Fund

Gregory Rouland

Interested in supporting scholarships for Spartan biosystems engineers?

[Click here](#) to make a donation.

About the MSU Biosystems Engineering Program

BE graduates are expected to succeed in diverse careers where they integrate and apply principles of engineering and biology to globally important problems in food, energy, environment and health. This success is attained through a curriculum that focuses on:

- Identifying and solving problems at the interface of biology and engineering, using modern engineering techniques and systems approaches.
- Analyzing, designing, and controlling components, systems and processes that involve critical biological components.
- Demonstrating vision, adaptability, creativity and a practical mindset when solving problems.
- Developing communication skills for technical and non-technical audiences.
- Working with diverse, cross-disciplinary teams.
- Integrating sustainability into all facets of biosystems engineering.
- The importance of continued professional growth and ethical conduct.

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***Full descriptions and project posters are at:
www.canr.msu.edu/bae/senior-design-2024***

