

NSF Award #2119691

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# AI SUSTEIN

EPSCoR RII Track-2 FEC

## Newsletter

volume #1

“Technology  
has brought  
US  
together...”



## Words from the Investigators

### How we are doing and what we are up to.

“In recent years, extreme weathers occur frequently across the nation such as extreme cold/hot conditions, extreme dry conditions/wildfire, extreme heavy rain/flood, and hurricanes. The regional and national energy systems are vulnerable to these extreme weather conditions, which may lead to risks in life and economic losses. The Artificial Intelligence on SUSTainable Energy Infrastructure Network (AI SUSTEIN) program intends to pave a pathway to address this regional and national challenge by seeking for more sustainable and reliable energy networks in extreme weather conditions through the applications of artificial intelligence. It has been wonderful to watch the AI SUSTEIN program grow from where it started. From an idea, to a paper, to a proposal, and then to the program we are today funded by the National Science Foundation. New technology has been essential to what has brought us together. Researchers with different expertise from non-neighboring states come together and collaborate towards the goal of implementing new technology into our energy network systems. It has truly been an honor to lead the AI SUSTEIN program. I look forward to seeing the success of this program and the impacts this program can bring to the region and the nation.” ~Ying Haung, (Associate Professor, North Dakota State University), Principal Investigator

“AI SUSTEIN is an exuberant program to be a part of! It is a great opportunity to share and spread knowledge about what AI is capable of and how it can revolutionize industries that are crucial to our being. The to-be developed framework using machine learning can be used to understand the interdependency of the power grid, the pipeline

system, and other renewable energy sources. With the help of the great minds gathered for this, AI SUSTEIN will bring impacts to the region and nation!” ~Trung (Tim) Le, (Assistant Professor, North Dakota State University), Co-Principal Investigator

“I am very excited about the joint effort that is taking place in the AI SUSTEIN program. Through our active collaboration and research exploration, AI SUSTEIN will create strategic frameworks for improving the resilience of energy infrastructure via stochastic optimization, and AI-enhanced condition-based maintenance and decision-making.” ~Haitao Liao, (Professor, University of Arkansas), Co-Principal Investigator

“It has been my pleasure serving as a member of the AI SUSTEIN team. Together, AI SUSTEIN will also quantify the economic, risk, and social impacts from failures of energy network failures for better preparedness towards extreme weathers. In addition, the program will also develop a diverse and readily workforce through developing undergraduate minors in AI.” ~Eakalak Khan, (Professor, University of Nevada, Las Vegas), Co-Principal Investigator

“Being able to put together a revamped Computer Science Degree and introducing Artificial Intelligence on top of it will really help the students at Nueta Hidatsa Sahnish College (NHSC). This program will do wonders for spreading knowledge about AI and what can be created with it! We are genuinely grateful to be a part of the AI SUSTEIN program!” ~Jeremy Lewis, (Comptroller, NHSC), Co-Principal Investigator, and Kerry Hartman, (Dean, NHSC), Co-Principal Investigator

# Welcome to AI SUSTEIN

AI Meets the Energy Networks

## Introducing [aisustein.com](https://www.aisustein.com)

### The site for everyone to see what we're up to and who we are!

AI SUSTEIN is excited to be able to deliver everything from a summary of what we are about and details of the research we have completed to who we are and how you can join us in both mobile and desktop formats at [https://www.aisustein.com/!](https://www.aisustein.com/)

For those who just want a brief summary of what the program is about, by default the home page will be what you are looking for. Still not enough to really understand what we aim to do? A more detailed explanation is within the "About" section, this is also where a dropdown menu will appear to give you the option to learn about the people and companies who are taking part in this program. For those who are curious about how we plan on improving energy infrastructure networks, look into the "Research" section. We divide research into three different themes with similar ideas that each build on each other. Check out the goals of each research theme by going to each theme's page under the "Research" drop down menu! In a similar vein to research, the "Showcase" section of the site will

illustrate the showcases on both the research and education theme goals. Each showcase has a pdf summary that includes a link to the full case study.

For those who are more interested in what we are striving towards in the education perspective, take a look into the "Education" section. This will eventually include information about future minors created at the participating universities!

The site also includes awards that have been given to the team, newsletters, and upcoming events in the "News & Events" section. Wondering about whether you can join or take part in anything? Available positions for both students and faculty members are under the "Job" section, with any questions or concerns to be for the "Contact" section.

Lastly for those new to the site, there are fun "Did You Know?" boxes spread around sections of the site that contain fun facts or interesting articles related to the area of the power grid. See more at [aisustein.com!](https://www.aisustein.com)

# Congratulations to Our Seed and Start-Up Grant Awardees!

In the year of 2022-2023, AI SUSTEIN selected six outstanding faculty as the Seed and Start-up grant awardees. Congratulations to: Alan Vazquez, Jeehee Lee, Marie-Odile Fortier, Surya Sarat Chandra Congress, Thi Hoang Ngan Le, and Wenjie Xia! Let's meet them!

Alan Vazquez is an Assistant Professor in Industrial Engineering at UARK. Prior to joining UARK, he was an Assistant Adjunct Professor in the Department of Statistics, at the University of California, Los Angeles. His research interests include statistics, Experimental design, model selection and longitudinal data analysis, and heuristic algorithms and mixed integer programming.

Jeehee Lee is an Assistant Professor in Construction at UNLV. She joined UNLV in the spring of 2021 and had been a postdoctoral researcher at Texas A&M University before that. With 3+ years of industry experience at a global construction management company, her overarching research goal is to develop "Human-Technology-Built Environment Interaction" as a driving force of sustainable/resilient buildings, communities, and cities.

Marie-Odile Fortier is an Assistant Professor in Civil and Environmental Engineering and Construction, specifically Sustainability in Arid Lands, at UNLV. Previously she was an assistant professor at the University of California, Merced, and before that at State University of New York College of Environmental Science and Forestry. Her research interests include: life cycle assessment (LCA) methodology development, parametric life cycle modeling of energy systems, increasing geographic specificity in LCA, climate change mitigation strategies, and novel renewable energy systems.

Surya Sarat Chandra Congress is an Assistant Professor in the Department of Civil, Construction and Environmental Engineering

Alan Vazquez  
(UARK)



Jeehee Lee  
(UNLV)

Marie-Odile  
Fortier  
(UNLV)



Surya Sarat  
Chandra  
Congress  
(NDSU)

at NDSU. He is part of the ASCE Committee on Innovative Technologies and Tools in Geotechnical Engineering task force. He is interested in sustainable and resilient infrastructure design, ground improvement techniques, and smart city concepts using innovative sensors and smart monitoring technologies.

Thi Hoang Ngan Le is an assistant professor in Computer Science & Computer Engineering at the UARK. She used to be a research associate in the Department of Electrical and Computer Engineering at Carnegie Mellon University. Her research interests focus on Image Understanding, Video Understanding, Computer Vision, Robotics, Machine Learning, Deep Learning, Reinforcement Learning, Biomedical Imaging, and SingleCell-RNA.

Wenjie Xia is an Assistant Professor in the Department of Civil, Construction and Environmental Engineering at North Dakota State University. Prior to joining NDSU, he was an MGI-CHiMaD (Materials Genome Initiative – Center for Hierarchical Materials Design) Fellow at National Institute of Standards and Technology. His research interests include multiscale modeling of polymers, soft matter physics, and mechanical behaviors of complex materials.

Congratulations once again on your efforts and joining the team!

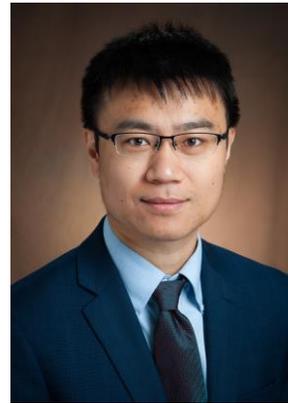
## Other Awards

This year has been successful not only for the team here at AI SUSTEIN but also for those whose hard work has come to light! Congratulations to everyone who has received an award!

Trung “Tim” Le received [NDSU’s Peltier Award](#) for Teaching Innovation on May 10<sup>th</sup>, 2022. This award is given to those recognized for their contributions towards teaching innovation and student success.

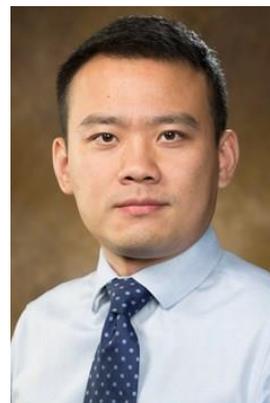
Xiao Liu received the [NSF CAREER Award](#) on July 22<sup>nd</sup>, 2022. This award is given to those in their early career who have the potential to be an academic role model in research in their department. On top of the NSF CAREER Award, Xia Liu and team also received an [NSF Grant to build “Urban Resilience”](#).

Thi Hoang  
Ngan Le  
(UARK)



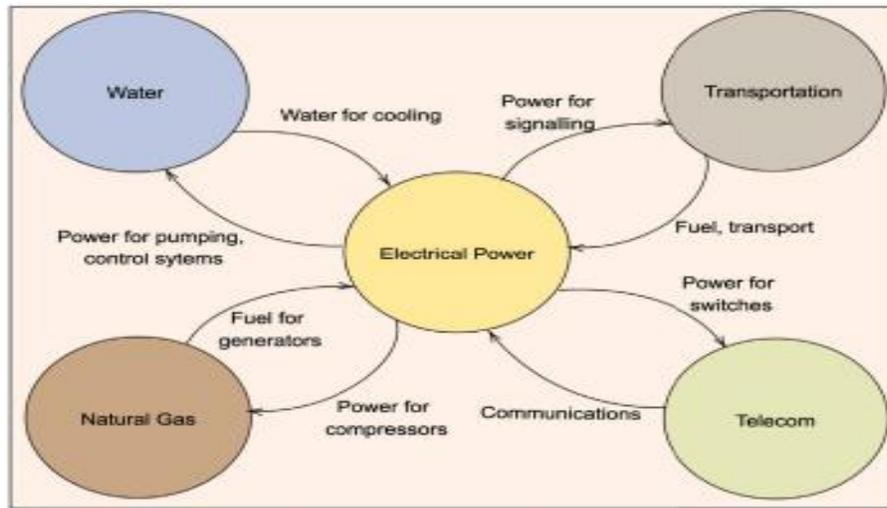
Wenjie Xia  
(NDSU)

Trung “Tim” Le  
(NDSU)



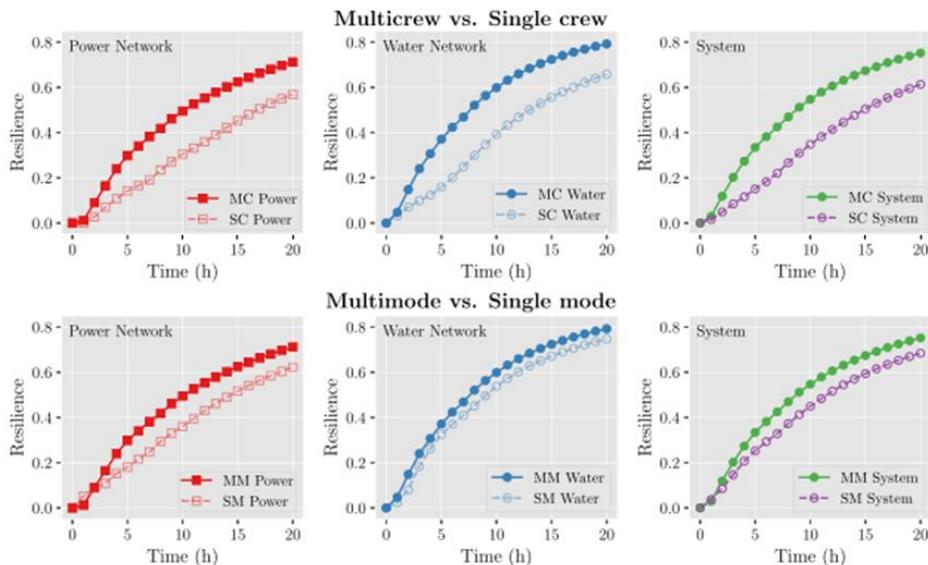
Xiao Liu  
(UARK)

# SHOWCASES



## #1 Resilience & Cost

This showcase called “Model and solution method for mean-risk cost-based post-disruption restoration of interdependent critical infrastructure networks” by Basem A. Alkhaleel, Haitao Liao, and Kelly M. Sullivan is about creating a model to speed up the recovery of a critical infrastructure network (shown above) if it were to malfunction. This is done by expanding on previously studied restoration models that do not include cost, repair, flow, and resilience loss. This expanded version has two stages; with the first stage looking for any failed components, scheduling a crew to fully restore it or restore enough to function, and calculating the restoration cost, and the second stage calculating the other costs like unmet demand and flow. Upon testing this model with earthquake scenarios, the model was able to show a 10-20% decrease in economic loss, 27% decrease in repair costs, and 20% decrease in disruption costs when compared to other models.



# SHOWCASES

## #2 Integrated Systems

Our second showcase puts the focus on the less studied topic of integrated power and gas systems (IPGS). Written by Almir Ekic, Di Wu, and Ying Huang, this study, “A Review on Cascading Failure Analysis for Integrated Power and Gas Systems” takes a deep dive into the attributes that correspond with cascading failures in IPGS. General attributes that have been looked into for the systems include things like redistribution and redispatching, flow dynamics, and stability. When these systems are on their own they have different attributes that are important to cascading failure. For example, the power system has multiple different kinds of stability, like voltage, small signal, and frequency. This study concludes with the knowledge that although the specific attributes of cascading failure have been studied for these systems on their own, only the general attributes have been looked at for IPGS. In other words, when these systems are put together there is opportunity to research and study those same specific attributes. For example, IPGS research has yet to include attributes like voltage stability, small signal stability, etc.

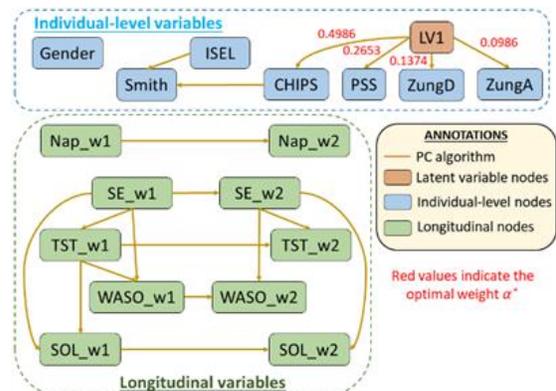
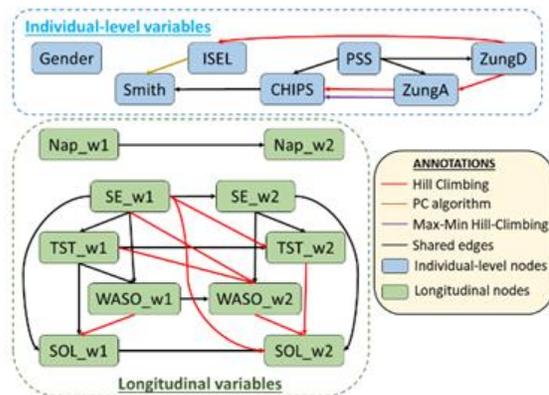
Investigated Features for Cascading Failure Analysis	Power System	Gas System	IPGS
Power Flow Redistribution and Redispatching	Yes		Yes
Voltage Stability	Yes		No
Transient Stability	Yes		No
Small Signal Stability	Yes		No
Frequency Stability	Yes		No
Protection and Relay	Yes		No
Gas Flow Redistribution and Redispatching		Yes	Yes
Transient Flow Dynamics		Yes	Yes
Transient Stability		Yes	Yes

# SHOWCASES

## #3 Causal Relationships

The third showcase called “Causal Inference in Longitudinal Studies Using Causal Bayesian Network with Latent Variables” by Phat Huynh, Leah Irish, Arveity Setty, Om Yadav, and Trung Q. Le we are looking at a model that can be used with more certainty for different cause and effect variables. This study adds on to an existing framework called Bayesian Network for Latent Variable (BN-LV) where the conditional probability that another variable/event may occur based on some variable is made evident. The additional piece put into this framework allows for locating different latent variables and estimating their values, which are then changed to a causal structure with causal techniques. Something else that was added to lower the complexity of learning the structure was to include the constraint that only preceding variables can cause future ones. This model was tested with the case study “Temporal Associations Between Daytime Napping and Sleep Outcomes” and the results show the model works as intended.

For a more in-depth summary go to <https://www.aisustein.com/showcase>.



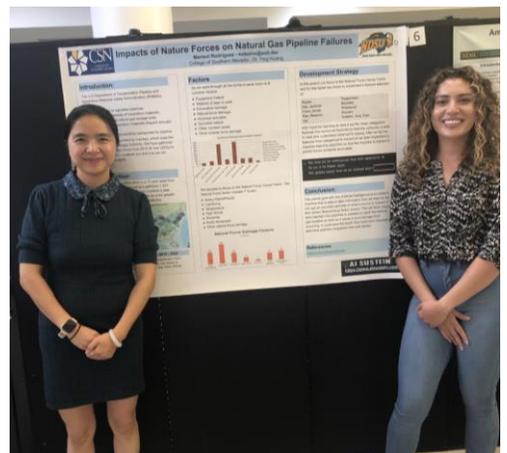
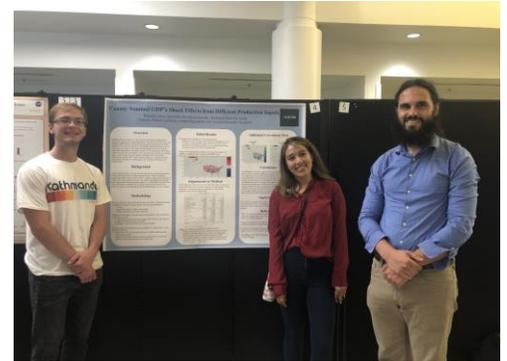
# REU Program



Pictured above from left to right are our summer 2022 REU Students: Martin Rodriguez Maciel, Marisol Rodriguez, Michael Rowe, Ethan Regal, Nicholas Walters, Aaron Qiu, Priyanka Davis, and Nour Hakim.

Through an eight-week summer REU program with different training and weekly workshops, our REU students learned new knowledges in AI, energy networks, and economic impact analysis, and achieved new heights. Mentors taught alongside the participants with problem solving and critical thinking. With the intensive research experiences during the eight weeks, the REU students presented their new knowledge and accomplishments with a poster presentation to the NDSU summer research symposium. Selected photos are as seen in the photos to the right.

In addition to the successful summer REU program, NDSU and UNLV have started planning towards AI minors in addition to an AI certificate at UARK, and a restructured Computer Science field for NHSC. Each university has presented their AI minors, and some should be ready to be offered as soon as 2023! For more information visit the AI SUSTEIN site at <https://www.aisustein.com/showcase>.





# 2022 AI SUSTEIN Annual Meeting

The AI SUSTEIN first annual meeting was held at North Dakota State University in Fargo, ND on August 10 and August 11, 2022. The next meeting will be held next summer at the University of Arkansas in Fayetteville, AR. Faculty, students, and members of the governance board attended the meeting. There was representation from all four higher education partner institutions. The meeting focused on:

- Collaboration between the faculty and students across institutions;
- Early faculty and seed awardee workshops on proposal writing;
- Graduate student research presentations;
- Networking;
- Theme updates;
- Additional education opportunities for institutions;
- External board evaluations;
- Planning for Year 2.

There were many great discussions in the meeting. The next meeting will be held next summer at the University of Arkansas in Fayetteville, AR. There is much excitement for next year's meeting!

## AI SUSTEIN

**AUGUST 12**

Zoom link: <https://ndsu.zoom.us/j/94879993732>  
 Location: Sahred, MI

8:30-9:00am: Breakfast  
 9:00-10:30am: AI SUSTEIN round table discussion  
 9:25-9:45am: Opportunities for liberal colleges  
 9:45-10:00am: Mentoring a liberal workshop (senior master EC, EC mentor grad students, graduate student mentoring undergraduate students)  
 10:00-10:30am: Planning for FY2  
 10:30-11:00am: Networking break  
 11:00am-11:45am: Breakfast work sessions for inter-jurisdictional research collaborations (powered table work groups) for RT1, RT2, RT3, EWOT

11:45am-12:00pm: Reporting out from breakout work sessions  
 12:00-12:30pm: External Advisory Board group observations and discussions with all participants  
 12:30-2:00pm: Luncheon and closing remarks (Meadow Lake, MN)

Invited speaker: Dr. Margaret Fitzgerald, Provost, NDSU, Dr. Colleen Fitzgerald, Vice President for Research, Research & Creative Activity, NDSU, and Dr. Michael Krosner, Dean, College of Engineering, NDSU (introduction of NDSU research capacity and social event for collaboration opportunities)

AI SUSTEIN would like to thank you for attending the annual meeting

Website: [www.ai-sustain.org](https://www.ai-sustain.org)  
 Contact: Karla Tabority (701) 231-7541  
 karla.tabority@ndsu.edu

**AUGUST 11, AND AUGUST 12, 2022**

### ANNUAL MEETING AT NORTH DAKOTA STATE UNIVERSITY

An NSF EPSCoR Track 2 RB Program (NSF-OIA-2119091)

Guest Web Access Instructions:

1. Connect to the NDSU Guest website: [www.ai-sustain.org](https://www.ai-sustain.org)
2. Open a Web browser and go to any webpage
3. Enter your name in the Full Name field and Interacting in the Password field
4. Once you click Submit, you will be redirected to your home page and will have Internet access.

**Schedule of Events**

## AI SUSTEIN

**AUGUST 11**

Zoom link: <https://ndsu.zoom.us/j/9670766963>  
 Location: Sahred, MI

8:30am-9:00am: Registration and breakfast  
 9:00-9:15am: Opening remarks (Welcome) and ice breaker  
 9:30-9:45am: AI-SUSTEIN - Project Mission, Goals, and Milestones  
 9:45-9:55am: Introduction of External Advisory Board  
 9:55-10:00am: Networking break  
 10:00am-11:00am: Theme Presentations and Discussions  
 10:00-10:15am: Research Theme (RT) 1  
 10:15-10:30am: Research Theme (RT) 2  
 10:30-10:45am: Research Theme (RT) 3  
 10:45-11:00am: Education and Workforce Force Development (EWOT) Theme

11:00-11:15am: Elevator Talks (2-minute talk by each EC-researcher and graduate student)  
 11:15-11:30am: Networking break  
 11:30am-12:15pm: Graduate Student Presentations  
 11:25-11:55am: Phai Hoang (Dr. Trung Le, Member)  
 11:55am-12:15pm: Mojib Alarabi (Dr. Roy McCann, Member) Virtual  
 12:15-1:30pm: Luncheon  
 Invited Speaker: Dr. Kelly A Busch, Professor and Director of ND EPSCoR, NDSU, Current NSF EPSCoR Track-1 PI  
 1:30-3:30pm: Proposal Writing Workshops

Virtual Workshop Provided by Lucy Deckard, President of Academics, Research Funding Strategies, LLC, Associate Director, Office of Proposal Development, Texas A&M University  
 (More information for Lucy Deckard, please refer to [www.ai-sustain.org](https://www.ai-sustain.org))

1:30-2:30pm: Session A - NSF proposals, including regular, CAREER and others  
 2:30-2:35pm: Break  
 2:35-3:30pm: Session B - Non-NSF proposals including DOE, DoI, DoT, etc.  
 3:30-3:50pm: Networking break  
 3:50-4:30pm: Graduate Student Presentations  
 3:50-4:15pm: Rathi Yasode (Dr. Ying Huang, Member)  
 4:10-4:30pm: Shunsheng Shi (Dr. Ying Huang, Member)  
 4:30-6:30pm: Dinner Reception (Check-in: Alaura, Harry D. McGovern NDSU Alaura Curran) with Galia Sokolov, Chris Argentianni at 5:00-6:00pm.

# Introducing the AI SUSTEIN TEAM

Our members are from different backgrounds and disciplines to create a holistic view of this program. Names will be listed in alphabetical order starting with NDSU, NHSC, UARK, UNLV, then our external advisory board, students, and lastly our industry partners. For more information go to <https://www.aisustein.com/about>.

The NDSU team includes Di Wu in Computer and Electrical Engineering, James Caton in Economics, Kirstin Saulsbury as the project coordinator, Nita Yodo in Industrial and Manufacturing Engineering, Saeed Salem in Computer Science, Trung (Tim) Le in Industrial and Manufacturing Engineering, and Ying Huang in Civil, Construction, and Environmental Engineering.

The NHSC team has Kerry Hartman, the Academic Dean, and Jeremy Lewis the Comptroller.

The UARK team consists of Ed Pohl in Industrial Engineering, Haitao Liao in Industrial Engineering, Roy A. McCann in Electrical Engineering, Xiao Liu in Industrial Engineering, Xintao Wu in Computer Science/Engineering, and Yue Zhao in Engineering.

The UNLV team includes Eakalak Khan in Civil and Environmental Engineering, Erica Marti in Civil and Environmental Engineering, and Krystyna Stave in Public Policy and Leadership.

The external advisory board consists of Brij Singh from John Deere, Darcy Neigum from Montana-Dakota Utilities Company, Douglas Bowman from Southwest Power Pool, and Michael Kessler from NDSU.

Students include Allison Scharmer, Tiffany Meeks, Dylan James Zapzalka, Almir Ekic, Karuna Bhaila, Melika Ansrinejad, Mireille Tankoua Sandjong, Mishkatur Rahman, Mojtaba Ahanch, Phat Kim Huynh, Quoc Huu Nguyen, Seyyed Farid Hashemian, Shuomang Shi, and Tanzina Afrin. The list of students grows as the project progresses.

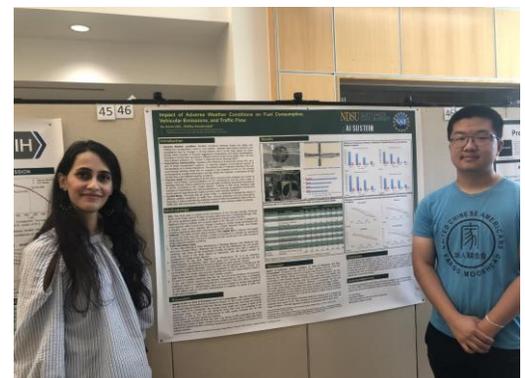
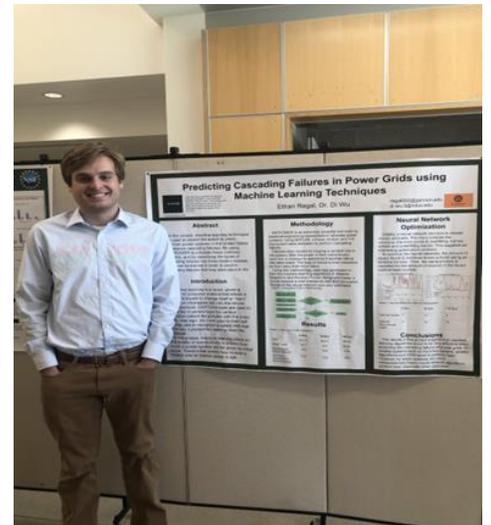
Lastly, our industry partners are Montana-Dakota Utilities Company (MDU), Oklahoma Gas and Electric Company (OGE), and Southwest Power Pool (SPP).



# CLOSING STATEMENTS

AI SUSTEIN successfully created its strategic plans during the first year and has moved on its path to grow artificial intelligence applications for improving the sustainability and reliability of the region's and nation's energy networks during extreme weathers. Together, we believe AI SUSTEIN will achieve its goal and impact society!

Thank you for taking the time to read this newsletter and help support AI SUSTEIN! Please feel free to reach the AI SUSTEIN team anytime if you have any questions or are interested in collaborating with us, or contact us at <https://www.aisustein.com/contact>.



# Contact Us!



# AI SUSTEIN

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