UNIVERSITY OF MICHIGAN

Input on Clean Energy Conversation Research Themes

The following themes, research gaps and interdisciplinary questions reflect input from UM faculty, researchers and staff participating in initial Clean Energy Conversations events.

We welcome additional input. Contact cleanenergyconversations@umich.edu with ideas or questions.

THEMES OVERVIEW

1. Incorporating new technologies with current infrastructure
2. Equity impacts of decarbonization
3. Identifying policy challenges/gaps/opportunities
4. Public acceptance of technology/ decarbonization
5. Connections/links to other systems (health, ecosystem, transportation, etc.)
6. Consideration of localized infrastructure in energy transition
7. Challenges of/importance of scaling -up
8. Considering circular economy in decarbonization
9. Comparison of US to other countries

1.
Incorporating new technologies with current infrastructure

RESEARCH GAPS

- Creating infrastructure for storage in grid, idea of building-to-grid and building-to-vehicle
- Integrating renewables into the grid and required storage
- How do you commercialize new technology/infrastructure and its impacts on current infrastructure? Process of the new replacing the old?
- Consideration of how streets are used for other purposes than vehicle ownership/ driving in reconsideration and redesign of infrastructure.
- What are opportunities for existing infrastructure to become more energy efficient?
- The extent to which existing infrastructure (refinery, pipeline, distribution of fuels) can remain in use but with low-carbon fuels.
- Policy infrastructure in place doesn't lend itself to adoption of new technology, how to avoid policy from delaying/discouraging adoption of new processes/technologies
- Role of cities in infrastructure construction decisions for carbon neutrality, can contribute as drivers but decision are also made by value chain

INTERDISCIPLINARY QUESTIONS

Is deployment more successful if the new technology somewhat mimics the current structures?

How does automated transport affect the economies of public transport and equity in access to transport?

How do we make effective use of the energy resources that we are effectively wasting right now? What are the barriers to adoption of those?

What is the best, safest path for refueling vehicles?

2.
Equity impacts of decarbonization

RESEARCH GAPS

- Socioeconomic impacts of those that are dependent on fossil fuel industry
- EVs not as common in low-income and rural settings, how to ensure that there is a grid or whether it makes sense to connect to a grid
- How federal government can engage with state/local/community stakeholders to enable fair processes for decision-making about clean energy future (i.e. fed govt enable procedural justice)
- New valuation systems for decarbonization emphasizing social and economic aspects
- Efficacy of new social-technological paradigms to reduce residential energy insecurity
- Environmental and social impacts of electricity storage infrastructure (and other technology), how it can be expanded while protecting environment and communities
- What are the equity implications of commercializing new technology/ infrastructure and its impacts on current infrastructure? Process of the new replacing the old?
- Effect of wide-spread electrification on people's energy bills - will demand management strategies exacerbate the issue that poorer people spend a greater proportion of income on energy?
- Strategies to improve IEQ in low-income communities without access to modern building systems (i.e. heating) can be limited

INTERDISCIPLINARY QUESTIONS

How do we form the best balance between electrification, ultra low carbon fuels, urban redesign, connected and autonomous vehicles, etc. that yields a future with less inequity?

How do we assess the impact to equity from various incentives aiming to increase the adoption of clean energy technology

How much say should we give high-resource communities to block clean energy infrastructure, what is the impact of that on perpetuating use of fossil generation in lower-resourced communities?

3. Identifying policy challenges/gaps/ opportunities

RESEARCH GAPS

- Policy infrastructure in place doesn't lend itself to adoption of new technology, how to avoid policy from delaying/discouraging adoption of new processes/technologies
- Identifying the current standards now that are most efficient and give the best energy reduction for the cost
- Federal policies that will provide support to those dependent on fossil energy production and will be likely negatively impacted by transition - what are most effective strategies and at what scale?
- Local climate action plans with city governments to create sustainable and resilient cities
- Role of cities in infrastructure construction decisions for carbon neutrality can contribute as drivers, but decision are also made by value chain
- How federal government can engage with state/local/community stakeholders to enable fair processes for decision-making about clean energy future (i.e. fed govt enable procedural justice)
- Opportunities to address regional issues by developing regional green transportation plan
- Policy interventions needed to mitigate resistance to new technology and infrastructure
- Question of cost and ability to forecast costs - how do we get better at forecasting infrastructure costs?
- Innovative funding mechanisms that can be used to fund smart infrastructure in future

INTERDISCIPLINARY QUESTIONS

How do we encourage business and policy acceptance issues with new technology such as carbon capture and utilization?

How to encourage collaboration between stakeholders at local and regional levels

4.
Public acceptance of technology/decarbonization

RESEARCH GAPS

- What will motivate people to make the transition to replace fossil fuel sources with cleaner technology
- How local communities will respond to new technology and infrastructure, and widespread deployment of these
- How much say should we give high-resource communities to block clean energy infrastructure, what is the impact of that on perpetuating use of fossil generation in lower-resourced communities?
- Understanding public perceptions of new technologies
- How tolerance for and acceptance of intermittency play a role in the future of energy

INTERDISCIPLINARY QUESTIONS

Do we need to change how society looks at the built environment in terms of work-home-life in making consumer decisions to enable the transition to a decarbonized world?

How do we embrace conversation with people who feel that rel (sic) conversations aren't technical?

How can we educate the public and gain broader and deeper support for decarbonization?

How can we motivate different stakeholders to accept urgency and act?

5.
Connections/links to other systems (health, ecosystem, transportation, etc.)

RESEARCH GAPS

- Link between carbon neutral or negative technology and ecosystem services, i.e. relationship with water quality, biomass production, biodiversity
- Integration of changes in climate and land use, ecosystem function, etc. in modeling
- Opportunities to address regional issues by developing regional green transportation plan
- Gaps in technology for design of buildings to passively control environment - how technology can be low-cost, low-energy, low-emissions
- Interdependency between infrastructures (i.e. internet and energy)
- Indoor environmental quality (IEQ) and effect on people's health, well-being, productivity
- How we generate the needed feedstock while also minimizing adverse impacts to environmental and community needs

INTERDISCIPLINARY QUESTION

How does transportation and infrastructure fit into whether buildings are considered green or not?

6. Consideration of localized infrastructure in energy transition

RESEARCH GAPS

- EVs not as common in low-income and rural settings, how to ensure that there is a grid or whether it makes sense to connect to a grid
- Placing value on resilience at the local level - i.e. enabling district energy microgrids

INTERDISCIPLINARY QUESTIONS

Does electricity infrastructure need to be re-distributed to be more localized (i.e. EV charging stations with their own designated energy sources)?

Question of extending to grid/connecting vs. setting up micro-grids or household level?

7. Challenges of/ importance of scaling -up

RESEARCH GAPS

- How we create infrastructure at the scale that it can replace the amount of fossil fuels utilized today
- How we generate the needed feedstock while also minimizing adverse impacts to environmental and community needs

INTERDISCIPLINARY QUESTIONS

Is there a link between the size of an energy technology and the scope of the decision making body?

What investments/changes need to be made at the individual level, and which ones need to be made at the collective/system level? (i.e. smart thermostats v. ability of a utility to actively manage demand)

8. Considering circular economy in decarbonization

RESEARCH GAPS

- Cost-effective carbon capture and utilization that translates to valuable and marketable products to support the circular carbon economy and be used as a tool for climate change mitigation
- Distributive effects of resource extraction (i.e. mining for uranium) and disposal - especially for electronics
- Lifecycle and technoeconomic analyses of potential pathways to inform decision-making

INTERDISCIPLINARY QUESTION

How do we restructure industrial supply chains (i.e. energy producers, steel, cement, mining, product manufacturing, etc.) to accommodate the circular carbon economy?

9. Comparison of US to other countries

RESEARCH GAPS

- How are needs and gaps different internationally?
- Understanding the difference in costs of infrastructure in the US compared to other high-income countries

INTERDISCIPLINARY QUESTION

What can be learned from international success stories (i.e. European cities)?

OTHER GAPS & QUESTIONS

RESEARCH GAPS

- Concept of Smart City is a term that can mean lots of different things
- Resilience in terms of mass migration of people moving along with changing weather patterns.
- In agriculture - profit for large-scale production in non-sustainable practices, how small practitioners with focus on sustainable practice can compete
- Centralized v. decentralized decision-making for the University - one person who provides overall guidance to energy issues at the university

INTERDISCIPLINARY QUESTION

How do you avoid dead ends - build infrastructure that gives you some, even significant, reduction in emissions, but makes total decarbonization harder (i.e. natural gas CCGT)?