PLAN IOWA ENERGY (PIE)

Evaluating & Strengthening Iowa's Power Grid for High Wind/Solar Penetration Levels

A 3-Year Project



Project Advisory Board Meeting

Wednesday, September 13, 2023, 8-9amCT



James McCalley, Colin Christy, Investigators Gustavo Cuello-Polo, Ph. D. Student Dut Ajang, M.S. Student

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Meeting Agenda

- 1. Introduction
- 2. Project essentials
 - Project motivation, objectives and tasks
 - Key power system design tool:
 - Adaptive Coordinated Expansion Planning (ACEP)
 - Visions (& uncertainties, futures, plans)
- 3. Highlights of recent work
 - Extreme conditions
 - Extreme events
- 4. Next steps
- 5. PAB feedback (last 20 minutes)

Introduction

• Website:

https://home.engineering.iastate.edu/~jdm/pie/index.htm

- ISU personnel
 - James McCalley, Colin Christy, Investigators
 - Gustavo Cuello-Polo, Ph. D. Student
 - Dut Ajang, M.S. Student
- PAB members
- What we request from you:
 - Attend meetings/review reports;
 - Represent your org & the state of lowa;
 - Help identify "visions";
 - Give opinions, suggestions, corrections;
 - Respond in meetings, by email, phone.
- Goals of this meeting
 - Provide project essentials;
 - Motivate your thought and input.

Organization	Person	Title	
STATE AGENCIES			
Iowa Economic Development Authority	Stephanie Weisenbach	Program Manager	
Iowa Utilities Board	Sarah Martz	Board Member	
Iowa Utilities Board	Edgard Verdugo	Utilities Regulatory Engineer	
Iowa Office of the Consumer Advocate	Tim Tessier	Utility Specialist	
Iowa Department of Transportation	Sam Sturtz	Chair, Iowa DOT Resiliency WG	
OTHER AGENCIES			
Iowa Association of Municipal Utilities	Troy DeJoode	Executive Director	
Iowa Association of Elect. Cooperatives	Ethan Hohenadel	Regulatory Affairs Director	
Iowa Utility Association	Chaz Allen	Executive Director	
Iowa Environmental Council	Steve Guyer	Energy Policy Manager	
Iowa Industrial Energy Group	Amanda James	Executive Director	
Iowa State Institute for Transportation	Shauna Hallmark	Director	
REGIONAL TRANSM. ORGANIZATIONS			
Midcontinent Independent Sys Operator	Armando	Sr. Engr., Strategic Assessments	
	Figueroa-Acevedo		
Southwest Power Pool	<mark>Sunny Raheem</mark>	Manager, Planning Policy&Rsrch	
	Clint Savoy	Manager, Interregional Strategy	
INVESTOR-OWNED UTILITIES			
Alliant Energy	Mike Graves	Lead Engineer	
MidAmerican Energy	<mark>Dehn Stevens</mark>	VP, Transm Planning & Dvlpmnt	
ITC Transmission Midwest	Rob Wells	Supervisor, Planning	
MUNICIPAL UTILITIES			
City of Ames Electric	<mark>Don Kom</mark>	Director	
Cedar Falls Utilities	Ken Kagy	Principle Transmission Engineer	
Muscatine Power and Water	Ryan Streck	Director, Utility Service Delivery	
COOPERATIVE UTILITIES			
Central Iowa Power Cooperative	Ethan Tellier	Planning engineer	
Corn Belt Power Cooperative	Tyler Baxter	Engineer III	
Dairyland Power Cooperative	Ben Porath	Chief Operating Officer	
Maquoketa Valley Electrical Cooperative	Nik Schulte	Distribution system manager	

Project Motivation, Objectives, & Tasks

- Motivation
 - Energy planning is done for regions, for utility areas, but not for lowa
 - Establish *visions*:
 - emphasizing cost minimization;
 - emphasizing CO₂ reduction;
 - emphasizing energy export;
 - emphasizing resilience.
 - Develop benchmark plans on what, ^{2.} when, where, how much GTD to develop_{3.}
 - Compare/contrast to RTO/utility plans
- Objective:

Identify several 25-year plans to position Iowa's low carbon electric infrastructure to perform well under normal and climate-influenced extreme events & conditions.

Tasks G2-G3, RTO processes: Describe MISO/SPP planning processes; monitor.

- ✓ MISO Planning Subcommittee (PSC) -
- Long Range Transmission Planning (LRTP) Workshops
- ✓ SPP Transmission Working Group
- ✓ SPP Future Grid Strategy Advisory Group

<u>**Task G4, Resilience</u>**: Assume IA/MISO are producing very high % of energy from non-CO2 sources by 2050 - what will be conditions & extreme events that cause high risk, and how to mitigate those risks?</u>

Task G5, G6, G7, Tools: Apply/illustrate the following tools for this project.

- 1. <u>Model Reduction</u>: Develop a high-fidelity reduced expansion planning model, with high detail in Iowa, from a 90,000 bus EI power flow.
- 2. <u>Adaptive Coordinated Expansion Planning (ACEP)</u>: Provides the best 25-yr G,T,D plan given a number of possible futures.
 - . <u>Resilience-based Coordinated Expansion Planning (R-CEP)</u>: Identifies leastcost investments for normal and extreme events & conditions.
- 4. <u>Folding Horizon Simulation (FHS)</u>: Assesses a 25-yr plan for cost & reliability.

<u>**Task G8-G9, 5 plans</u>**: Use tools to develop/evaluate 5 electric infrastructure build plans for Iowa, accounting for different technologies (e.g., new nuclear, carbon-capture, load control, storage, HVDC) according to different visions:</u>

- <u>Minimum cost</u>: Maintain avg annual R/C/I cost of 12, 10, 6 ¢/kwh (EIA).
- <u>*Minimum CO*</u>: Cut 2025 CO_2 levels from electric/transportation by 90%.
- <u>Maximum energy export</u>: Produce 1.5× in-state electric energy requirements
- *Maximum resilience*: Reduce extreme event cost of electric outages by 60%.
- <u>Balanced</u>: Seek a balanced portfolio of above 4 features.

Key Power System Design Tool: Adaptive Co-optimized Expansion Planning

A computer model we have developed:

→Identifies a *plan* (where/when/what/how-much

G, T, D to build) over ~25yrs to minimize NPW

investment costs plus

operational costs
subject to multiple futures
and system constraints.



TODAY

Exploratory, not predictive:

We "point it" in the direction of a particular vision.

We identify several "futures".

-2030

It gives least-cost G,T,D plan for that vision subject to specified futures & sys constraints. 5

2035

FUTURE1

2040

2050

FUTURE 2



Highlights of recent work (see website for report): Task G2, Project Report #1: MISO & SPP Planning Processes



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Highlights of recent work (see website for report): Task G4, Project Report #2: High-risk conditions & events



wind/solar, expressed as a function of % solar.

Highlights of recent work (see website for report): Task G4, Project Report #2: High-risk conditions & events

1 Int	roduction	
2 Extreme conditions		
2.1	Overview of datasets	
2.2	Calculation of hourly wind and solar output7	
2.3	Analysis of results: times of low renewable generation	
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2.5	Future work	
3 Extreme weather events		
3.1	Extreme weather event categories	
3.2	Extreme weather event data	
4 Cc	nclusions and next steps	

See www.ncei.noaa.gov/access/billions/events/US/1980-2023?disasters[]=all-disasters



Iowa Billion-Dollar Disaster Events 1980-2023 (CPI-Adjusted)





Updated: July 11, 2023

Next Steps

- 1. Extend work on high-risk conditions and events:
 - Enhance modeling on future load and resource projections;
 - Compare to similar analysis using other datasets;
 - Develop R-CEP to balance investments between normal & extreme events.
- 2. Continue monitoring MISO and SPP processes;
- 3. Refine visions, uncertainties, and futures;
- 4. Develop network model: consider using model to be used in MISO LRTP Tranche 2 studies, with review/updates from SPP.
- 5. Next PAB meeting: January, 2024.

PAB Feedback

- Provide feedback now or else by e-mail to jdm@iastate.edu or phone at 515-294-4844 (v) or 515-460-5244 (cell) at any time after the meeting, but within next 2-3 days. Other questions in which we are interested:
- 1. Do you see ways to modify motivation, objectives, and/or tasks to make this project more valuable to you and/or to lowa?
- Do you believe the 5 visions we intend to plan for are an appropriate capture of different directions lowa may choose to go? (energy cost, CO₂ reduction, energy export, resilience, balanced)
- 3. Are there significant uncertainties beyond those listed on slide 6? (policy change, demand growth/electrification, retirements, fuel price, technology costs);
- 4. Do you find our reports 1 and 2 useful/informative? Do you have questions related to them?
- 5. Any other questions, comments, suggestions, opinions you have? 11

Modeling – DER Representation

