

MINUTES OF THE MEETING
OF THE
MICHIGAN STATE UNIVERSITY
BOARD OF TRUSTEES

September 8, 2017

President Simon called the meeting of the Board of Trustees to order at 9:30 a.m. in the Board Room.

Trustees present: Brian Breslin, Dianne Byrum, Joel Ferguson, Melanie Foster, Dan Kelly, Mitch Lyons, and Brian Mosallam.

Trustee absent: George Perles.

University officers present: President Simon, Provost and Executive Vice President Youatt, Executive Vice President Udpa, Vice President and Secretary Beekman, Vice President and General Counsel Noto, Vice Presidents Burnham, Gore, Groves, Haas, Hsu, Maybank, and Swain, and Senior Advisor and Director Granberry Russell. Faculty liaisons present: Rob LaDuca, Richard Miksicek, Deborah Moriarty, Thomas Tomlinson, and Ned Watts. Student liaisons present: Lauren Bernhardt, Ashley Fuente, Malik Hall, and Lorenzo Santavicca.

All actions taken were by unanimous vote of the Trustees present, unless otherwise noted.

1. On a motion by Trustee Kelly, supported by Trustee Mosallam, the **BOARD VOTED to approve** the agenda.
2. On a motion by Trustee Mosallam, supported by Trustee Kelly, the **BOARD VOTED to approve** the minutes of the June 21, 2017 and July 13, 2017 Board of Trustees meetings.
3. President's Report

President Simon provided the following report to the Board.

A. Opening of Academic Year

With more than 8,000 first-year students arriving on campus August 27, MSU's Class of 2021 will be one of the largest planned freshman cohorts in University history. MSU met its goal to recruit 8,000 new students, and this year's class is the product of approximately 36,000 freshman applications from students wanting to attend MSU.

Provost Youatt said that MSU currently has students from every county in Michigan, every state in the United States, and 97 countries. She also spoke briefly about the new Counseling and Psychiatric Services (CAPS) unit. Provost Youatt introduced Thomas Jeitschko, Dean of the Graduate School, and Kristen Renn, Associate Dean of Undergraduate Studies.

Dean Jeitschko commented on activities for incoming graduate students, including a Teaching Assistant orientation as well as the summer research opportunity program for students from underrepresented backgrounds.

Dean Renn stated that four main themes will be emphasized, all of which focus on increasing graduation rates and closing opportunity gaps across demographic groups. Spartan Pathways will center on how students get to MSU and make their way through the curriculum and into majors. Spartan Community focuses on inclusion, equity, and diversity. Spartan Identity concentrates on how students understand themselves intellectually as a community of Spartans. Go Green Go 15 is focused on helping students get a successful start.

Vice President Gore made brief comments about the success of this year's fall move-in and presented a video.

Vice President Maybank spoke about some Fall Welcome 2017 activities, including the COGS cookout, a luau themed pool party, Convocation, Sparticulation, Spartan Spectacular, and Spartan Remix.

B. University Achievements

Money magazine has named MSU number 30 on the list of "711 Best Colleges for Your Money." With a graduation rate of 77 percent and the average salary within five years at \$50,000, MSU landed in the top 1.5 percent of colleges considered for the ranking.

The National Research Center for College & University Admissions, a leading provider of data and analytics solutions to public and private colleges and universities, announced MSU as a winner of the Eduventures 2017 Innovation Award. The award is given to institutions that have excelled at creating innovative programs that yield tremendous results for their colleges and universities.

C. Faculty and Staff Achievements

Vice President Gore received the 2017 Association of College and University Housing Officers International Parthenon Award. The Parthenon award is the Foundation's most prestigious award and recognizes an individual within the collegiate housing profession for service, leadership, achievement and contributions to the housing field.

An MSU Press publication has been recognized for recognition in the newly released American Book Award list. The MSU Press winner is Brian D. McInnes' *Sounding Thunder: The Stories of Francis Pegahmagabow*.

D. Athletics

Former MSU basketball coach Jud Heathcote passed away August 28 at the age of 90 in Spokane, Washington. Jud coached the Michigan State men's basketball team from 1976-95, guiding the Spartans to 340 victories, three Big Ten titles, nine NCAA Tournament berths, and one national title during his 19 seasons in East Lansing. Heathcote is the second-winningest coach in MSU history.

E. Sustainability Report

Dan Bollman, Associate Vice President for Infrastructure Planning & Facilities, presented the Sustainability Report. (Appendix A)

F. Capital Campaign Announcement

President Simon made an announcement about the capital campaign and funds raised.

The *Empower Extraordinary* campaign has been an extraordinary success since it began July 1, 2011. The University has surpassed its initial goal of \$1.5 billion, 16 months ahead of schedule. More than 230,000 donors have contributed to the campaign. Every gift has made a difference. In fact, 86 percent of donors to *Empower Extraordinary* have given gifts of less than \$1,000.

President Simon thanked the more than 10,000 faculty, staff, and retirees who have collectively given more than \$99.4 million to the

campaign. This amount of faculty and staff giving is the highest in the Big Ten and fourth largest in the AAU peer set.

MSU has made significant progress in each of the major campaign priorities. For example, more than 1,200 scholarships have been created, providing more than \$398 million in endowed and expendable funds for financial aid and nearly \$22.6 million in support for experiential learning opportunities. MSU has been able to create 71 new endowed positions toward the campaign goal of 100. Since the launch of the campaign, more than \$622 million in new commitments have been directed to MSU endowments. The combined value of MSU's endowment and the endowment of the MSU Foundation exceeded \$3 billion as of June 30, 2017. MSU's endowment, once the smallest in the Big Ten, is now the sixth largest.

During the 2017 fiscal year, donors contributed more than \$255 million to MSU, making it the second year in a row that gifts to MSU surpassed a quarter billion dollars. MSU fundraising has been on the rise since the start of the campaign. Fiscal Year 2016 was the most successful fundraising year in the University's history, with \$272 million raised. That success followed record-breaking years of \$238 million raised in each of the 2014 and 2015 fiscal years. To put those numbers in perspective, before the last campaign that concluded in 2007, MSU raised about \$70 million in private funds each year.

Every year some of the gifts received come in the form of pledges and charitable estate commitments. This year the portion of actual dollars received was more than \$200.8 million, the highest amount to date. Throughout the campaign, that number has steadily grown by an average of more than 12 percent each year. Today, \$1.01 billion in campaign gifts have been received and put to use at MSU. This success would not have been possible without the strong support of our volunteers; more than 300 volunteers are serving on college boards, regional committees, and the Campaign Cabinet. Representing the campaign volunteer leadership are the campaign co-chairs: Trustee Emerita Cook, a 1954 graduate of the College of Communication Arts and Sciences, and Bob Skandalaris, a 1974 graduate of the College of Business, entrepreneur and philanthropist. President Simon thanked Ms. Cook and Mr. Skandalaris for their personal generosity and leadership.

Trustee Emerita Cook spoke of the campaign's success and thanked the volunteers.

President Simon noted that the MSUFCU has helped MSU surpass the \$1.5 billion goal. Its \$5.5 million gift is the one that put MSU over the top. The gift will be paid over five years and places MSUFCU among MSU's top 20 donors, the largest in Mid-Michigan. Once the gift commitment is completed, the cumulative charitable support for MSU from MSUFCU will total nearly \$20 million.

The gift today is MSUFCU's second in the campaign. A previous \$3 million gift, made during the silent phase of the campaign in 2013, created three new endowments: the MSUFCU Broadway Series at Wharton Center, the MSUFCU Jazz Studies Visiting Artist program, and the MSUFCU Artist Studio Series at the Broad MSU.

This new gift is set to unleash some of the best ideas MSU has to offer to benefit individuals throughout Michigan. The areas supported are some of the most public-friendly at the University, including the Broad Art Museum, Wharton Center for Performing Arts, and WKAR, as well as six colleges and the first Science Gallery Lab program in the United States.

In addition to its major campaign commitments, MSUFCU has a positive impact on the MSU community through annual charitable support averaging \$700,000 each year for programs across the University. A portion of the \$5.5 million gift commitment includes a realignment of some of the MSUFCU's annual support.

April Clobes, President and Chief Executive Officer of MSUFCU, presented President Simon and the Board of Trustees with the \$5.5 million check.

President Simon noted that, in an act that is symbolic of the campaign's progress, the University would that afternoon officially break ground on the Business Pavilion, destined to be a new focal point for the Broad College. The project, launched with a gift from philanthropist and MSU alumnus Eli Broad and his wife Edythe, will be funded entirely through philanthropy. This is one of four key projects on which MSU will focus as the campaign continues.

4. There was no Public Participation on Issues Germane to the Agenda.
5. Personnel Actions

Provost Youatt presented the following personnel actions:

Gondro, Cedric, AY – Professor, Department of Animal Science, \$156,000, with Tenure, effective September 12, 2017.

Gordon, Marcia, AY – Professor, Department of Translational Science & Molecular Medicine, \$160,000, with Tenure, effective November 1, 2017.

Haddad, Nicholas, AY – Professor, Department of Integrative Biology, \$190,000, with Tenure, effective August 16, 2017.

Hine, Darlene, AY – Hannah Professor, Department of History, \$300,000, with Tenure, effective August 16, 2017.

Jiang, Jiming, AY– MSU Foundation Professor, Department of Plant Biology and Department of Horticulture, \$195,000, with Tenure, effective August 16, 2017.

Leon, Sharon, AY– Associate Professor, Department of History, \$90,000, with Tenure, effective August 16, 2017.

MacKeigan, Jeffrey, AY– Professor, Department of Obstetrics, Gynecology & Reproductive Biology, \$180,000, with Tenure, effective August 16, 2017.

Morgan, David, AY– Professor, Department of Translational Science & Molecular Medicine, \$180,000, with Tenure, effective November 1, 2017.

Ruegg, Pamela, AN– Professor, Department of Animal Science, \$210,000, with Tenure, effective January 22, 2018.

Zinn, Kurt, AY– Professor, Department of Radiology, Department of Biomedical Engineering, and Institute for Quantitative Health, Science and Engineering, \$185,000, with Tenure, effective August 16, 2017.

Trustee Byrum moved to approve the recommendations, with support from Trustee Foster.

THE BOARD VOTED to approve the resolution.

Provost Youatt also presented the following personnel actions:

Jeitschko, Thomas, AN – Associate Dean, College of Social Science; Professor, Department of Economics, is changing title to Associate Provost for Graduate Education and Dean of the Graduate School, and for a change in salary to \$ 267,000, effective September 16, 2017.

Largent, Mark, AN – Associate Dean, Lyman Briggs College; Professor, James Madison College, is changing title to Interim Dean, Lyman Briggs College, and for a change in salary to \$175,000, effective September 8, 2017.

Trustee Byrum moved to approve the recommendations, with support from Trustee Breslin.

THE BOARD VOTED to approve the resolution.

6. Gifts, Grants, and Contracts

Vice President Hsu presented the Gifts, Grants, and Contracts Report for the period May 26, 2017 through August 6, 2017. The report is a compilation of 680 gifts, grants, and contracts plus 104 consignment/non-cash gifts, with a total value of \$156,330,031.

Trustee Breslin **moved to approve** the recommendation, with support from Trustee Kelly.

THE BOARD VOTED to approve the resolution.

Vice President Hsu introduced Hayder Radha, Professor of Electrical and Computer Engineering in the College of Engineering. Professor Radha gave a presentation on autonomous vehicle research. (Appendix B)

7. Finance Committee

Trustee Foster presented the Trustee Finance Committee Report and recommendations.

A. Wonders Hall – Teaching, Learning, and Student Support Renovation

It was recommended that the Board of Trustees authorize the Administration to plan for renovations and technology and infrastructure improvements to various areas of Wonders Hall as part of the University's commitment to student success.

BE IT RESOLVED, the Board of Trustees of Michigan State University hereby authorizes the Administration to plan for the project entitled "Wonders Hall – Teaching, Learning, and Student Support Renovation."

Trustee Foster **moved to approve** the recommendation, with support from Trustee Byrum.

THE BOARD VOTED to approve the resolution.

B. Project Approval—Authorization to Proceed—Communication Arts and Sciences – Replace Roofs

It was recommended that the Board of Trustees authorize the Administration to proceed with the replacement of deteriorated roofing at the Communication Arts and Sciences Building.

BE IT RESOLVED, that the Board of Trustees of Michigan State University hereby authorizes the Administration to proceed with the project entitled “Communication Arts and Sciences – Replace Roofs (16-17 major maintenance),” with a pre-bid project budget of \$1,900,000-\$2,200,000.

Trustee Foster **moved to approve** the recommendation, with support from Trustee Lyons.

THE BOARD VOTED to approve the resolution.

8. Policy Committee

Trustee Byrum presented the Trustee Policy Committee Report and recommendations.

A. Change of Building Name: National Superconducting Cyclotron Lab (NSCL) to Facility for Rare Isotope Beams (FRIB)

It was recommended that the Board of Trustees approve changing the name of buildings located at 640 South Shaw Lane from the National Superconducting Cyclotron Laboratory to the Facility for Rare Isotope Beams.

BE IT RESOLVED, that the Board of Trustees hereby approves changing the name of buildings 164 and 164A, located at 640 South Shaw Lane, from the National Superconducting Cyclotron Lab to the Facility for Rare Isotope Beams.

Trustee Byrum **moved to approve** the recommendation, with support from Trustee Kelly.

THE BOARD VOTED to approve the resolution.

B. Piazza Secchia

It was recommended that the Board of Trustees name the entrance plaza on the southeast side of the Breslin Center Piazza Secchia.

BE IT RESOLVED, that the plaza on the southeast side of the Breslin Center be named the Piazza Secchia.

Trustee Byrum **moved to approve** the recommendation, with support from Trustee Lyons.

THE BOARD VOTED to approve the resolution.

C. Approval of Contract Terms

It was recommended that the Board of Trustees approve a contract between Michigan State University and *Bio-Electrica*, a company in which faculty member Dr. Gemma Reguera and employees Rebecca Steidl and Alexander Grohalski hold a financial interest.

BE IT RESOLVED, that the Board of Trustees of Michigan State University hereby approves an option agreement with *Bio-Electrica*, consistent with earlier public notice given at a Board meeting and with an "Option Agreement Term Sheet" presented to the Board for inclusion in its minutes. (Appendix C)

It was recommended that the Board of Trustees approve a contract between Michigan State University and *Bio-Electrica*, a company in which faculty member Dr. Gemma Reguera and employees Rebecca Steidl and Alexander Grohalski hold a financial interest.

BE IT RESOLVED, that the Board of Trustees of Michigan State University hereby approves a service agreement with *Bio-Electrica*, consistent with earlier public notice given at a Board meeting and with a "Service Agreement Term Sheet" presented to the Board for inclusion in its minutes. (Appendix D)

It was recommended that the Board of Trustees approve a contract between Michigan State University and *Bio-Electrica*, a company in which faculty member Dr. Gemma Reguera and employees Rebecca Steidl and Alexander Grohalski hold a financial interest.

BE IT RESOLVED, that the Board of Trustees of Michigan State University hereby approves a sponsored research agreement with

Bio-Electrica, consistent with earlier public notice given at a Board meeting and with a "Sponsored Research Agreement Term Sheet" presented to the Board for inclusion in its minutes. (Appendix E)

It was recommended that the Board of Trustees approve a contract between Michigan State University and *Cultural Intelligence Center, LLC*, a company in which faculty member Dr. Linnea Van Dyne holds a financial interest.

BE IT RESOLVED, that the Board of Trustees of Michigan State University hereby approves a professional services contract with *Cultural Intelligence Center, LLC*, consistent with earlier public notice given at a Board meeting and with a "Professional Services Contract Term Sheet" presented to the Board for inclusion in its minutes. (Appendix F)

It was recommended that the Board of Trustees approve a contract between Michigan State University and *Drawbridge, Inc.*, a company in which faculty members Drs. Jeffrey Grabill and William Hart-Davidson hold a financial interest.

BE IT RESOLVED, that the Board of Trustees of Michigan State University hereby approves a license agreement with *Drawbridge, Inc.*, consistent with earlier public notice given at a Board meeting and with a "License Agreement Term Sheet" presented to the Board for inclusion in its minutes. (Appendix G)

Trustee Byrum **moved to approve** the recommendations, with support from Trustee Kelly.

THE BOARD VOTED to approve the resolutions.

D. Notice of Intent to Negotiate Contracts

Pursuant to State law, Trustee Byrum gave public notice of the University's intent to negotiate contracts with *PhotosynQ, LLC*, a Michigan limited liability company. Dr. David Kramer, a Professor in the Department of Biochemistry and Molecular Biology, and Dr. Sebastian Kuhlert, an employee in the Department of Plant Biology, and members of their families, have, or have options to buy, an interest in the company.

Pursuant to State law, Trustee Byrum gave public notice of the University's intent to negotiate contracts with an as yet unnamed Michigan limited liability company in which Dr. Fathi Salem, a

Professor in the Department of Electrical and Computer Engineering, and members of his family, will have, or have options to buy, an interest.

9. Audit Committee

Trustee Lyons presented the Trustee Audit Committee Report and recommendations.

The Trustee Audit Committee has no action items; however, it did receive an overview of the Internal Audit Office functions and a review of that Office's audit plan for this fiscal year. Internal Audit Director Marilyn Tarrant reviewed the areas of risk for the University and audit focuses for the fiscal year.

Committee members also received information about the Athletic Department's compliance with NCAA rules. Director of Intercollegiate Athletics Mark Hollis continues to expect an athletic program with a strong compliance environment. The athletics compliance unit is headed by Senior Associate Athletic Director Jennifer Smith. Her position not only reports to the Athletic Director, but also is further strengthened by her ability to report to the General Counsel. The athletic compliance unit leads with a strong proactive and educational approach.

10. Trustee Comments

Trustee Breslin congratulated Dean Jeitschko as the new dean of Graduate Education. He also congratulated the football team for its victory in the first game of the season. Trustee Breslin thanked Dee Cook and Bob Skandalaris for their commitment to MSU and commended Dan Bollman and his team for its work.

Trustee Mosallam gave his condolences to the family of Jud Heathcote. He thanked Dee Cook and Bob Skandalaris for their work on the Empower Extraordinary campaign. Trustee Mosallam congratulated University Advancement for being 16 months ahead of schedule with fundraising goals and asked the student liaisons to give brief remarks.

Lorenzo Santavicca, student liaison, spoke of welcoming students back to MSU and presented a video. Mr. Santavicca also made a statement regarding the importance of inclusion and empathy.

Trustee Kelly stated that he did not support the City of East Lansing's proposed income tax.

Trustee Foster noted that she also did not support the City of East Lansing's proposed income tax. She welcomed Dee Cook and congratulated the Empower Extraordinary campaign team. Dean Gupta was congratulated for the groundbreaking of the Business College Pavilion.

Trustee Byrum welcomed Dee Cook and thanked everyone involved in making MSU a beautiful and welcoming place. Trustee Byrum stated that she opposes the City of East Lansing's proposed income tax.

Trustee Lyons stated his opposition of the City of East Lansing's proposed income tax. He also recognized Dee Cook and Bob Skandalaris for their fundraising efforts. Trustee Lyons offered his condolences to the Heathcote family.

Trustee Ferguson noted Jud Heathcote's career and legacy at MSU. He also stated that he hoped the City of East Lansing and MSU would work together to create a solution that would eliminate the need for an income tax.

11. Public Participation on Issues Not Germane to the Agenda.

A. Affordable Graduate Student Housing

Sapna Naik, MSU Graduate Employees Union member, noted the importance of affordable housing for graduate students. She stated that 1855 Place is not an affordable housing option for graduate students and that there are few single units. Ms. Naik urged the Board of Trustees to consider ways to ensure safe and affordable housing for all graduate students.

Erica Holt, MSU Graduate Employees Union member, stated that 1855 Place does not provide affordable graduate student housing. She noted that many MSU graduate students are unable to live off-campus due to the high cost of rent and their limited income.

B. Campus accessibility

Sara Bijani, President of the MSU Graduate Employees Union, urged the Board to create a policy that supports the rich diversity of campus, while also promoting accessibility and providing safety to the students, staff, and faculty who live and work on campus. She noted that MSU needs to carefully manage access to campus facilities, protecting academic speech while also protecting the safety of the campus community.

C. Anti-discrimination

Kathleen Fry, MSU Graduate Student Union member, requested that MSU adopt stronger anti-discrimination policies for MSU. She noted that the Office of Institutional Equity has the power to investigate claims of harassment and discrimination and make recommendations for sanctions, have little enforcement power. Ms. Fry said that in order for an anti-discrimination policy to be effective, longitudinal enforcement is necessary.

D. Space policy for speakers

Maximilian Hughes, MSU Graduate Student Union member, suggested that external speakers be required to have invitations from student organizations hosting their events.

12. Request to Adjourn

On a motion by Trustee Byrum, supported by Trustee Mosallam,
THE BOARD VOTED to adjourn at 11:20 p.m.

Respectfully submitted,



William R. Beekman
Vice President and Secretary of the Board of Trustees



Sustainability report

A FIVE YEAR REVIEW AND
REAFFIRMATION OF INTENT, AUGUST 2017



> CONTENTS

Letter to Michigan State University Board of
Trustees..... **3**

Energy Transition Plan: five-year review..... **4**

 Key accomplishments..... **5**

 Energy investments..... **7**

 Energy projects in progress..... **13**

 Peer and industry benchmarking..... **15**

Summary of recommendations..... **19**

Sustainability 2.0: plan for the future..... **21**

Appendix..... **24**

July 24, 2017

To: Michigan State University Board of Trustees

The Energy Transition Plan (ETP), accepted by the MSU Board of Trustees in 2012, sought to balance energy capacity, health, reliability, environment and cost. This report summarizes the progress we've made with regards to sustainability at MSU following adoption of the plan, and includes a summary of strategies to meet the goals and a recommendation for validation or revision of the goals. It provides a comparison of energy progress achieved by our institutional peers and an outline of MSU's recent energy improvements. Also included are estimates for impacts relating to activities in FY2017 and a roadmap for the next five years of energy progress. This process ensures that MSU continues to make progress toward its long-term vision of sustainability.

We have reviewed the original goals and assumptions of the ETP and reaffirm their intent, as MSU remains committed to displaying leadership in sustainability and enacting sustainable practices in a financially acceptable manner. But in order to maximize impact on each goal, we recommend that the university employ a more centralized facilitating body to implement the practices, initiatives and strategies that truly drive progress. While the original goals should remain, we also recommend that the language is refined to accommodate the financial, academic and other operational variables that impact energy progress.

The outcomes and recommendations from this review will be used as part of our more extensive engagement of campus leaders on the integration of sustainability into operational and academic strategy, and will be launching in the fall of 2017. A separate Energy Plan, outlining an energy roadmap for the T.B. Simon Powerplant will be discussed with the Board of Trustees in October. The Energy Plan will focus on improving reliability, maintaining flexibility and realizing additional cost savings through improvements in energy generation.

Best Regards,

Ann Erhardt, MM, ISSP-SA
Director of Sustainability
Infrastructure Planning and Facilities

cc: Dan Bollman, Associate Vice President of Infrastructure Planning and Facilities

ENERGY TRANSITION PLAN REVIEW

An overview of the ETP's progress over the first five years since the plan's inception on the following goals:

Fiscal Year	% Campus Renewable Energy	% GHG Emission Reduction
FY 2015	15%	30%
FY 2020	20%	45%
FY 2025	25%	55%
FY 2030	40%	65%

ETP: FIVE-YEAR REVIEW



In 2012, Michigan State University’s Energy Transition Plan (ETP) was formed to address growing campus energy needs within a framework that encouraged sustainable transition alongside changing technologies and regulations. To ensure that this plan continues to serve these needs and is appropriately facilitating progress, it is reviewed every five years to report on the following:

KEY ACCOMPLISHMENTS



I. FY 2016 demonstrated a total renewable energy portfolio increase of 10.4% from baseline year through numerous projects. (See Figure 1)

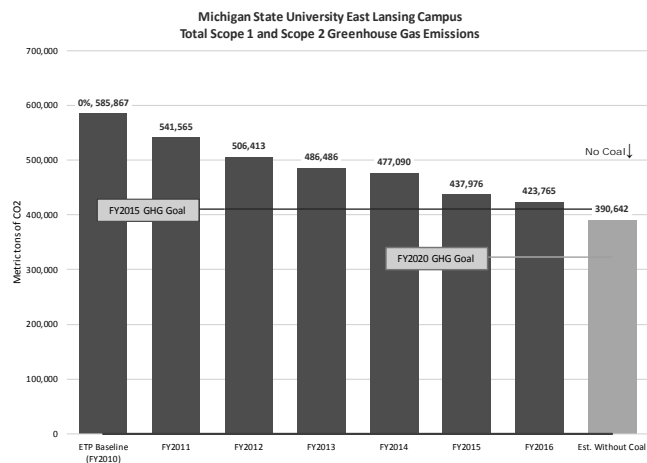
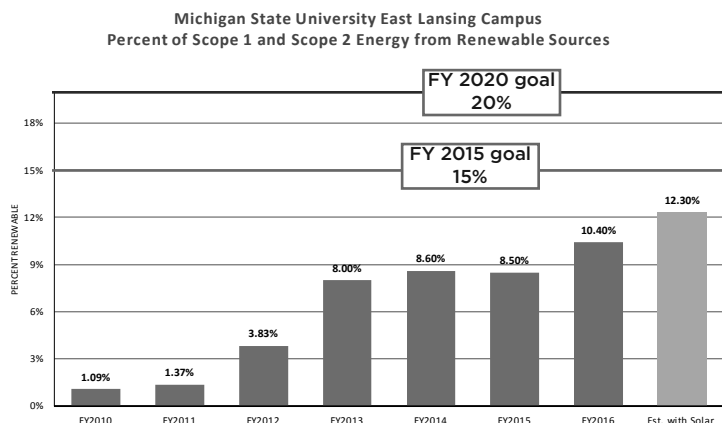
- a. Geothermal installation at Bott Building (2012)
- b. MSU’s South Campus Anaerobic Digester (2013)
- c. Installation of solar carports in 2017 across MSU’s campus is projected to increase portfolio by another 2-3%.

II. FY 2016 yielded a total GHG emissions reduction of 27.7% from baseline year. (See Figure 2)

- a. The reduction in coal as a fuel source at the T.B. Simon Power Plant contributed to the majority of GHG emission reductions over a five year period. To learn more, see the [Infrastructure Planning and Facilities \(IPF\) Annual Report](#).
- b. The elimination of coal entirely in FY 2016 is expected to reduce GHG emissions by 2-3%.
- c. The Better Buildings Challenge, investment in MSU Transportation’s hybrid vehicle fleet and investment in Energy Conservation Measures (ECM) also contributed to 2-3% in reductions.

Figure 1

Figure 2



KEY ACCOMPLISHMENTS, CONTD.



III. Used energy savings to reallocate 7% of the energy budget to the academic side, helping to keep tuition costs from rising

- a. Energy saving measures beginning to bear fruit, leading to increased cost savings.

IV. MSU continues to foster research relationships between students, faculty and external stakeholders.

- a. Student groups, like Student Planning of Advanced Retrofit Technology Applications (SPARTA), use campus as a test site for renewable energy technology. (See Figure 2)

V. Campus continues to serve as a location for sustainable demonstration projects.

- a. MSU's South Campus Anaerobic Digester
- b. MSU's Energy Innovation Award and Student Solar Design Competition

VI. Information about MSU's Energy Conservation Measures (ECM's) practices are shared at town hall meetings.

- a. Space temperature controls at zone level
- b. Retrofit lighting

VII. Through the Better Buildings Challenge, MSU IPF identified and shared key information regarding building efficiency that can be applied to many university spaces.

- a. Staff broadly demonstrate efficient practices and become peer ambassadors for efficient behaviors
- b. Presentations on our progress to organizations such as APPA, SCUP, BIG10 & Friends, AASHE, Better Buildings (DOE), EPA, ABMA and COOA

VIII. Met the Governor's energy reduction goals as outlined in Public Act 342.

KEY ENERGY INVESTMENTS

Project summaries of significant energy investments that impacted GHG emissions reduction, renewable energy portfolio growth and general campus sustainability.

Fuel Source Switching

INVESTMENT: \$3.0 million

Impacts

In April 2016, MSU announced that it would no longer burn coal in its on-campus T.B. Simon Power Plant. The university's final coal delivery arrived in September of 2015. **By the end of 2016, MSU completely discontinued the burning of coal** and switched almost entirely to natural gas.

The switching of fuel sources has drastically reduced particulate matter 2.5 emissions, lowered fuel costs, and decreased costs of converting the input fuel into electricity and heat within the power plant. The fuel conversion is resulting in **250,000 tons of CO₂ emissions reductions** - approximately equivalent to planting half a million trees annually, a **43% reduction in overall CO₂ emissions from campus**.



Leaders of environmental efforts on campus celebrate the final delivery of coal to the T.B. Simon Power Plant.

Surplus Store and Recycling Center

INVESTMENT: \$13.3 million

Impacts

MSU'S 74,000 square foot Recycling Center and Surplus Store serves as a hub for waste diversion operations on campus and in the greater Lansing community, including a 24-hour recycling drop-off center. Technology at the facility allows employees to collect and bale their own materials and sell directly to the market, nearly quadrupling recycling revenue since 1990.

In FY 2015-16, MSU diverted **60% of its waste, preventing over 216 tons of material from entering the landfill. 4,138,221 pounds of recyclable material were collected from the public drop-off center.**

Through a pilot project of construction waste clean up, the Surplus and Recycling Center **diverted 216 tons of wood, dirt, rock and more, saving \$46,000 in landfill costs.**



MSU's Surplus Store and Recycling Center Facility off Green Way Drive.

Anaerobic Digester

INVESTMENT: \$5.0 million

Impacts

MSU's South Campus Anaerobic Digester turns food waste and animal excrements into half a megawatt of electricity, day and night, every hour of every day of the year. **A sustained 400kW of electricity and 450kW of heat is produced continuously, which is used to offset energy purchasing in 10 south campus buildings.** The facility produces high quality organic fertilizer which is used on our own agricultural fields, contributing to a tremendous reduction in chemical fertilizer purchases.

The digester is now estimated to pay for itself within 7-8 years, several years ahead of the originally-projected 15-year payback.



Leaders involved with design, planning and construction of MSU's Anaerobic Digester cut a ribbon to commend the opening of the facility.

Bott Building Geothermal Field

INVESTMENT: \$750,000

Impacts

Opening in 2012, the Bott Building for Nursing Education and Research became the first campus facility to use geothermal energy for heating and cooling. In its first year, **the geothermal field contributed approximately 467 million BTU of geothermal energy to the overall building energy consumption, an approximate share of about 20% of the total consumption in the building.**

Nearly 75% of the building's space uses natural daylight, reducing the need for artificial lighting. The building earned LEED certification from the U.S. Green Building Council and amounts to **significantly lower annual energy costs, helping MSU use the least amount of electricity per square foot in the Big Ten.**



The Bott Building for Nursing Education and Research on Bogue Street.

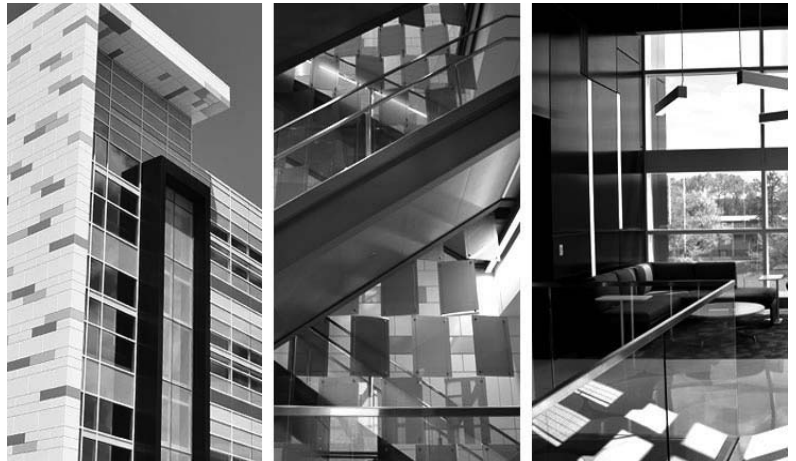
Better Buildings Challenge

INVESTMENT: \$5.0 million/year in BBC Energy Conservation Measures

Impacts

Through the Better Buildings Challenge, MSU committed to increasing energy efficiency by 20% on 20 million square-foot of contiguous campus by 2020. After just two years of the program, the university was more than halfway to meeting that goal. **In 2013, Anthony Hall was selected as a showcase project, and over ten conservation measures were installed, with an expected annual cost savings of \$536,000, or 34% of the building's total consumption.**

Energy conservation measures to reduce consumption through this program include enhancing building insulation, improving steam traps, adding LED lighting, using variable speed fans, etc. **These investments typically result in a 5-year payback.**



A photo collage highlighting features within MSU's new Bio Engineering Facility.

Spartan Treasure Hunts

INVESTMENT: Assessment of 40 buildings on the East Lansing campus

Impacts

The Spartan Treasure Hunt (STH) program, was adopted in 2014 and integrated with campus retro-commissioning to improve engagement of building occupants and facilitate the identification of efficiency opportunities. During a typical event, teams of building occupants and facilities experts tour a building and identify best practices that lead to energy savings, waste reduction, water conservation, and improvements to their environment.

To date, **40 buildings have been evaluated, totaling 8,116,124 square feet, and 1,105 energy conservation measures have been identified.**



Jason Vallance and Andrew Luzenski perform a Spartan Treasure Hunt in Kedzie Hall in June of 2016.

Aircuity

INVESTMENT: \$1.6 million

Impacts

Aircuity creates smart airside solutions through its intelligent building platform, significantly reducing energy costs and improving the indoor environmental quality for occupants. Based on several prior Aircuity installations creating measurably better environments on campus, the university implemented the Safe Sustainable Labs concept.

Today the program consists of **268 Lab installations in 7 buildings that are saving the university over half a million dollars per year.** Aircuity has given Environmental Health and Safety additional means to closely monitor the labs while saving energy and helping the university to meet its goals. **MSU is continuing to expand their airside program with installations in two more lab buildings planned for the next year term.**



A photo of Anthony Hall, which was outfitted with Aircuity installations along with six other campus buildings.

Energy Conservation Measures

INVESTMENT: \$40.2 million

Impacts

Energy Conservation Measures (ECMs) have been identified across MSU through retro-commissioning, Capital Renewal opportunities, collaboration with student groups (such as SPARTA), and as part of building renovation projects. Examples of successful ECMs include retrofitting existing HVAC systems with new technology, making efficiency upgrades to cooling systems, implementation of preventative maintenance strategies, window replacements and LED lighting control system installation.

ECMs on campus have amounted to **over \$10 million in savings since 2010 and nearly \$1 million received from Consumer's Energy as part of their incentive program.** Currently, with the completion of all funded ECMs, a **13% reduction in steam and electricity use is expected on campus.**



A map highlighting where many of the Energy Conservation Measures have been implemented on campus.

Spartan Green Certification

INVESTMENT: 794 Certified Spaces

Impacts

MSU's [Spartan Green Certification](#) is an online self-assessment program that educates, assists and recognizes campus units taking steps toward energy efficiency and conservation, waste reduction and recycling, water conservation, and sustainable purchasing practices.

The program offers certification opportunities for MSU offices, information technology spaces, science laboratories, kitchens and MSU extension spaces, and **since the program's inception in 2010, a total of 794 spaces have been certified on campus.**



Student Project Fund

INVESTMENT: \$163,000 has been awarded for student sustainability research

Impacts

To support MSU's commitment to furthering knowledge and improving life around the world through the convention of research, MSU Sustainability's [Be Spartan Green Project Fund](#) provides financial support for students looking to use campus as a laboratory to investigate solutions for today's most pressing and relevant sustainability issues.

A total of 48 student grants have been awarded since the programs inception in 2012, amounting to an investment of over \$160,000, helping to position MSU as an educational leader in the area of sustainability.



Laurie Thorp, Director of the Residential Initiative on the Study of the Environment, at Bailey Hall with students who funded the Bailey Bee Project through a Be Spartan Green Student Project Fund grant.

ENERGY PROJECTS IN PROGRESS

An overview of approved projects that will continue reducing energy use and will be completed within the next five years.

Data Center Redesign (2016)

INVESTMENT: \$46.0 million

Impacts

The new central data center on MSU's campus will be constructed following an aggressively low **Power Usage Effectiveness (PUE) target < 1.3**, which will **dramatically cut the energy we consume to cool larger computer systems on campus.**

The redesigned **data center will consolidate over 70 facilities across campus** that house computing equipment, providing flexible and expandable white space at the lowest possible energy consumption for data center cooling. **Annual utility savings as a result of the data center consolidation are estimated at approximately \$600,000.** Efficiencies in processing, security and more standardization will improve business operations, decrease cost, and reduce risk to MSU.



Construction progress as of August 25, 2017 on the MSU central data center.

Solar Carport Installation (2017)

INVESTMENT: \$2.5 million connection cost

Impacts

In partnership with Inovateus Solar and Customer First Renewables, a solar initiative is under construction to cover MSU's five largest commuter parking lots with carports that have solar panel roofs. **This will be the largest non-utility owned solar park in the state of Michigan by a factor of 10**, and will provide students opportunities for academic research.

The array will provide **15% of the total electricity used on campus during peak times, producing 15,000 MWh of energy per year**, and is projected to save the university **\$10 million dollars in avoided electricity costs over the next 25 years.**

Additionally, the solar array will account for **over 10,000 metric tons reduction in Greenhouse Gases per year.**



Construction progress as of August 25, 2017 on one of MSU's five commuter parking lots getting outfitted with a solar carport.

PEER AND INDUSTRY BENCHMARKING

A comparison between MSU's progress and that of institutional peers and industry organizations across a range of metrics related to sustainability.

INSTITUTIONAL PEER BENCHMARKING

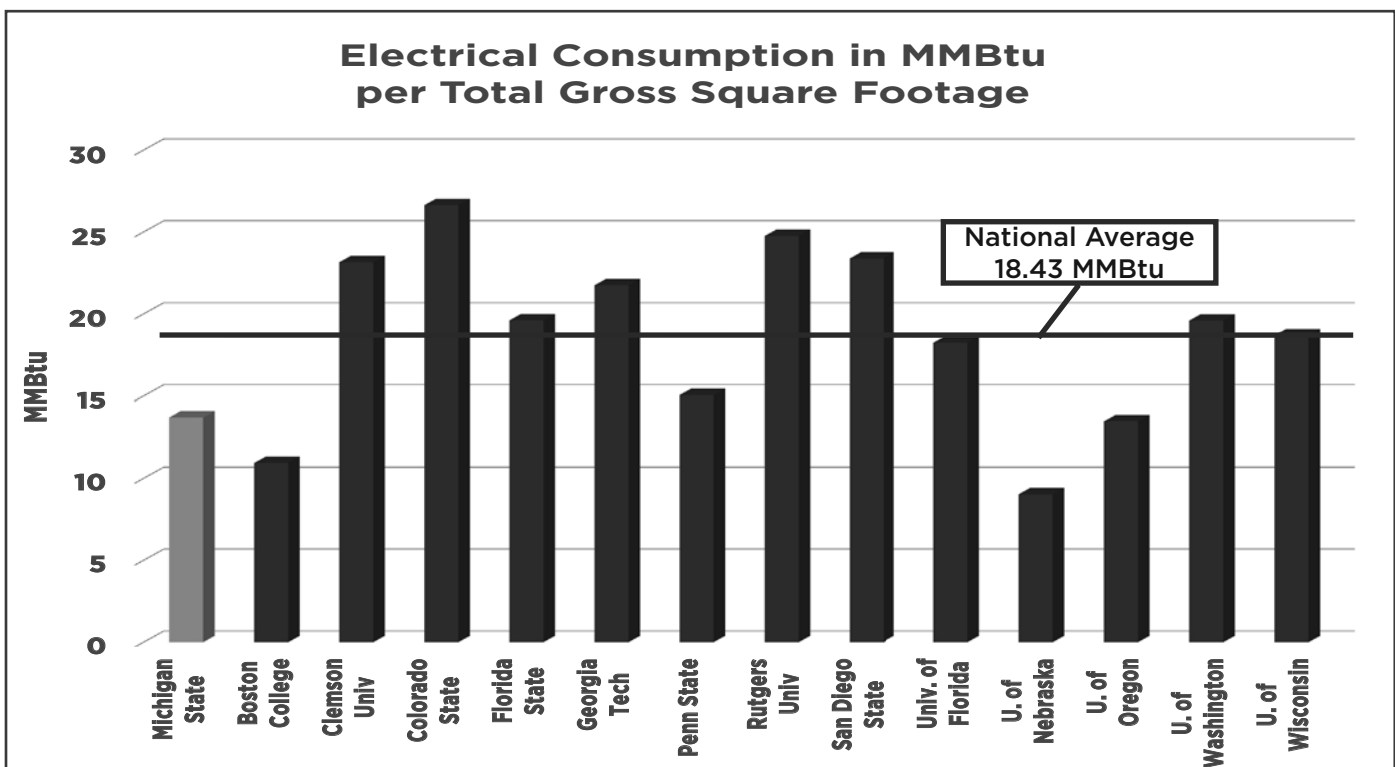
The data in the following section, serving to compare MSU's performance against institutional peers across a range of sustainability metrics, can be found within the 2014-15 APPA/NACUBO Key Facilities Metrics Report, unless otherwise specified. The purpose of the report is to increase an institution's knowledge of their own consumption: crucial knowledge for improving strategic planning. The report captures Btu (energy), electrical, water, waste and carbon.

GREENHOUSE GAS EMISSIONS

Comparison of Scope 1 Greenhouse Gas emissions data from the Association for Advancement of Sustainability in Higher Education (AASHE) STARS 2.0, baseline year 2009-10 to performance year 2014-15, demonstrates that MSU has reduced emissions by 30 percent. This reduction surpasses all institutional peers, nearly 10 percent more than the next best reduction of 21 percent at the University of Minnesota. Additionally, data from the 2014-15 APPA/NACUBO Key Facilities Metrics Report demonstrates that in a study of BIG 10 universities, MSU ranks third in relative energy improvement. The data represented in figures one, two and three can be found within this APPA/NACUBO Report from 2014-15.

ENERGY CONSUMPTION

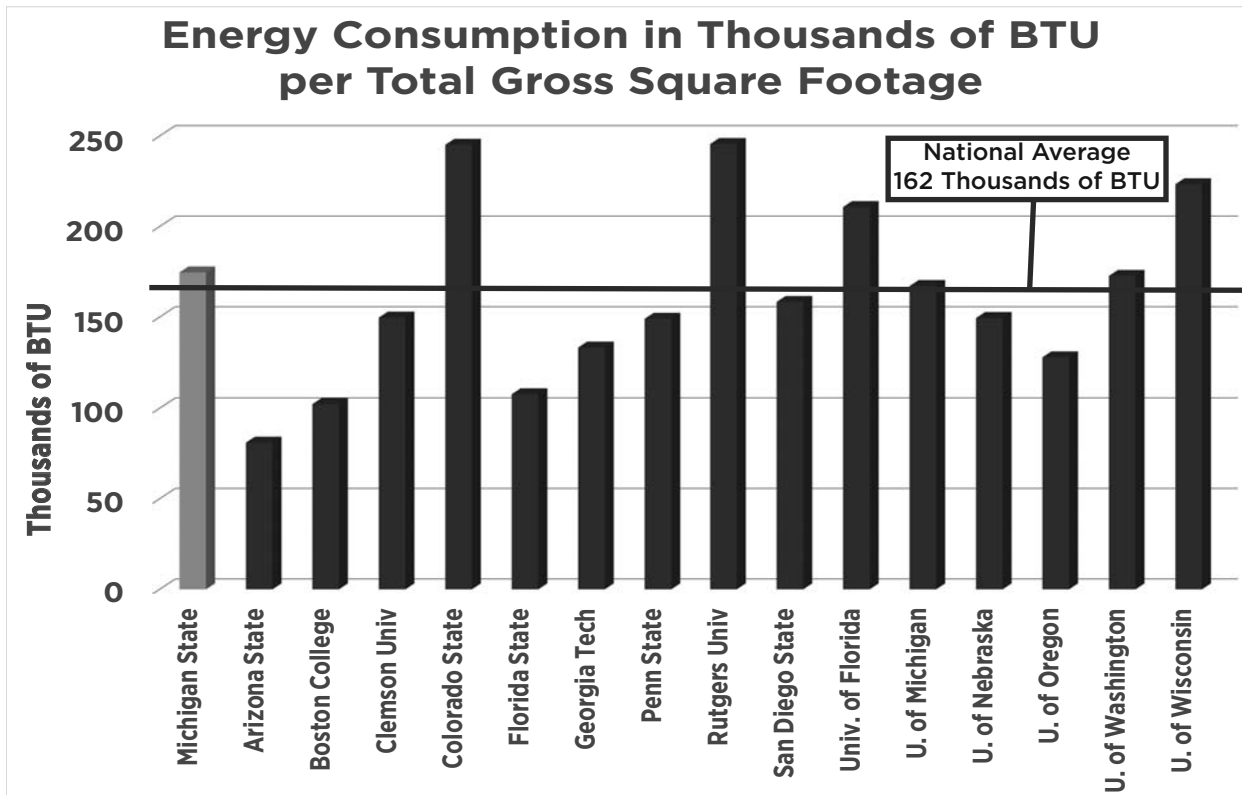
Figure 1: Electrical consumption in MMBtu per total gross square footage



From the APPA/NACUBO Key Facilities Metrics Report for 2014-2015: MSU is significantly below average in electrical consumption per total gross square footage, at only 13.71 MMBtu compared to an institutional average of 18.43 MMBtu.

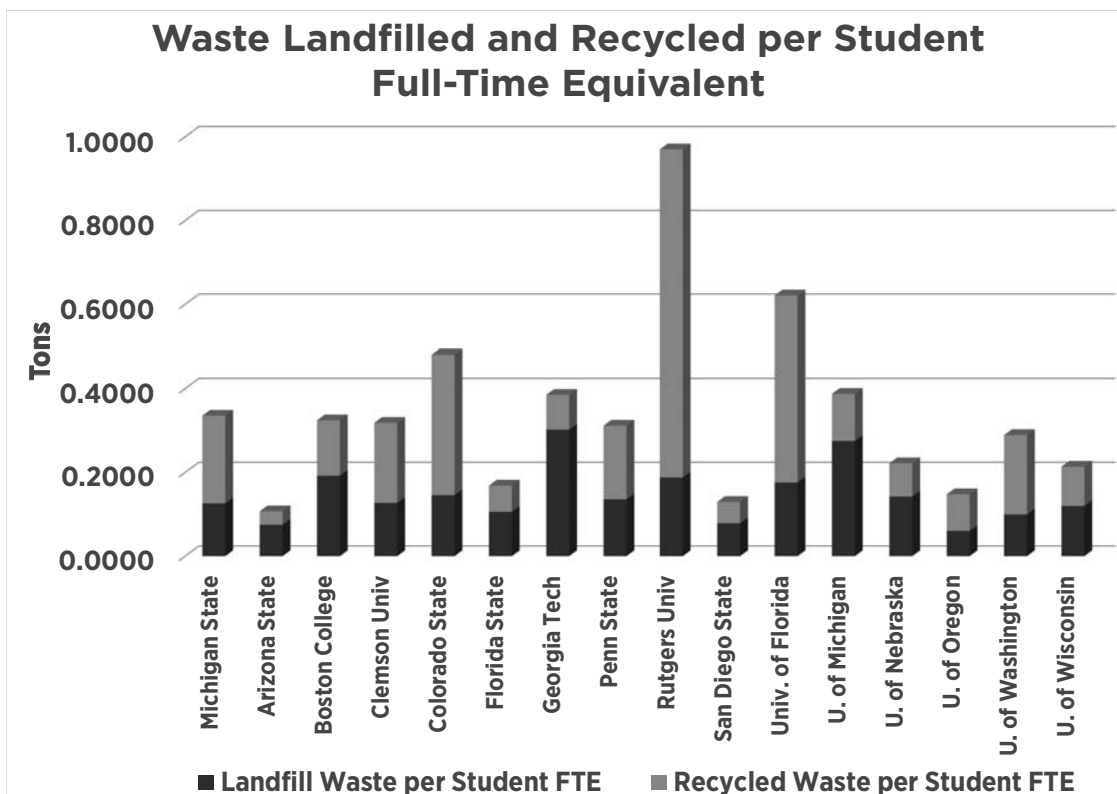
ENERGY CONSUMPTION CONTINUED

Figure 2: Energy consumption in thousands of BTU per total gross square footage



LANDFILLED AND RECYCLED WASTE

Figure 3: Waste landfilled and recycled per student full-time equivalent



From the APPA/NACUBO Key Facilities Metrics Report for 2014-2015: MSU is below average in landfilled waste per student and above average in recycled waste per student, surpassing institutional peers with smaller student bodies and campuses.

INDUSTRY BENCHMARKING

A more thorough review of our energy progress requires comparison of our achievements and goals against industry organizations that lead the way in sustainability. MSU not only utilizes institutional peers as a format for evaluating success, but also considers the dynamic industry organizations that provide relevant points of comparison as we look toward outlining goals for MSU's future of energy progress.

As an example, Walmart has increasingly adapted to global pressures such as rising energy demands, worsening water security and climate change. The organization's goals for lessening energy consumption have amounted to a 26 percent reduction in emissions from their operations as a result of their increasing reliance on renewable energy. By comparison, MSU has reduced Greenhouse Gas emissions by 30 percent, occurring as a result of similar increases to our renewable energy portfolio.

Additionally, Walmart's goals for eliminating waste in their operations have amounted to achievement of a 77 percent landfill diversion rate. Similarly, MSU has reached nearly the same diversion rate, at approximately 70 percent landfill diversion from campus.

MSU's commitment to sustainability is illustrated clearly through comparison with industry organizations, as often the university's achievements, across areas such as emissions reductions and waste diversion, illustrate that MSU is reaching similar sustainability goals, or even surpassing industry successes.

STATE OF MICHIGAN COMMITMENTS AND STANDARDS

In 2016, Governor Snyder signed Public Act 342 into law, amending Act 295 to increase the renewable portfolio standard from 10 percent in 2015 to 12.5 percent in both 2019 and 2020, and finally 15% by 2021. The new act became effective in April of 2017. **“Energy efficiency doesn't mean doing less; it means doing as much or more, but using less energy to get it done,”** said Snyder, **“Energy efficiency is the best example of a no-regrets policy Michigan can have. It makes us more reliable, more affordable and protects our environment.”**

In 2015, as reported by the electric providers in the state, the number of energy credits generated is equivalent to 9.6 percent of retail sales. As allowed by the Act, electric providers used banked energy credits and excess energy optimization to achieve the 10 percent requirement. In 2015, all 68 of Michigan's electric providers met the 2015 requirements. Projections for 2016 forecast continued increases in renewable energy credits.

By comparison, Michigan State University parallels the state of Michigan's commitments to increasing our renewable energy portfolio through a combination of emissions reductions, efficiency upgrades and improvements made to our campus energy generation infrastructure. Currently, MSU's renewable energy portfolio comprises 8 percent of energy generation, not far from reaching the achievements of electric providers in the state. Construction of solar carports on five commuter lots on campus is expected to generate 15,000 MWh of energy per year, approximately 15 percent of the university's energy consumption during peak times.

SUMMARY OF RECOMMENDATIONS

A review and reevaluation of the goals detailed in the original Energy Transition Plan: a vision for the future of energy progress at MSU.

RECOMMENDATIONS

The original Energy Transition Plan, approved by the Board of Trustees in 2012, was created to address the needs of a continually growing campus, while following a framework that facilitated increases in support for sustainable facilities, paralleling the dynamic landscape of technology and regulation. A review of the original ETP must ensure that MSU's plans for the future of energy progress, on campus and beyond, continue to encourage the appropriate improvements and reductions. Please refer to the Appendix for identified challenges

A compilation of stakeholder information, reviews of performance as well as current supporting projects, and benchmarking against both institutional peers and industry organizations reveals that the original goals of the ETP remain valid. However, the methods enlisted to reach those goals and the timeline within which the university will meet them require reevaluation.

The future Energy Plan for Michigan State University continues to view the transition to a 100 percent renewable energy portfolio as our vision for the future. However, rather than committing to a date by which this will occur, the new Energy Plan endeavors to, instead, commit to yearly increases of approximately three percent within this renewable energy portfolio.

While global issues such as energy demand, water security, food supplies and climate change continue to rise to the forefront of concern, MSU understands that advancement in the area of sustainability requires strategic planning. Review of the original ETP in consideration of MSU's future Energy Plan demonstrates that, while MSU's progress in sustainability shows strong leadership, a thorough plan for future success will ensure our continued commitment to reducing the university's impact on the environment.

Summary of recommendations:

- The goals of the original Energy Transition Plan remain valid as a long term vision for MSU's future Energy Plan
- The methods and timeline for achieving this vision will be reevaluated and adapted to meet the demands of a dynamic environmental landscape
- MSU will enlist the Roadmap Objectives found in the following section to ensure the university remains viable as a leader in sustainability

SUSTAINABILITY 2.0 - FUTURE PLAN

A summary of the steps MSU is taking over the next five years to continue energy progress through sustainability engagement with the campus community.

SUSTAINABILITY 2.0 - FUTURE PLAN

To remain relevant throughout the technological, regulatory, and environmental changes in the higher education landscape, the Energy Transition Plan should be dynamic and adaptive. The original goals of ETP have been reviewed, and their intent reaffirmed. As MSU has reached the first five-year mark, departments within MSU will lead the process to review the current plan, engage a wide audience of stakeholders, and provide the President and Board of Trustees with recommendations for the future of energy and sustainability on campus.

In order to ensure continued sustainability for MSU as a business, an evolving and leading approach to energy and sustainability should be adopted, protecting key resources for the university and community stakeholders, and garnering the longevity of the university.

Additionally, while increasing conservation and reducing energy demand are critical to the global future, energy tomorrow cannot cost more than it does today. MSU will pursue sustainability in the largest sense, with consideration to the longevity and financial success of the university, conserving resources, avoiding risk, reducing waste and “greening” transportation.

To meet this rising challenge at MSU, under leadership of the Executive Vice President and Administrative Services, energy progress will focus on the following objectives:

ROADMAP OBJECTIVES

I. Stakeholder Engagement in Energy and Sustainability Future.

- Enhance two-way communication with other communities and entities to generate innovative ideas and perspectives about the university’s energy future
- Engage leading edge companies, universities, and municipalities for partnerships
- Engage MSU and other leading researchers

II. Invest in energy technologies that have a five year (or less) payback.

- Research and employ cutting edge energy technologies
- Advance in sustainable infrastructure
- Invest in Power Plant efficiency and augmentation
- Conserve energy in the built environment

III. Embed sustainability into the campus fabric.

- Develop sustainable business principles across the institution
- Form cross-sector sustainability committee to continue to advance sustainability initiatives on campus
- Work with departments and colleges to integrate sustainability into their strategic plan
- Create a distinctive vision for sustainability on campus

IV. Advance sustainability in infrastructure.

- Mobility Planning (Transportation Demand)
- Power and Water Infrastructure
- Material and waste management infrastructure
- Planning, Design, and Construction, Commissioning, Capital Renewal and other conservation strategies
- Expand renovation and construction standards: LEED, ASHRAE, etc.

EXPLORATION OF THE ROADMAP OBJECTIVES

Exploration of the above “Roadmap Objectives” will allow MSU to develop and implement a plan for future energy progress and sustainability on campus. MSU Administrative Services will lead a review process of the current plan with the ultimate goal to provide the President with recommendations for a comprehensive energy and sustainability plan.

I. Conduct technical review of Energy Transition Plan progress and outcomes to date including but not limited to the following activities. (Spring 2017)

- a. Review the current assumptions of the plan for relevance and future viability
- b. Review current metrics, goals and strategies; are they reasonable, achievable, aggressive, etc.
- c. Review current progress and implementation of goals; improve physical environment, invest in sustainable energy research and development, and become an educational leader in sustainable energy
- d. Review plan for gaps and opportunities since inception
- e. Assess greenhouse gas emission goals for development and inclusion of Scope I, II, III
- f. Review current vision of “transition” and assess next level of energy planning
- g. Review current regulation, policy, technology and energy modeling

II. Engage and build consensus on priority energy, environment and climate issues through active engagement, focus groups, interviews and town hall meetings. (Begins Fall 2017)

III. Incorporate energy transition planning and emerging concepts of organizational resiliency by comparing impact of renewables vs. conservation strategies.

IV. Incorporate transportation demand management (Mobility Plan) concepts relative to impacts on university energy goals.

V. Provide supplementary data to infrastructure and utility planning to support strategic space planning initiatives especially the focus on research growth.

VI. Establish key performance indicators for all aspects of the plan.

VII. Provide assessment of current plan and recommendations for future evolution of MSU’s Energy and Sustainability Plan.

APPENDIX

Key barriers and drivers of success as identified by Infrastructure Planning and Facilities business leaders, recommendations for the future of energy progress at MSU.

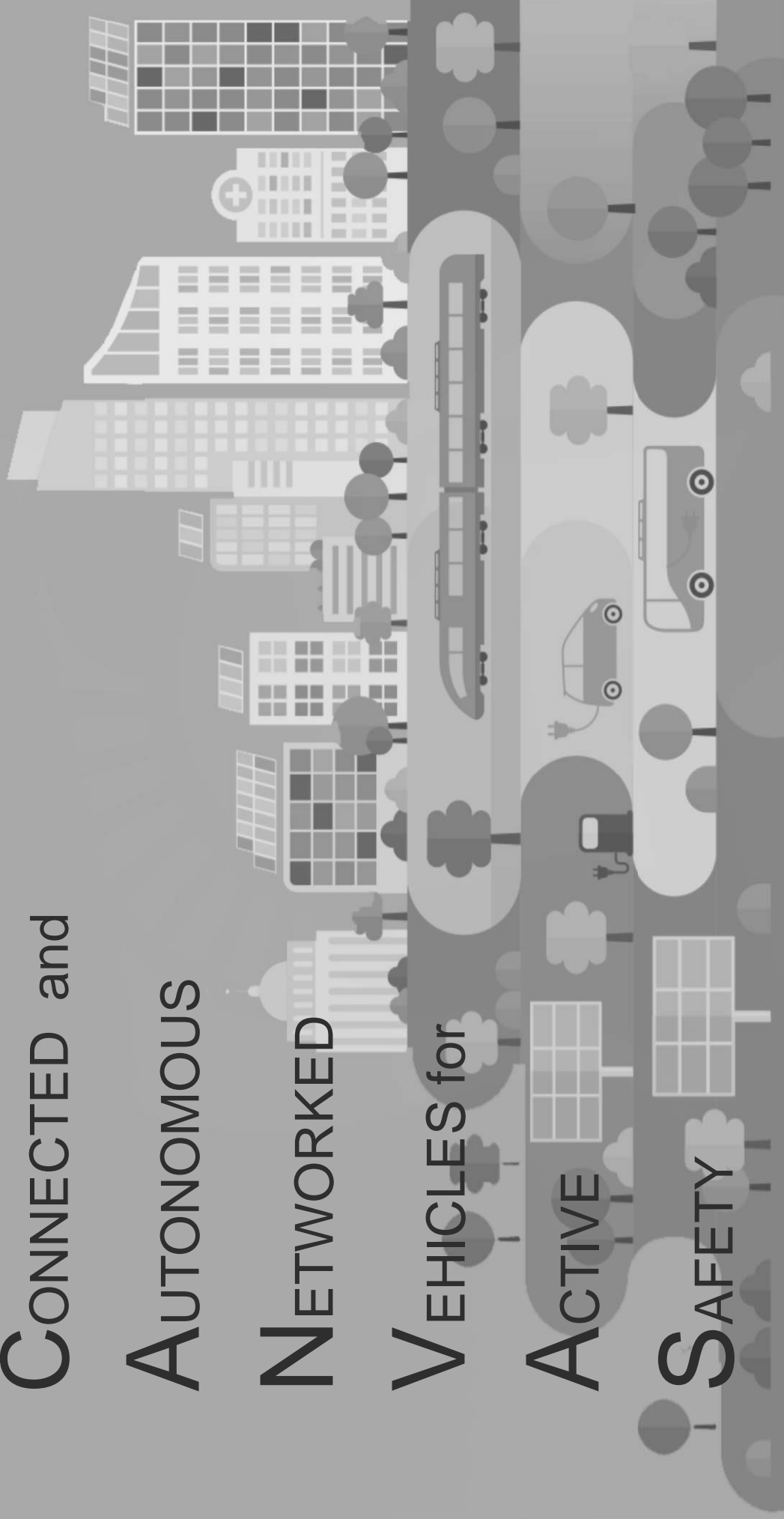
IDENTIFIED CHALLENGES AND RECOMMENDATIONS

To gain deeper understanding about the ETP's implementation and alignment with university sustainability goals, qualitative data was collected from MSU Infrastructure Planning and Facilities (IPF) business leaders, specifically seeking to identify key barriers and drivers of success, while also informing recommendations for the future of the plan. The following challenges were identified as top concerns for participants, and recommendations were made to address each.

CHALLENGE	RECOMMENDATION
Lack of centralized ownership and integration of the plan beyond IPF.	<ul style="list-style-type: none"> - Identify centralized leadership of the plan; EVPAS - Identify facilitating body of the plan; Sustainability department. They will oversee and track the implementation of projects and efforts that directly contribute to each goal
Limited financial investment capability and ability to demonstrate holistic value of investments	<ul style="list-style-type: none"> - Expand and align internal reporting by linking energy metrics to IPF Scorecard and Office of Planning and Budgets - Integrate energy and performance progress reporting into high level data for Business Leaders, Manager and other IPF decision makers to enhance sustainability strategies by department
Irregular reporting as a result of vague goals that can't be quantified and no uniform reporting method.	<ul style="list-style-type: none"> - Develop a uniform internal reporting structure, to be executed by the Sustainability department, with contributing data provided by various IPF units - Add supporting ancillary goals to each of the core goals, which each contain measurable benchmarks - Restructure benchmark language, i.e. "We will reduce GHG emissions by the maximum reasonable projection given current technology and investment potential."
Lack of facilitated collaboration between departments, leading to isolated projects and efforts	<ul style="list-style-type: none"> - Establish engagement structure for facilitating body; Sustainability department will engage departments outside of IPF to learn their sustainability status/ efforts - Engagement should identify where various strategies can be implemented to generate cost/energy savings
Difficulty externally communicating the goals, progress and milestone accomplishments	<ul style="list-style-type: none"> - Rename the plan "MSU's Energy Plan." - Reduce the external visibility of the original ETP document; reduce to a single page on IPF's website - Make the revised energy and sustainability plan externally visible on sustainability.msu.edu, to be managed by the Sustainability department, and use as a regular communication tool - Use example-based storytelling in external communication, using collaborative projects and milestone achievements to showcase goal progress
Slow adoption of plan and outlined energy strategies	<ul style="list-style-type: none"> - Evaluate current strategies contributing to progress on goals - Establish additional energy benchmarks, including Scope III emissions goals, and internally communicate those goals to MSU units, encouraging collaboration and innovation - Align Energy and Sustainability Plan with other broad campus plans; Mobility Plan, Campus Land Use Master Plan, etc.

CANVAS

CONNECTED and
AUTONOMOUS
NETWORKED
VEHICLES for
ACTIVE
SAFETY



CANVAS Research, Student Engagement & Outreach

Research

Faculty, Grad/Undergrad Students & Industry

Education, Student Engagement & Outreach

CAV Related Courses

CAV Practical Training

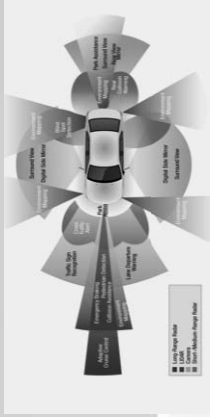
CAV Students' Club

CAV International Competitions

CANVAS Autonomous Vehicle Platform



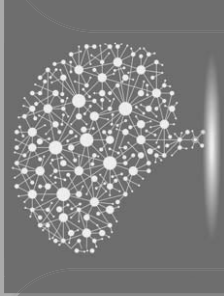
Autonomous Vehicle: Architecture



- Sensing
- Cameras
- Radars
- Lidars
- Ultrasonic
- Position

Communication

Vehicle-2-Vehicle (V2V) & Vehicle-2-Infrastructure (V2I)



- Recognition
- Pedestrians
- Vehicles
- Cyclists
- Animals
- Activities

- Planning & Control
- Path planning
- Optimal path selection
- Uncertainty response
- Optimal control
- Actuation

Localization & Mapping

Maps & Data

Autonomous

CANVAS

CONNECTED &
AUTONOMOUS
NETWORKD
VEHICLES for
ACTIVE
SAFETY

Seamlessly integrating mobility, safety, and security
in autonomous and connected vehicles.



MSU KEY AREAS

Multi-modality sensing



Radars and antenna design



X2X networking

Sensor and data fusion



Deep learning



Biometrics and cybersecurity

CANVAS Autonomous Vehicle: Sensing





Hannah Administration

Olds

MSU Museum

Beaumont Tower

MSU Library

Human Ecology

MSU Union

London Hall



3:32:15

canvas RESEARCH FOCUS: deep learning

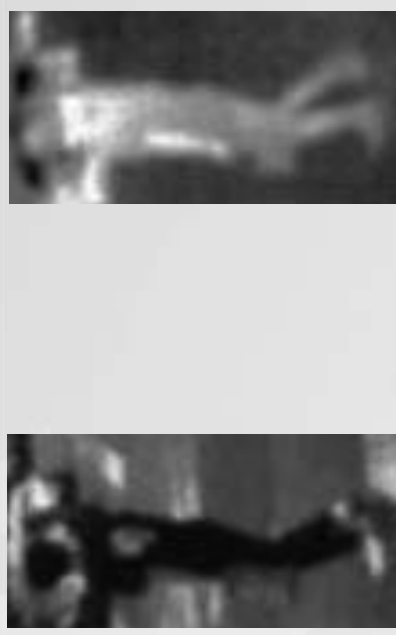
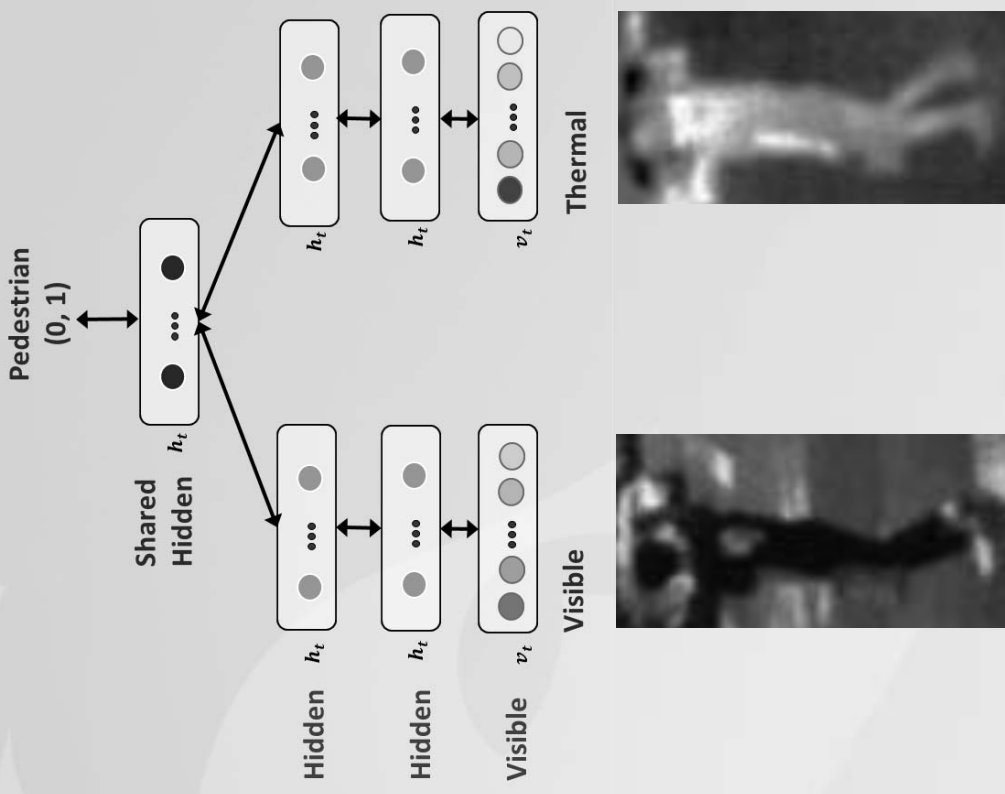


Canvas Pedestrian Detection with Deep Learning

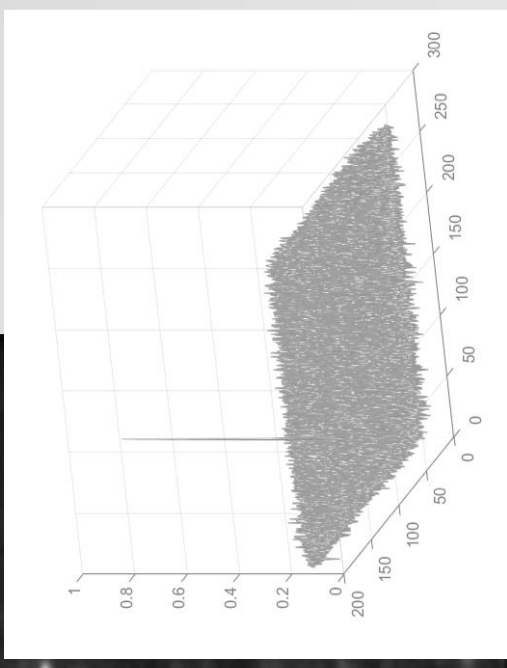
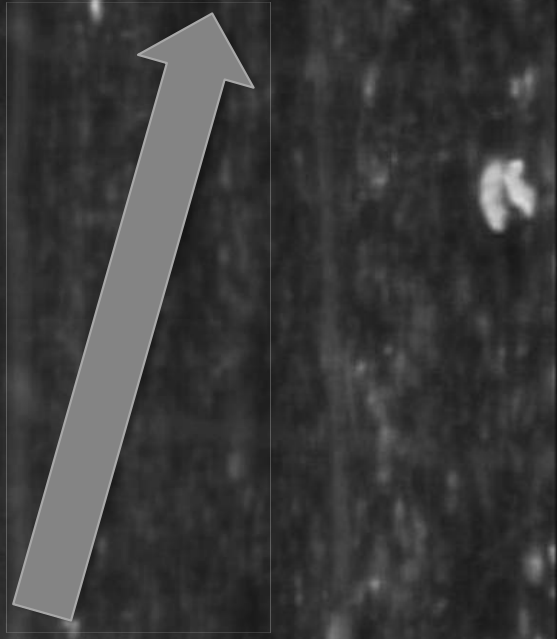
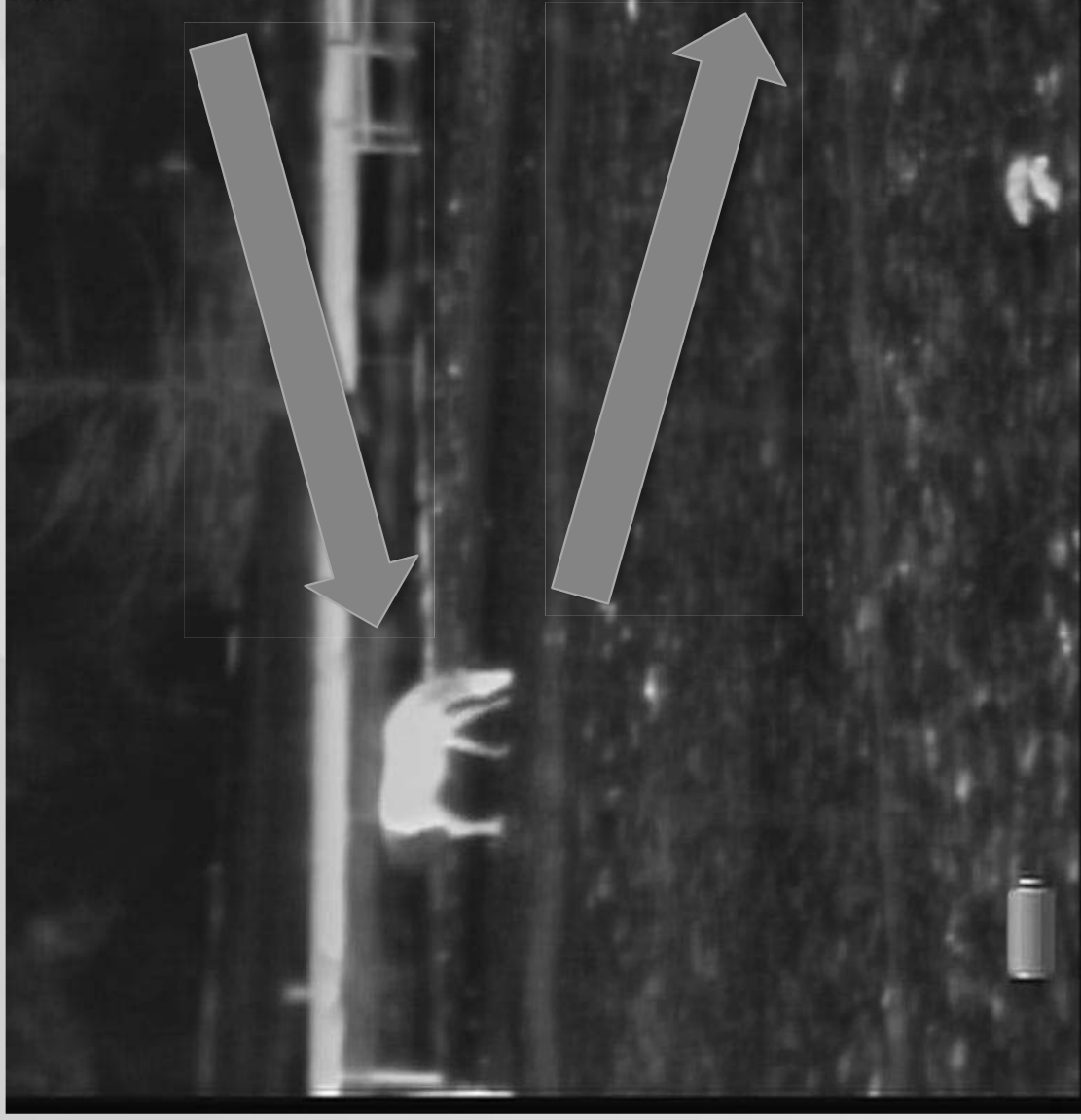


MSU Video: SDS on 30 classes

Pedestrian Detection using Deep Learning with Thermal & Visible Spectral Fusion

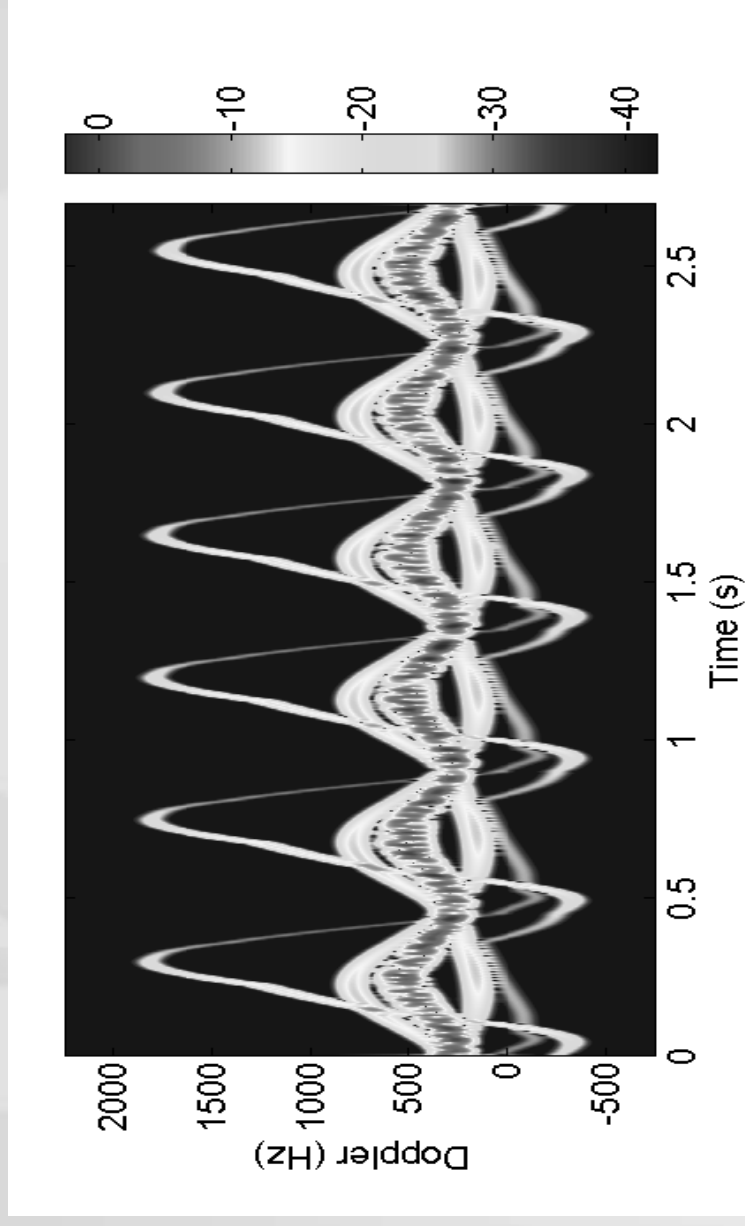


Object Detection and Tracking in the Thermal Infrared Spectrum



CANVAS Advanced Radar Research

- Detection and classification of pedestrians, vehicles, animals, etc...
- Classification of people and activities



canvas RESEARCH: V2X sensor fusion

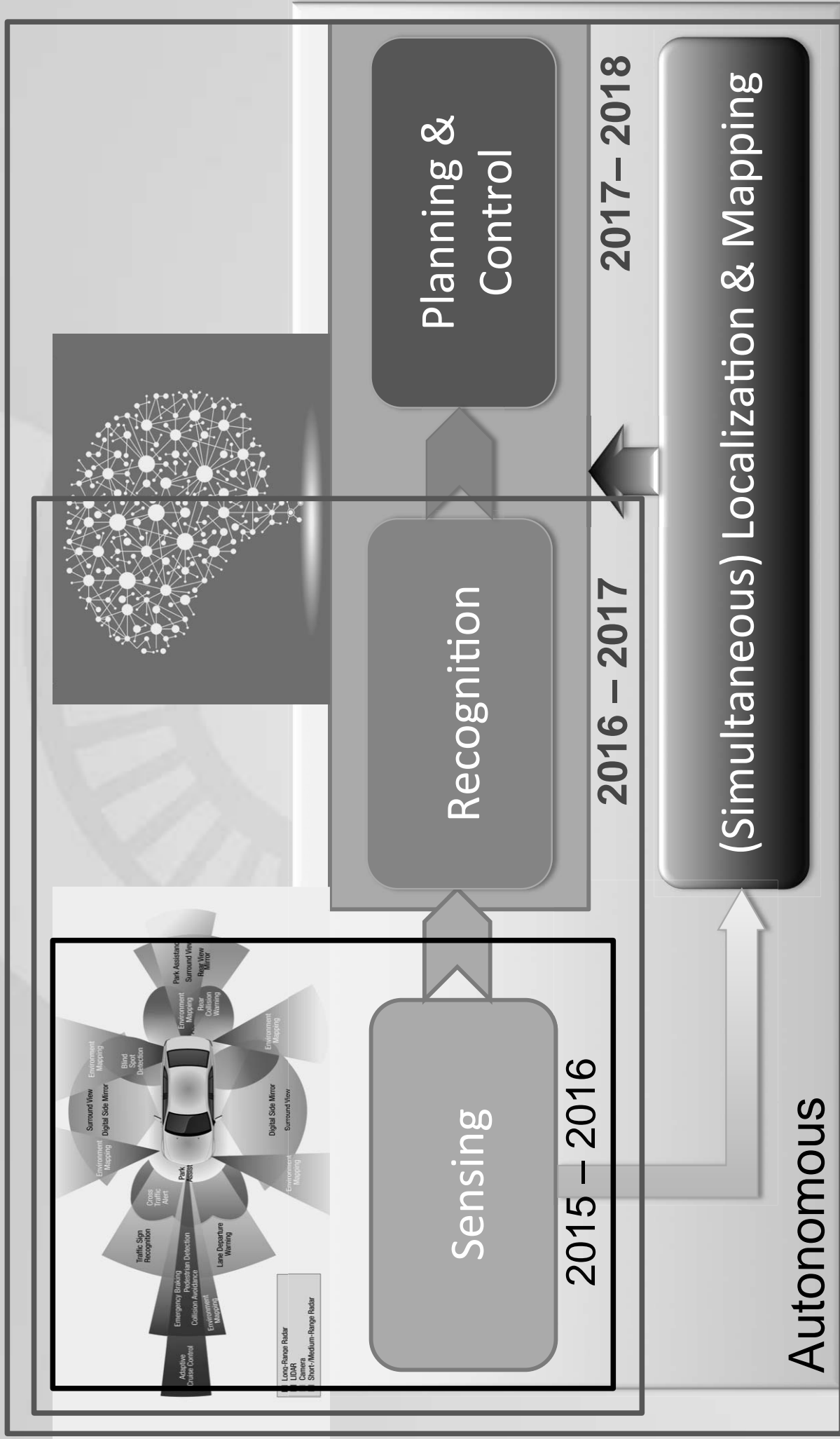
- **sensor & data fusion**

Intra- & inter-modality fusion of sensed signals





Autonomous Vehicle: Architecture



CANVAS Research, Student Engagement & Outreach

Research

Faculty, Grad/Undergrad Students & Industry

Education, Student Engagement & Outreach

CAV Related Courses

CAV Practical Training

CAV Students' Club

CAV International Competitions

CANVAS Education & Student Engagement

CANVAS Students' Club & Practical Training



CANVAS Education & Student Engagement

CANVAS Students' Club

- **Attracted ~ 50 students**
- **Electrical & Computer Engineering 45%**
- **Computer Science & Engineering 36%**
- **Mechanical Engineering 9%**

CANVAS Education & Student Engagement

NHTSA Enhanced Safety Vehicle (ESV) Competition



CANVAS Education & Student Engagement

SAE/GM AutoDrive Challenge



Autonomous Technology for People with Disabilities



- Autonomous technology could benefit the 1.9 million people living with disabilities in MI
- The lack of transportation limits:
 - Independence
 - Economic opportunity
 - Community inclusion
- Ensuring accessibility goes beyond operating systems
- Autonomous technology presents an opportunity to overcome these barriers



CANVAS OUTREACH: Michigan Protection & Advocacy Service, Inc.

- MPAS sees a unique opportunity for people with disabilities in the emergence of Michigan's autonomous vehicle industry
- Michigan can be a leader in improving the lives of these individuals
- MPAS is very interested in working cooperatively with MSU's College of Engineering to ensure accessible autonomous technology







Thank You!

OPTION AGREEMENT TERM SHEET

Party: *Bio-Electrica*

Agreement: Option to exclusively license patent rights in all fields of use

Term: One year from SBIR funding, expected January 1, 2018, term extension for up to two years

Technology: TEC2010-0031 (US Patent 9,716,287, US Application 15/589,950 and foreign equivalents) "Microbial Fuel Cells powered by cellulolytic-geobacter consortia for efficient bioenergy conversion"
TEC2015-0128 "Microbial electrochemical cells and methods for producing electricity and bioproducts therein"
TEC2016-0100 (US Application 14/705,766) "Single Chamber microbial electrolysis cell (SCMEC) and biocatalyst engineered for operation within"

Technology's Potential Commercial Utilization: Microbial electrochemical reactors which are capable of fermenting insoluble or soluble biomass to produce either electricity or fermentative products such as ethanol and 1,3-propane-diol from a polyol biomass

Payment Terms: Option fee of \$1,000, first one-year extension \$2,000, second one-year extension \$4,000

Services Provided: By MSU to *Bio-Electrica*: None contemplated under the agreement
By *Bio-Electrica* to MSU: None contemplated under the agreement

Organization Type: Michigan corporation

Personnel Interest: Dr. Gemma Reguera, an Associate Professor, and employees Rebecca Steidl and Alexander Grohalski, all in the Department of Microbiology and Molecular Genetics, and members of their families have, or have options to buy, an ownership interest of more than 1% of the company.

SERVICE AGREEMENT TERM SHEET

Party: *Bio-Electrica*

Agreement: Service Agreement for fermentation process and production of 1,3-propane-diol from glycerol

Term: Effective date to December 31, 2019

Payment Terms: \$40,490 budgeted on a fee for service basis with the total cost dependent upon actual services rendered

Services Provided: By MSU to *Bio-Electrica*: Receive strains, establish growth, validate analytical methods and set-up requirements for fermentation, test ratios of inoculation, test fermentation optimization strategies
By *Bio-Electrica* to MSU: None contemplated under the agreement

Organization Type: Michigan corporation

Personnel Interest: Dr. Gemma Reguera, an Associate Professor, and employees Rebecca Steidl and Alexander Grohalski, all in the Department of Microbiology and Molecular Genetics, and members of their families have, or have options to buy, an ownership interest of more than 1% of the company.

SPONSORED RESEARCH AGREEMENT TERM SHEET

Party: *Bio-Electrica*

Agreement: Subcontract under National Science Foundation Institutional Proposal Number 00307141 "(Phase I) Electro-fermentation of Glycerin for the Production of Value-Added Chemicals"

Term: January 1, 2018 to June 29, 2018

Payment Terms: Award amount of \$45,510.84

Services Provided: By MSU to *Bio-Electra*: Research Technician, supplies, and laboratory for construction of vector and CRISPR-Cas9 nickase system for genome editing of *Clostridium butyricum* and testing of mutant strains for electro-fermentation performance
By *Bio-Electra* to MSU: None contemplated under the agreement

Organization Type: Michigan corporation

Personnel Interest: Dr. Gemma Reguera, an Associate Professor, and employees Rebecca Steidl and Alexander Grohalski, all in the Department of Microbiology and Molecular Genetics, and members of their families have, or have options to buy, an ownership interest of more than 1% of the company.

PROFESSIONAL SERVICES CONTRACT TERM SHEET

Party: Cultural Intelligence Center, LLC

Agreement: Professional services contract for orientation, training, assessment, and feedback services for MSU leaders and students related to international travel and diversity and inclusiveness on campus

Term: September 8, 2017 to September 7, 2018

Payment Terms: Cultural Intelligence Center LLC to provide up to seven training sessions for a fee from MSU of \$7,500* per session for up to 50 participants per session. Additional participants above 50 per session for an additional fee of \$50 per person, plus reasonable travel expenses. An additional training program for Human Resources is planned for \$20,000.

Services Provided: By MSU to Cultural Intelligence Center, LLC: venue, use of audio/visual equipment, any catering deemed appropriate by MSU

By Cultural Intelligence Center, LLC to MSU: training, research-based and validated assessment, and feedback related to international travel, cultural intelligence, and diversity and inclusiveness; certification program

Organization Type: Michigan limited liability company

Personnel Interest: Dr. Linnea Van Dyne, a Professor in the Department of Management, and members of her family own, or have options to buy an ownership interest of, more than 1% of the company.

*Cultural Intelligence Center, LLC is the only provider of the described services to include research-based, validated assessment with in-depth and individualized reports. Cultural Intelligence Center, LLC has agreed to give MSU the discounted price reflected above. In a separate program in another topic area, similar services that include research-based, validated assessments were priced 10% higher than the agreed price for the Cultural Intelligence Center, LLC services described above.

LICENSE AGREEMENT TERM SHEET

Party:	Drawbridge, Inc.
Agreement:	Drawbridge to continue to license Eli Review writing instruction software service to MSU and provide support and hosting of the software
Term:	August 28, 2017 to August 27, 2020
Payment Terms:	\$44,100 annual license fee
Services Provided:	By MSU to Drawbridge: None By Drawbridge, Inc. to MSU: Drawbridge will provide hosting services, customer service and technical support to MSU with respect to problems related to access and/or use of Eli Review writing instruction software.
Organization Type:	Michigan corporation based in East Lansing
Personnel Interest:	Dr. Jeffrey Grabill, a Professor in the Department of Writing, Rhetoric and American Cultures, and Dr. William Hart-Davidson, an Associate Professor in the Department of Writing, Rhetoric and American Cultures, and members of their families own or have options to buy an ownership interest of more than 1% of the company.