# Midwest Carbon Leadership Project
# Knowledge Gap Breakout Synopsis




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# Midwest Carbon Leadership Project
# Aggregated Actionable Ideas

## Unlocking Cold-Climate Innovation Pathways
Nina Axelson, Grid Catalyst

- Define specifics of the issue: what about the cold, e.g., affecting battery storage, transition from carbon intensive home heating, etc.?
- Make additional calculations about total emissions associated with cold climate issues/technologics, as well as geographic reach.
- Enhance regional coordination of R&D and entrepreneurship activities.
- Coordination among research, professional training and technical training; in collaboration among university and private sector and technical colleges
- Build curriculum for students in higher education, to inspire innovation and issue recruitment

## Why We Harvest Crops and the Connection to Climate-Smart Agriculture
Deepak Ray, Institute on the Environment, UMN

- Initiate a data clearinghouse with participation from universities and private sector that generates and compiles new data products – but also designs and tests incentives for data collection and sharing and protocols for data evaluation / data quality
- Propose protocols for agricultural data curation, format, and sharing to transform understanding of global agricultural practices and products, toward enabling insights that are larger than any private entity or public government could achieve alone

## A Changing Planning Paradigm:
## The Jigsaw Puzzle Challenge of Planning for a Decarbonized Grid
Laura Hannah, MISO

- Testing the viability of attribute markets, e.g, with private partners, regional demonstration, or modeling
- Analysis of who pays in system optimization: tax payer versus rate payer versus private parties versus investors
- Analysis of growing energy demand, from electric vehicles but also regional economic development, e.g., CHIP manufacturing

## How Can Nature-Based Solutions Sustainably Address Climate Change and Biodiversity Loss?
Forest Isbell, MnDRIVE Environment, UMN

- Develop biodiversity targets for industry comparable to GHG emission targets and measurement tools to track progress against targets
- Awareness campaign targeting Midwestern private sector on biodiversity crisis, values, losses, ecosystem services; cultivate awareness of Midwestern species and ecosystems and value of biodiversity loss (cultural and economic)

Agronomic and Climate Benefits of Biochar and Basalt
Joe Fargione, The Nature Conservancy

- Developing, facilitating, or testing region service or distribution models
- Meta-analysis or other synthesis of site-specific field tests, including effectiveness at sequestration and soil health, impact on yields, amount of additive needed, timing of application
- Propose and evaluate regional incentive program involving a variety of policy and economic tools
- Develop research agenda and/or informational materials and play a role in information distribution
- Possible role for university in biochar production?

Is the Shared Language We Use Today Keeping Us from the Solutions We Seek for Tomorrow?
Bob Blake, Solar Bear

- How to expand our notions of climate change beyond science, technology, and commercialization, in a way that makes it harder to stoke doubt, perpetuate fear, and minimize connection to one another, land and culture?
- Use language and cultural storytelling to move understanding of climate from pocketbook to connection to Earth, other creatures, one another
- Expanding our diction and ways of discussing climate to include Indigenous knowledge and values

The Lost Science of Changing Your Mind
Joe Árvai, Wrigley Institute for Environmental Studies, University of Southern California

- Developing storytelling as a tool – for increasing mindfulness and inquiry in individuals choices and other aspects of public decision making around decarbonization

Food Waste: Does Circularity Lead to Carbon Neutrality?
Jennifer Schmitt, Institute on the Environment, UMN

- Advance a food waste data clearinghouse by connecting stakeholders in food value chain
- Propose and test food waste metrics and accounting standards within the Midwest

Unlocking Climate Tech Innovation Finance
Ian Adams, Evergreen Climate Innovations

- Develop and promote a clean tech innovation ecosystem that attracts venture capital to Midwest-based businesses and competes with coasts for new business creation

The Wisdom of Crowds
Susanna Gibbons, Carlson School of Management, UMN

- Could we develop a pilot market around some carbon price, within our region and network, and deploy or test crowd pricing (e.g., its impact on consumer behavior)?
- Develop a test case around the IRA and a related regional phenomenon such as demand prices for electricity; pursue this in a way that connects disciplinary research to the way that businesses are thinking about carbon emission goals and internal carbon pricing

Learning from Community to Close Will and Wisdom Gap – and Avoid Deepening Inequalities
Huda Ahmed, Transformational Solutions

- Cultivate a platform for sustained community collaboration on regional decarbonization, that could be the basis of productive grant proposals, demonstration projects, community economic development, etc.
- Engaged funders in dialog about supporting best community-engaged research practices

## Unlocking Cold-Climate Innovation Pathways

Speaker: Nina Axelson, Grid Catalyst

Key Takeaways:

- Embracing cold climates could be a regional strategic advantage and opportunity for economic diversification
- The cold-climate market could be extremely large (15% of the planet)
- People would invest in our region for cold weather expertise
- Requires a technical innovation, market development, policy solutions, and penetration to underserved communities
- Opportunity to expand application: "cold weather solutions in warm weather places"
- Lack of adoption due to factors such as inertia, that HVAC replacements happen infrequently or in emergencies, lack of expertise for installation
- Cold climate solutions less flashy than, e.g., renewable energy
- Multiple entry points for decision making and thus places to engage: personal commercial decisions, sector issues and management, statewide codes, standards and policies
- Low unemployment means that workers must shift to this issue / sector than be newly developed
- Anxiety about brain drain to other states, regions, issues (and thus insufficient talent and attention to cold weather issues)
- Given extent of cold climate, even small improvements or adjustments could have impact

Group Consensus Definition:

- Strategy, communication, education on cold-climate solutions that increases workforce alignment

Additional Perspectives Needed for Future Discussion:

- Agriculture
- Investors
- Market researchers

Actionable Ideas:

- Define specifics of the issue: what about the cold, e.g., affecting battery storage, transition from carbon intensive home heating, etc.?
- Make additional calculations about total emissions associated with cold climate issues/technologics, as well as geographic reach.
- Enhance regional coordination of R&D and entrepreneurship activities.
- Coordination between research, professional training and technical training; in collaboration between university and private sector and technical colleges
- Build curriculum for students in higher education, to inspire innovation and issue recruitment

Presentation Abstract:

We are at the beginning of a global revolution in clean energy and clean tech that will overhaul our energy system and solve enormous challenges in decarbonization. Cold-climate regions need custom solutions that result from focused research and innovation pathways for the next generation of technologies.

We need to have more ambition and coordination across the Upper Midwest for the most promising technology fields and we need to build pathways that support innovation from idea through commercialization, with an emphasis on use-inspired research partnerships with regional corporate and industrial leaders.

In the absence of this, research will emerge from other regions that lack our understanding of cold-climate conditions and regional opportunities, slowing the development and adoption of critical technologies. Strengthening these pathways will build regional prowess for our higher education institutions, support new businesses developing these solutions, and catalyze existing businesses to pivot to more sustainable solutions sooner. This also translates to wider system change, accelerating decarbonization and resilience in areas heavily dependent on fossil fuels for heating, agriculture, and transportation.

## Why We Harvest Crops and the Connection to Climate-Smart Agriculture

Speaker: Deepak Ray, Institute on the Environment, UMN

Key Takeaways:

- There is a surprising lack of data about agricultural production around the world lack of a central clearing house where it is available
- The lack of spatial and temporal data makes it difficult to study changes in agricultural practices and changes and, specifically, evaluate if local interventions translate to global effects; also limits to description of the current system rather than making future projections and exploring prescriptive scenarios
- The lack of a system wide perspective makes it challenging / impossible to achieve a global or system-level outcome, e.g., toward greater sustainability; scope 3 is attempting to do this but unless / until all firms adopt, unsustainable producers and their consumers will shift production elsewhere
- Underappreciated importance of global market finding a willing supplier somewhere in the world, such that changes in production in one place (e.g. toward sustainability) may be made up for with practices elsewhere (e.g. less sustainably)
- With global economic development, can expect production around the world to follow same pathway as US Midwest with grassland / habitat conversion and increasing commodity production for products other than food (fuel, commercial / industrial products)
- Overall lack of incentives for data integration and data sharing and lack of investments in data collection and curation
- Much data is collected by private companies with no incentive to share with one another, with government, with researchers, or the public
- Most agricultural research is conducted at the field level to test the viability of a product or practice; much less analysis conducted at the regional or global scale
- Increasing availability of data in the form of remote sensing, drones, etc. but much of those data private and not collated into a common data bank
- Challenges of conducting research with private data because of goal of publishing so that all can see and need to evaluate and critique
- The data that do exist are typically crop planted and yield but additional information on practices desired too, e.g., fertilizer use, amount and timing of irrigation, irrigation source, seed source
- Challenges to data ownership, e.g., if a company is working with a customer and collects information, who owns the data

- Broad agreement that data is valuable and potentially commercializable, causing a great deal of concern about data sharing, but still weak incentives for robust data collection and curation
- There is no international body responsible for global data coordination; UN collates only national level data
- Data exist in many forms and places, from local computers to pieces of paper
- Need to make rapid progress as agricultural system under intense pressure and great urgency to decarbonize

Additional Perspectives Needed for Future Discussion:

- MBOLD – and the companies that make it up
- Data collectors and owners
- Data scientists
- USDA
- Ag retailers
- Corn growers or other industry group with decarbonization goal

Actionable Ideas:

- Initiate a data clearinghouse with participation from universities and private sector that generates and compiles new data products but also designs and tests incentives for data collection and sharing and protocols for data evaluation / data quality
- Propose protocols for agricultural data curation, format, and sharing to transform understanding of global agricultural practices and products, toward enabling insights that are larger than any private entity or public government could achieve alone

Presentation Abstract:

Agriculture is dynamic. It responds to the food habits of society and industry requirements around the world – which often puts it at odds with climate, given its global greenhouse gas (GHG) footprint. If somehow more efficient agriculture (from a GHG perspective) were fused with agricultural requirements around the world, then agriculture and climate would stop being at such odds with each other, as they are now.

What's holding us back? We know a lot about efficient agriculture, but we actually know very little, at a granular level, about why we harvest crops and farm livestock all across the world, even here in the Midwest. In other words: We have a lot more knowledge about yields, and practices that affect yields, but much less granular-level understanding about what we grow and why – and the consequences for our global goals.

Without granular-level prognosis, agriculture will remain in a cycle of responding to shifting demand changes. Current practices such as bringing more land into production – or pursuing less carbon efficient crop and animal production – stem from unanticipated changes. Policies respond after the demand curve arises and at the macro country or state level, and not before – that is, ahead of the curve – and without the granular perspective.

The knowledge gaps: How might we map the recent-past and near-future agriculture scenario both (a) temporarily and (b) at high-resolution, globally? And from there: How might we identify regions where changes in agriculture (food and industry) are expected – ahead of the curve – and where we can deploy our knowledge of carbon-efficient agriculture?

## A Changing Planning Paradigm:
## The Jigsaw Puzzle Challenge of Planning for a Decarbonized Grid

Speaker: Laura Hannah, MISO

Key Takeaways:

- We simply need more grid development and integration
- Fear (or perception) of energy scarcity, of energy availability; greater acceptance for traditional energy sources on the impression that they're more reliable
- Foster a market(s) for attributes on the grid that provide value to others, e.g., stabilizing capacity, standby power; these attributes could be part of bidding process
- Ensure black start capacity, ability to restart production source or grid system in the event of a failure
- Need account for redundancy in the system for resilience but not costly overbuild
- Grid management with distributed resources is a kind of jigsaw puzzle; allow people to put pieces on the table but regulator will need to fill in the gaps
- Mixture of information about assets coming on the system, some transparent (e.g., via regulatory process) and some proprietary
- Mixture of private and public assets and lack of clarity about who pays the cost to fill gaps in production, grid stabilization and distribution
- System advantages first movers; later movements to decarbonization will cost more
- New financial instruments in the Infrastructure and Inflation Reduction Acts that interact with costs covered by ratepayers
- Unclear: siting of resources in the future – doing more to avoid sitting in particular locations
- MISO and transmission grid cross state lines and therefore regulatory boundaries, complicating system optimization and design
- A challenge: The average member of the public does not understand the electrical system and the issues it is facing
- New climate risks to energy system, that intersect with policy and system management (e.g., Texas cold spell)
- Misc. system challenges such as north-south orientation of MISO, which is less ideal than east-west for solar management
- System design is not one-size-fits all, with geographic differences in energy mix and grid structure; need integration but in the face of regional variation

- We cannot and do not have the "ideal" grid; we have a "realized" grid that we inherited and build upon; risk that poor decisions made now will be "locked in" for the future
- Regional variation of MISO is also a strength that allows different renewables to be operating under different weather, sunlight conditions
- We not only only distributed assets on the system but also have increasing need for microgrid integration
- There's a temporal gap between problems now and anticipated issues later; need to plan now for problems that are not currently pressing / occurring
- Distributed energy resources allow for wide distribution of economic benefits, in comparison, e.g., to single location of a coal plant

Group Consensus Definition:

- Generating the knowledge system to build and operate a decarbonized grid

Additional Perspectives Needed for Future Discussion:

- Utility representatives
- Disadvantaged communities
- Innovators of "point" technologies, to understand what needs grid integration
- People working on grid aesthetics or ecological / biodiversity impacts of transmission

Actionable Ideas:

- Testing the viability of attribute markets, e.g, with private partners, regional demonstration, or modeling
- Analysis of who pays in system optimization: tax payer vs rate payer vs private parties vs investors
- Analysis of growing energy demand, from electric vehicles but also regional economic development, e.g., CHIP manufacturing

Presentation Abstract:

Resource planning is the process by which utilities and their regulators make generator retirement and investment decisions to meet the needs of customers. This exercise used to be relatively simple when there was excess capacity on the grid and the region's generation mix consisted of mostly uniform conventional thermal resources (coal and fossil gas) with expected availability. Both load and generation were predictable and relatively consistent. Utilities and states planned for the future within the confines of their own needs and policy objectives, without a compelling need to know about their geographic neighbors' plans.

Today presents a much different situation. Utilities and states are rapidly retiring existing resources – but not only retiring the capacity (and the emissions), but also the attributes that are inherent to those resources. Thermal resources provide needed attributes to the physics and operability of the grid, such as controllable ramping, spinning mass, and black start capability. These generating resources are primarily being replaced with renewables such as wind and solar, and some battery storage. These inverter-based resources have different inherent capabilities and attributes, and today's inverter-based technology cannot provide some of the needed grid-supporting functions. The fleet transition may result in a scarcity of attributes needed to operate the system without additional investment in new solutions and advancing technologies.

This generation fleet change trend creates new challenges and complexities in the realm of resource planning. Before, planning was a relatively well-understood task, akin to arranging generally uniform building blocks. Now, planning is far more complicated, like assembling a jigsaw puzzle with many disparate pieces. There are "knowledge gaps" about the physics of the system – filling those gaps will require study of the evolving generation fleet to anticipate new and emerging needs with enough time to invest in solutions. And there are "knowledge gaps" about the people of the system – finding solutions will require resource planners across neighboring states and utilities to begin to communicate and make collaborative regional decisions to ensure their shared needs are equitably met.

## How Can Nature-Based Solutions Sustainably Address Climate Change and Biodiversity Loss?

Speaker: Forest Isbell, MnDRIVE Environment, UMN

Key Takeaways:

- Strong science and policy linkage between climate and biodiversity crisis with nature based solutions at the intersection
- Need for restoration to store carbon and stem biodiversity loss
- Emphasis on carbon sequestration not enough to prevent biodiversity loss
- Nature based solutions allow "benefit stacking," layering co-benefits of carbon mitigation, climate change adaptation, ecosystem services, and conservation
- Need for corporate commitments on biodiversity and 30 x 30, comparable to carbon / climate commitments
- Need carbon markets to include restoration and loss of habitat if going to achieve biodiversity co-benefits
- Monitoring against targets will require better measurement and quantification techniques
- Private sector engagement on biodiversity loss extends across numerous sectors and includes notions of "scope 3"/ materiality assessment
- Traditional ecological knowledge critical and Indigenous land stewardship
- Uncertainty in carbon sequestration measurement and reliable accountability undermines carbon market and its connectivity to biodiversity
- Unclear value proposition of Midwestern biodiversity for Midwestern-based industry; overall lack of awareness among private sector of biodiversity crisis; primacy of climate in private sector awareness about sustainability issues
- Confusion in terminology: ecosystem services, nature's benefits to people, nature-based solutions
- Nature-based solutions requires action and human intervention rather than traditional environmental notions of "nature run its course"
- Perceived tradeoffs between nature conservation and other values such as production efficiency, economic value

Additional Perspectives Needed for Future Discussion:

- Tribal members and land managers
- UMN Extension
- Community development organizations
- Industries tied to land use / land conversion

Actionable Ideas:

- Develop biodiversity targets for industry comparable to GHG emission targets and measurement tools to track progress against targets
- Awareness campaign targeting Midwestern private sector on biodiversity crisis, values, losses, ecosystem services; cultivate awareness of Midwestern species and ecosystems and value of biodiversity loss (cultural and economic)

Presentation Abstract:

Since the Earth Summit in 1992, climate change and biodiversity loss have been dubbed the twin environmental challenges facing society. Climate change is contributing to biodiversity loss; the loss of plant diversity is contributing to climate change and making natural and social systems more vulnerable. It is increasingly appreciated that both issues must be solved together.

The downward spiral could be reversed: addressing climate change could help conserve biodiversity and restoring biodiversity, especially plant diversity, could help address climate change. Each year, terrestrial ecosystems soak up a full third of anthropogenic carbon emissions. Nature-based solutions are being widely implemented for their contributions to both adaptation and mitigation, but their effectiveness is currently limited by our inability to conserve or restore biodiversity.

Even in relatively undisturbed and protected areas, biodiversity is eroding, leading to insidious and largely ignored carbon emissions. Furthermore, in formerly used and degraded lands, such as abandoned croplands, recovery of biodiversity and carbon storage is slow and incomplete, limited by our inability to fully restore these lands. Finally, in currently used agricultural lands, there is interest in diversifying crop mixes and restoring rangelands, but not yet an understanding of how best to do so.

New knowledge is needed to improve nature-based solutions so that they maintain their effectiveness over time and reach their full potential for addressing both climate change and biodiversity loss.

## Agronomic and Climate Benefits of Biochar and Basalt

Speaker: Joe Fargione, The Nature Conservancy

Key Takeaways:

- Is literally stirring carbon into the soil
- Farmer awareness and buy-in critical to application of solution at scale
- Viable solution in both biochar and basalt additions with multiple unknowns, notably site-specific variation in effectiveness at sequestering carbon and recipes for making effective biochar
- Lack of awareness about solution, how to use, and supply chains for distribution
- Could be sold as a service rather than as a product
- Variety of co-benefits from increasing soil health: carbon sequestration and storage, resistant to drought and soil erosion
- Lack of carbon markets and incentives for carbon storage a major impediment to uptake
- Possible effects on methane and nitrous oxide production
- Many field-studies being conducted by synthesis or meta-analysis lacking
- Numerous intervention points, from farmer level to state or national policy (e.g. carbon price) but effectiveness of interventions at adoption unknown
- Failure to act is continued global warming, with time running short to achieve Paris Agreement
- Unknown long-term effects on productivity and soil quality resulting from biochar breakdown that could, e.g., reduce nutrient uptake
- Other possible uses for biochar could exist out there, still to be discovered
- Could be use as an offset for some emission source that cannot be substituted for renewables or eliminated (e.g., airplane travel)
- Failure to address knowledge gaps correctly or adequately could undermine use of the tool / approach: “you can ruin your reputation with farmers for a generation if you do it wrong”
- Always a risk of unintended consequences of new technologies – long-term impacts to soil and yield

Additional Perspectives Needed for Future Discussion:

- Farmers; Land O'Lakes has already approached university for research?
- UMN agricultural experiment stations
- UMN Extension
- Crop advisors and other agricultural marketing channels
- Carbon credit financiers

Actionable Ideas:

- Developing, facilitating, or testing region service or distribution models
- Meta-analysis or other synthesis of site-specific field tests, including effectiveness at sequestration and soil health, impact on yields, amount of additive needed, timing of application
- Propose and evaluate regional incentive program involving a variety of policy and economic tools
- Develop research agenda and/or informational materials and play role in information distribution
- Possible role for university in biochar production?

Presentation Abstract:

In the United States, turning agricultural residue into biochar – charcoal made from biomass – could sequester 95 million tons of carbon dioxide per year. Adding basalt rock dust could sequester over 400 million tons per year through enhanced rock weathering. Where will the funds come from to pay for these massive undertakings? A robust carbon market would go a long way, but what if they generated agronomic benefits that farmers were willing to pay for, creating a revenue stream that would not be dependent on carbon market gyrations?

The opportunity? Both soil amendments help reduce acidification. Farmers are willing to pay to reduce acidification – as evidenced by the fact that many farmers already pay to add lime to increase pH and boost yields. Academics can undertake the basic research – the field trials and the biogeochemical modeling – to prove out the expected yield benefits from these soil amendments, creating the business model that could drive adoption of these highly promising and scalable practices.

## Is the Shared Language We Use Today Keeping Us from the Solutions We Seek for Tomorrow?

Speaker: Bob Blake, Solar Bear

Key Takeaways:

- English language as relatively transactional and Ojibwe language relatively relational community-based
- Colonized language overlooks Indigenous knowledge
- Language can shift the we communicate from goal driven to change driven
- Staying away from transactional storytelling and de-commercializing climate because it oversimplifies culture
- Communication expertise needs to expand just from science and research, including spirituality
- Reason to take action is not just human, human survival and human values
- Language can show a connection to the Earth, connection to each other. How to make a connection over sustainability enrich people's lives?
- Don't have to talk about climate when talking about climate: preservation of land, crops, water,and culture
- Fostering multiple ways of knowing within and connected to the scientific community
- Seek common ground across difference to define common values

Additional Perspectives Needed for Future Discussion:

- Behavioral Scientists
- Community Organizers
- Student Groups

Actionable Ideas:

- How to expand our notions of climate change beyond science, technology, and commercialization, in a way that makes it harder to stoke doubt, perpetuate fear, and minimize connection to one another, land and culture?
- Use language and cultural storytelling to move understanding of climate from pocketbook to connection to Earth, other creatures, one another
- Expanding our diction and ways of discussing climate to include Indigenous knowledge and values

## The Lost Science of Changing Your Mind

Speaker: Joe Árvai, Wrigley Institute for Environmental Studies, University of Southern California

Key Takeaways:

- So frequently we call for or strive to change people's minds but they rarely do; how to cultivate a culture of open-mindedness among consumers, voters, and other sustainability stakeholders?
- Humans feel equivalent loss more than equivalent gain and have difficulty imagining a future much different from the current or recent past
- Positive associations with open mindedness seem to have declined in recent years
- Must promote the ability to talk about the things we value and cultivate an ability to discuss the things about which we disagree
- Humans need a reason or incentive to change their minds
- We know from research that when you ask what you should do vs. what you think others should do, you get different answers; what others should do gets a more accurate representation of what people actually care about.
- Value in seeking out information, opinions and positions that are different from one's own
- Need examples of people changing their minds at scale in response to a stimulus or changing situation; what are these examples?
- As companies become larger, they become more resistant to bring in disruptive change.
- Storytelling has the power to reboots norms
- Group think and group ideology

Group Consensus Definition:

- The importance of the steward - the leader of the company eg - how crucial the role of that leader is inviting alternative ways of thinking

Additional Perspectives Needed for Future Discussion:

- Editorial page and media owners
- Faith leaders

Actionable Ideas:

- Developing storytelling as a tool – for increasing mindfulness and inquiry in individuals choices and other aspects of public decision making around decarbonization

Presentation Abstract:

Discussions about knowledge gaps surrounding climate change often center on technical, social, and economic challenges: how to develop and deploy new energy infrastructure at scale, how to facilitate higher levels of awareness and concern, and how to incentivize desired market and behavioral transformations, just to name a few. However, a more fundamental challenge lurks in the background: an unwillingness, or inability, on the part of many Americans – independent of their political ideology – to change their mind.

So much of what we will need to do as a community to address the risks posed by climate change will be predicated upon changing how and what we think, and ultimately, what we do. Yet, many of us — including a broad swath of the public alongside leaders in business, policy, and science — are more entrenched in how we view the challenges and opportunities posed by climate change, and how or if we should respond to them.

What lies behind these cognitive, social, and behavioral restraints? Biases associated with psychological distance and loss aversion play a role. The same is true of the biases brought on by social pressures and motivated reasoning. And it's frequently the case that we fail to think clearly about what it is we hope to achieve with our strategies and choices, how we'll measure progress and make necessary tradeoffs along the way. With all this as backdrop, the inevitable question that follows is: How can we unchain ourselves from these restraints?

One answer is administrative: Businesses, governments, and other organizations must build capacity so that we can make objectively better decisions. Another answer is normative: We must rehabilitate once-prominent norms regarding the importance of data — vs. feeling and intuition — as inputs to decision-making, and we must celebrate — vs. stigmatize — the value of actively open-minded thinking.

## Food Waste: Does Circularity Lead to Carbon Neutrality?

Speaker: Jennifer Schmitt, Institute on the Environment, UMN

Key Takeaways:

- Circular economies are often proposed as a solution for food waste, i.e., to avoid land filling, but circular economies could have the perverse effect of increasing food waste demand and therefore carbon emissions; this issue – its potential, parameters, strategies for addressing – have not been investigated
- A circular economy is an alternative for both land filling and composting – putting wasted food to "good use"
- The question at the heart of this project suggests or implies that there is an optimal amount of food waste, that is sufficient to feed a circular economy but doesn't lead to enhanced greenhouse emissions / over production
- A key challenge is lack of data about the amount, source, and flow of food waste
- More research is interested into potential uses for food waste
- Data exist at a variety of levels and one challenges is that a lot of it is highly distributed, at the household level
- Other factors are important in the carbon footprint of food, notably production methodology and distance traveled
- Other factors are important in the amount of food waste generated, notably package and storage (to avoid spoilage), consumer preferences for unblemished food, and other cultural norms and preferences around food and food preparation
- There are unclear accounting standards for food waste
- We know where in the food value chain waste is happening (generally), but not well enough to explore specific interventions and their impact
- Food safety standards are also important, e.g., standards for animal feed
- Critical tradeoffs exist in alternative strategies for managing food waste
- Lack of information about the effect of possible solutions keeps the status quo, lack of action

Additional Perspectives Needed for Future Discussion:

- Food retailers
- Waste management

- Municipalities
- Behavioral economists
- Up-cycled Food Association / food recovery networks

Actionable Ideas:

- Advance a food waste data clearinghouse by connecting key stakeholders in food value chain
- Propose and test food waste metrics and accounting standards within the Midwest

Presentation Abstract:

Food waste offers many opportunities for "closing the loop" and circulating waste back into production. Safe and desirable food that is uneaten can be recovered and fed to people. Food waste can also be fed to animals, used to generate energy, or composted to bring nutrients back to soils. But how close do these circular solutions get us to carbon neutrality?

We face a knowledge gap when it comes to the carbon emission outcomes from achieving circularity with food waste. We do not have great data on food waste quantities, even less data on the potential waste available for each circular solution, and few empirical studies on how human behavior will impact the implementation of circular solutions.

We do know circulating food waste into other systems will prevent methane emissions from food in landfills, a key component for carbon reductions. However, circular solutions do not prevent the upstream emissions associated with producing food – and without more knowledge of the amount and likelihood of carbon benefits of circular food waste solutions, we may be falsely relying on circularity as a path to carbon neutrality.

## Unlocking Climate Tech Innovation Finance

Speaker: Ian Adams, Evergreen Climate Innovations

Key Takeaways:

- Avenues to access capital are evolving and changing; there is a high volume of investing in clean tech but still less than some other sectors
- Need to stage gate innovations in clean tech to encourage innovation to market
- There is money for clean tech innovation and with more innovative funding mechanisms could likely attract more capital
- Clean tech innovation considered more expensive and riskier than other green investment opportunities, because uncertain green premium, longer commercialization process, and fluctuating appetite for government support
- Potential for "concessionary capital" to drive clean tech market creation (e.g., IRA)
- Need for Midwest-specific support in venture development, stage-gating, and investor attraction
- Minnesota has investments that can be leveraged for public support of ventures, e.g., environmental trust fund endowment; this extends to other states in the region (e.g., Illinois growth and opportunity fund)?
- What is the "right" / best number and amount of venture capital in clean tech? Need to cultivate that capital for Midwest-based businesses
- The clean tech sector has a bit of "bad rap" that needs to be overcome
- Persistent underinvestment in low tech solutions such as weatherization and energy efficiency
- Risk of losing out to other states and regions without robust financing environment for clean tech innovation industry
- Industry must be attentive to inequality and strive to support diverse business ownership and access to capital

Group Consensus Definition:

- What financing mechanisms and capital enable regional decarbonization?
- how much money is needed / what mechanisms are best

Additional Perspectives Needed for Future Discussion:

- Center for Economic Inclusion

- Association for Black Economic Power
- Brown Venture Group

Actionable Ideas:

- Develop and promote a clean tech innovation ecosystem that attracts venture capital to Midwest-based businesses and competes with coasts for new business creation

Presentation Abstract:

While new funding has been flowing into the climate tech space (solutions that address climate change via mitigation or adaptation), financing and commercializing the innovations we need to address climate change remains challenging, because of long development timelines, complex problems, and capital-intensive spaces. Contrast this with biotech: in biotech, there is more of a moat for new entrants to protect profits and a clearer demand signal – and a more robust market of secondary buyers and acquisitive companies. These factors stimulate the flow of both entrepreneurs and capital to support them.

Regulatory uncertainty further complicates the picture for climate innovation because venture investors are leery of operating in markets which require regulatory changes for a business to scale. And, while the federal government has moved to help address the supply of new solutions (through investments in R&D), there is more to be done on the demand side – clear demand-side signals that stakeholders will buy solutions if they are scaled up make it much easier to finance these solutions.

Fortunately, there are solutions that can help at different stages to support the commercialization of climate tech innovation. These include catalytic capital (capital that is concessionary and/or impact-first rather than exclusively return-oriented) and early entrepreneurship support, as well as advance market commitments. Catalytic capital and early entrepreneurship support can be an efficient way to alter the trajectory of companies that might otherwise struggle, improve the economics of investments in the space, and help to pull in new venture capital money, while advance market commitments can help address the demand side of the equation.

Advance market commitments are a nascent space: researchers can help fill in knowledge gaps here by analyzing technology and solution fit, maturity and scale requirements, and the efficacy of efforts to date. This can help send a clearer demand signal to entrepreneurs, enabling them to invest their efforts where they have the greatest potential opportunity.

## The Wisdom of Crowds

Speaker: Susanna Gibbons, Carlson School of Management, UMN

Key Takeaways:

- Imperfect information has value and collective knowledge can generate meaningful insights in sustainability; do not necessarily need deep expertise if many somewhat-informed people can take a reasonable guess
- Market = the crowd; value is the collective decision the crowd is making; extracting collective knowledge from a large number of independent actors
- Could be an approach for developing and deploying carbon markets, setting price on that market, or simply building awareness and interest in features of a carbon market ("cultural tipping point")
- Idea: "carbux" – 1000 carbon bucks to spend. If you don't spend them, you get a dividend; if you run out, you have to go buy some more
- In addition to imperfect estimation (that crowds could contribute to), another challenge is imperfect understanding of objectives and language (in sustainability)
- The "wisdom" of crowds is affected by herding behavior so need to minimize that effect or look over a longer time horizon; in other words, markets are really efficient at telling us things over time
- Seeking an opportunity to use
- Potential importance of caps or other policy tools to steer the market, e.g., so that it doesn't sustain fossil fuels
- The market also cannot directly address issues like equity / disparities; research on who benefits, negative side effects, feedback loops
- Risk of unintended consequences; could produce new instances of environmental justice?

Group Consensus Definition:

- Developing a carbon currency

Additional Perspectives Needed for Future Discussion:

- Greater diversity of participants: race, economic class
- People in industry operationalizing internal carbon prices (from variety of different business sizes)

- Government / decision-makers associated with carbon price / tax / markets

Actionable Ideas:

- Could we develop a pilot market around some carbon price, within our region and network, and deploy or test crowd pricing (e.g., its impact on consumer behavior)?
- Develop a test case around the IRA and a related regional phenomenon such as demand prices for electricity; pursue this in a way that connects disciplinary research to the way that businesses are thinking about carbon emission goals and internal carbon pricing

Presentation Abstract:

In the world of finance, we use the wisdom of crowds every day to choose investments. We think in terms of "Net Present Value," or maximizing excess returns compared to some market-based measure. In the realm of climate finance, however, we do not have the same metrics, and we don't even speak the same language.

According to the World Bank, we need to invest about $90 trillion globally over the next decade in adaptation and mitigation efforts. But we have come to an impasse when trying to figure out who should pay for what.

Governments have the tools they need to calculate expected economic benefits, and since the negative externality of greenhouse gas emissions is felt by everyone in some measure, they choose projects where benefits are also broadly distributed. But the scale of investment required is massive, and the speed with which we need to move is overwhelming. We cannot achieve our net zero ambitions without business.

Unfortunately, businesses don't have the information they need to make investments. Calculating expected returns so that corporations can prioritize opportunities and make decisions requires a price for carbon. We need the wisdom of the crowd for this missing information. Without it, a corporation has no mechanism for allocating capital.

## Learning from Community to Close Will and Wisdom Gap – and Avoid Deepening Inequalities

Speaker: Huda Ahmed, Transformational Solutions

Key Takeaways:

- Decarbonization is a laudable goal but must pay attention to unintended consequences and inequalities, particularly moving quickly without community consultation, arising from "urgency"
- When communities are meaningfully engaged in decisions, visions and actions can become very different, as well as durability of impact and scale of adoption
- We need careful consideration of who is making decisions and who is being consulted to advance procedural justice
- Accountability for decarbonization action should include authentic engagement of those impacted by decisions
- In addition to unintended (negative) consequences, decarbonization also has primary beneficiaries
- One example of critical community consultation: extractive mining for renewable energy
- Community consultation should be creative, exploratory and evoke co-design rather than prescriptive or perfunctory; different communities may require different methodologies; all require authentic relationships
- The timeline of many grants does not allow for thoughtful consultation and co-production; need to cultivate relationships before the grant is announced and encourage funders to either fund grant development or allow more time
- Need for increasing resilience and adaptation to minimize the need for loss and damage
- Power of storytelling: engaging those left out of the dominant narrative allows for alternative futures, where a wide range of people can imagine themselves and care for their concerns

Group Consensus Definition:

- What could it look like to collaborate with communities in research and funding?
- Pursue community relationships "moving at the speed of trust"

Additional Perspectives Needed for Future Discussion:

- Faith leaders
- Immigrant association leaders
- Community engaged scholars

Actionable Ideas:

- Cultivate a platform for sustained community collaboration on regional decarbonization, that could be the basis of productive grant proposals, demonstration projects, community economic development, etc.
- Engaged funders in dialog about supporting best community-engaged research practices

Presentation Abstract:

Many communities are worried about climate change, and it's often the most impacted that have the least amount of power in addressing it. Mitigation and adaptation efforts "happen" to them just as much as climate change. Continuing down this path where the masses, particularly the most impacted, are kept at a distance from the knowledge gathering, will building, and implementation planning can be detrimental to decarbonization efforts by contributing to:

- Slow change due to not enough public will or harnessing of existing local community knowledge
- Unintended and/or exacerbation of social, economic, and environmental risks that those with lived experience have the most wisdom about
- Tradeoffs and burdens that reinforce injustice and inequities

While the technical expertise that the scientific community holds is important, it is critical to understand, embrace, and leverage the lived wisdom and expertise of local communities for effective, efficient (in more ways than one), and quicker global decarbonization. In order to fully harness the wisdom and will that community has to offer, communities must be engaged in ways that move beyond just informing or persuading to co-creating and consulting. What's currently missing is a standardized process for consistently and meaningfully engaging communities as valued stakeholders and knowledge base in decarbonization efforts.