Highlights from FEWtures SciAG Meeting Feb 20, 2020. Slides referred to are at bottom of this document

Mary Hill, Introduction –

- Slide 3 – graphic for study area
- We need to be challenged, please feel free to share your opinions about our work with us. It will only help us get better.

Armando Zarco – Water technology farms

- The purpose of the farms is to show how technology can help water use decisions. It is helpful to demonstrate these technologies in person. Technology farms are set-up for the location, soil type, and crop choices for each farm.
- Discussions on what other states are doing to encourage water use efficiency and conservation. Nebraska has a competition. NRCS and FSA have cost-share programs.
- It was noted the price of corn greatly influences the amount of acreage going into corn, a high water demand crop.

Peter Pfromm, Ammonia production

- Slide 7 – Ammonia framework
- Worldwide demand for ammonia increases as desire for more dietary protein increases.
- Congressional House passed the Clean Future Act, which lists ammonia as a low-carbon **fuel**. If enacted, this could be a major boost for ammonia production.
- There is interest in ammonia as an energy vector. Large and small-scale research is ongoing in this area.
- Ammonia production and fuel technologies can be employed on a farm-scale. The question is not if it's do-able to make ammonia on a small scale but if it's economical.
- The energy requirements for ammonia production from natural gas are reasonable. The ammonia can be converted back to electricity.
- Small-scale ammonia production is a flexible technology that can be ramped up and shut off when needed. The large plants take a week to ramp up and ramp down.
- There are potential connections between locally-produced ammonia and local and global markets.
- Slide – Ammonia as renewable electricity storage.
    - Where is the technology risk? – Matt Gilhousen
    - Very little technological risk. Lower heat and pressure requirements than Haber-Bosch process – Peter Pfromm

Hongyu Wu, Microgrids

- Working to answer a suite of questions of how the system may be used, including specific siting and configurations of a plant.
- How can microgrids accommodate ammonia production and other agricultural loads?
- How can the system best plan for the complexities and unknowns of renewable energy generation?
- Matching local parameters for wind and solar resources with locally and regionally variable market factors such as electricity rates and policy incentives.
- Work product will be a software program for decision-support.

- Slide 15 – slide about integrated microgrid planning and operation
- May determine that a microgrid isn't needed; the system may function with fairly simple operations.

Sam Zipper, Water Supply

- Asking these research questions:
- What are the best ways to evaluate water quality and quantity in the research area?
- When will water become a constraint on the solutions this project is pursuing?
- Now considering the Dakota Aquifer, but it is not as clean as the Ogallala.
- Exploring new MAGNET water model
- Slide 19 – Water supply team graphic

Peter Pfromm and Ted Peltier, Water Treatment

- Cannot simply dump concentrate because there is nowhere to put it.
- If energy is free, treatment costs reduce by ~30%. Salt removal (main constituent of concern) is the driving cost that determines what is cost effective versus what isn't.
- There is a process to take the solids, which may be dumped in a landfill.
- Zero discharge desalination: $815/AF
- Deep well injection: $499 /AF
- Seawater desal: $375/AF
- In best scenarios, only getting down to about $370/AFt. But this is not going to be a free process.
- The numbers may look shocking, but intended use, water source, and the fact that water is scarce make it seem more reasonable.
- Vincent will run economic scenarios based on location, supply, etc.
- Slide – Key questions for water treatment group

Ben Gray, Jim Bloodgood, Engagement, Business, Resilience

- "Prospect Theory" – is the situation framed as a loss or a gain? In general, people are willing to take more risks to avoid a loss.
- Question about what social capital is. Reply:
    - the networks of relationships among people who live and work in a particular society, enabling that society to function effectively and <u>to address shared concerns</u>.

Bob Barron, Global Interactions

- Slide 34 –
- Technologies could be widely adopted if they are successful. They could change the economics of agriculture.
- GCAM goal - model impact of FEWtures technology if used on a global scale.
- Matt Gilhousen, advisory committee member, noted that he's worked with several PhD level global modelers that may be a good resource on this aspect. Mary Hill in 2025: We were working with climate modelers from CU Boulder and through GCAM; I don't think we followed up on Matt's suggestion here.

Jim, Bloodgood, Education

- Slide 38
- Grant indicates FEWtures will do the following: develop a 3-credit University graduate level class, educate at least 10 undergraduates, 5 PhD students, and underrepresented groups. Also hold workshops. Mary Hill 2025: We actually developed a 1-credit graduate level class (we told NSF of the change), and educated about 3 undergraduates through that class. Our project produced 1 incomplete PhD, 5 completed PhDs, 1 completed PhD of Practice, and 1 postdoc. We had on staff 4 PhD students from underrepresented groups, none of whom were hired for anything but their clear capabilities and expertise.

Economic Analysis

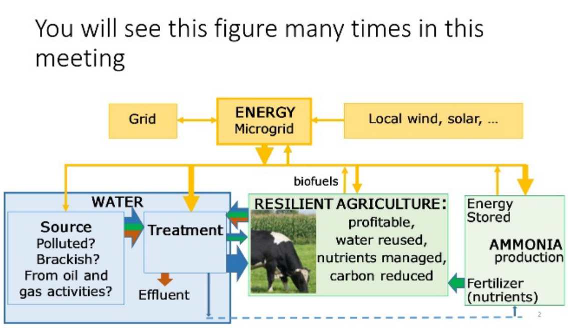
- Earnie L, advisory member, outlined areas that are important. Need to consider the legal and regulatory framework, as well as the configuration of the system, its complexity, resiliency, and cost to implement. Also what is the value to stakeholders, the time required to implement the systems, and how transferrable is the system.

Mary Hill, Conclusion

- Trying to understand dynamic complexities and how they can lead to unintended consequences.
- The decision support system can demonstrate novel futures so that people can evaluate alternative scenarios.
- We want to give stakeholders the building blocks and they will figure out how to put them together to best suit their needs.

Slides mentioned in notes above

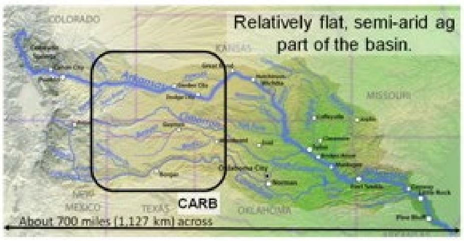
2 This figure is not mentioned in the text. It provides context .



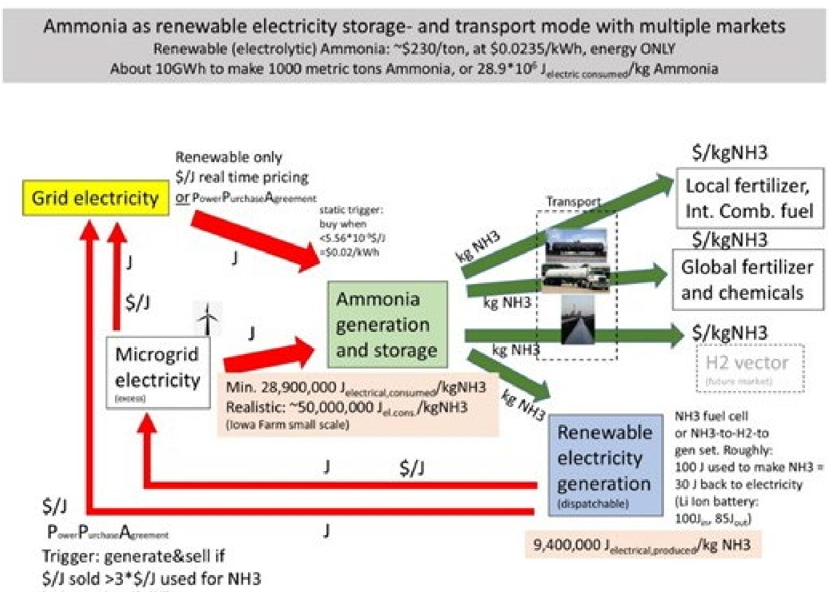
3 Location Map

You will see this figure some as well

Regional Testbed: Central Arkansas River Basin (CARB).



7 Ammonia Team (text suggested 7 but 9 is shown because it is a better fit)



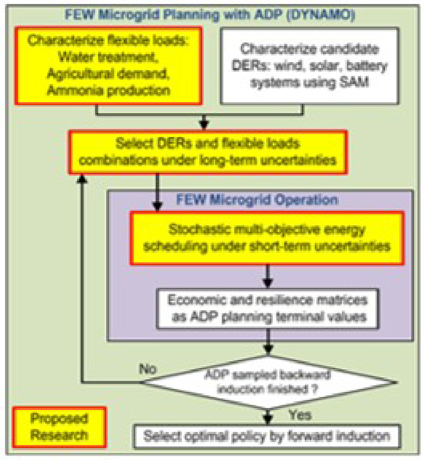
15 Energy Team

Integrated microgrid planning and operation (deliverables)

(i) Develop an integrative microgrid planning and operational model

(ii) Optimally dispatch uncertain distributed renewable energy

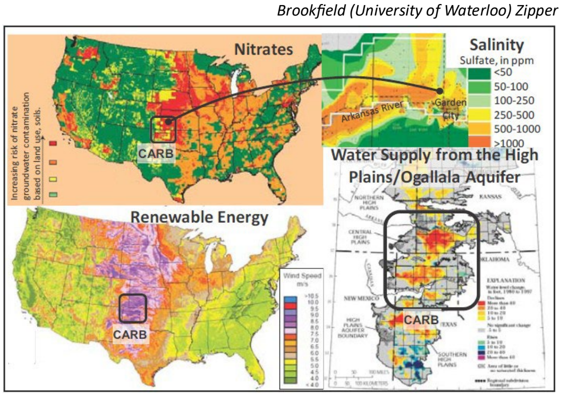
(iii) Consider new local demand response loads (ammonia production, water treatment)



19 Water Supply Team

Water Supply Team

Brookfield (University of Waterloo) Zipper (KGS)

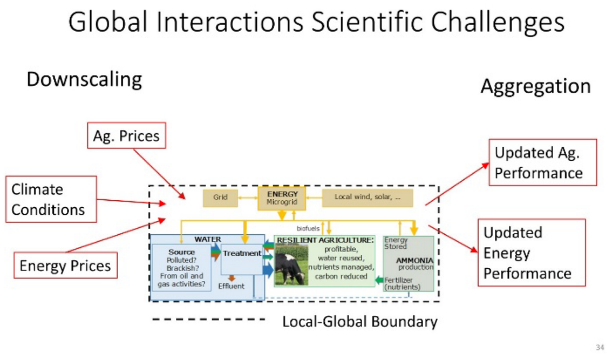


Anticipated Outcomes:

1. Estimate water quantity and quality status and trends for water treatment and ag teams.
2. Multi-team question: Can the water treatment activities help prolong agricultural activities in the state? Are they economical?
3. Train 1 Ph.D. student, maybe 2 (beginning summer/fall 2020)

19

34 Global Team – Broader context than found in Slide 2



38 Education, Business, Resilience Team

FEWtures Education

Educate:

- five PhD students
- 10+ undergraduate students
- Underrepresented groups
- Workshops (Kansas Youth Water Advocates)

Develop 3-credit, online course, active learning course:

Food, Energy, Water, the Environment, Economics, and Public Policy – Opportunities and Tradeoffs for Communities and Businesses

38