iSEE Critical Conversation Spring 2021: The Role of Nuclear Power in a Clean Energy Future

Summary of Discussion
By The Institute for Sustainability, Energy, and Environment (iSEE)
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Overview

On May 5-7, 2021, iSEE hosted academics, industry leaders, nonprofits, and government and NGO representatives via Zoom for a conversation about the role of nuclear power in a future of clean energy. Despite the challenges presented by the COVID-19 pandemic, everyone gathered to discuss the wicked problem that is climate change and nuclear energy's role in reducing emissions.

This safe space for a frank, unattributed discussion was a positive step toward exploring the complexities of nuclear's place among other energy innovations.

Keynote speaker Jim Hansen, Director of Columbia University's Climate Science Awareness and Solutions Program, got the conversation started on the afternoon of May 5, and three panel and breakout sessions continued the discussion the next two days.

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About this Document

The following sections outline the major talking points of each of the three topical discussion sessions. This is by no means a comprehensive listing of the ideas shared, but is a summary of the points participants spent the most time talking about. Our aim was to offer a look into the multitude of viewpoints and opinions about the nature of the problem and its possible solutions that were expressed.

Session 1: Safety

How do concerns about safety, risk, and the environment affect trust in the institutions that design, deploy, and govern advanced nuclear and other technologies?

The first session of the Critical Conversation centered on understanding the safety of nuclear power. The session began with a panelist discussion between Edwin Lyman (Union of Concerned Scientists), Sonja Schmid (Department of Science, Technology and Society, Virginia Tech), and Jacopo Buongiorno (Massachusetts Institute of Technology).

Major talking points

Environmental justice in terms of nuclear power is complex because of a variety of spatio-temporal risks

- What constitutes "justice" is not universal. Different communities will have different ontologies and epistemologies of place that inform different configurations of what is just. So there is a tension here between the broad, global capacity of anthropogenic climate change to cause harm everywhere (though some places experience it more than others) and the local character of justice concerns.
- Nuclear plants are not all sited in economically disadvantaged areas, many are located near affluent communities
- Environmental justice groups center negative impacts of mining on indigenous communities
    - Proponents of nuclear focus on its benefits for climate change mitigation
- Operational hazards trade-off between low probability, high consequence events (nuclear) vs. constant emissions of particulate matter
- What does consent mean in the context of nuclear technologies? The impact of the technology often manifests in places that don't benefit from the use of the technology
- Any discussion of nuclear safety cannot, and should not, ignore the hazards of the front end of the fuel cycle — the mining, processing, conversion, enrichment and fabrication of uranium. Uranium mining has disproportionately affected Indigenous people of the US, Canada, Australia, Namibia and other countries, and these impacts should be included in all metrics purporting to demonstrate nuclear power's safety.
- There are no consistent metrics to maximize greater good for the wider world. Ultimately it will come down to local impacts and decision making. Have to figure out how global policies can preserve the ability for local communities to make decisions that facilitate environmental justice. It's a complicated problem, but you need to have a framework where local concerns are not nullified by this greater drive to maximize the good for everyone.
- Utilitarian framings of injustice have been used to commit environmental justice in the nuclear space since the start of the field. Stark epistemological divides, and no one stance is correct. Not right to expect communities to come around to viewpoints that engineers and scientists are forming.
- Existing nuclear safety studies leave a lot to be desired.
    - The history of radiation knowledge is hugely political. Analysis done by Americans (at Hiroshima and Nagasaki?) didn't include many things like internal exposure to radiation.

Public trust in the nuclear industry

- How might nuclear institutions gain trust among the public, and how can perceptions of danger be meaningfully integrated into rebuilding this relationship?

    - The assumption is that before the public mistrusted us, they trusted us. Regardless of where we are with public trust, would a trusting public actually be desirable? An informed public will always have questions, concerns, and critique, which is healthy.
- The classic articulation of "The Deficit Model" is alive and well — but of course flawed and problematic — it assumes that criticisms come from misunderstanding or ignorance.
- The information shared with the public should be relevant (how to prepare for accidents, where to evacuate to), rather than irrelevant (how reactors work, the fatality rates/risk).
- Each time there's been an accident, it's been "the last time" again and again
- It is unhelpful to categorize public fear as radiophobia, when very real experiences lead the public to have concerns.
    - It is not helpful to dismiss fears of radiophobia. Just saying no one died of radiation in Fukushima is not necessarily helpful.
    - It is often assumed that the metrics tell the big picture, but they're not always relevant. What happens in situations where there's an evacuation? You can't just tell someone, "well at least you didn't die."
- Nuclear's association with weaponry is unique to nuclear power and needs to be considered and weighed in the context of safety.

<u>Measuring nuclear safety against the safety of other low-carbon energies</u>

- Who needs to be protected?
    - Workers, the public, and the environment
        - OSHA incidence rate: 0.2/200,000 worker hours; among the lowest rates for energy workers
        - For the public, fossil fuels release particulate matter which has documented mortalities. Nuclear on the other hand does not release particulates and the radiation exposure from nuclear plants is presumably negligible due to being so little compared to ambient radiation
        - For the environment, materials mined for a plant should be considered. Per unit energy generated, nuclear is much less material mined than other renewables. One person's energy footprint, if produced entirely nuclear, is equal to one coffee cup worth of spent fuel.
- Not "Nuclear or not" but "Nuclear or what else?" The risks need to be assessed relative to the alternatives.

Session 2: Grid Resilience

How can governance of nuclear and other energy technologies (grid planning, legal and regulatory frameworks) create a resilient and sustainable post-pandemic future?

Our second session of the day covered nuclear's place on the grid, and panel discussions and conversation revolved around the challenges involved in creating a resilient grid that consistently supplies energy when and where it's needed. Panelists were: Andrew Chapman (International Institute for Carbon Neutral Research, Kyushu University), Jill Engle-Cox (Joint Institute for Strategic Energy Analysis, NREL), and Kyoko Sato (Stanford University, STS Program).

Major keywords and talking points

<u>Important aspects in the transition to low-carbon</u>

- Japan as a case study
    - Centralized and decentralized renewables have increased in Japan, CO2 emissions going down, but electricity prices are going up. Two properties must be satisfied: base load and peak load.
    - Japan is likely to use nuclear energy to meet carbon goals. There must be trust in energy infrastructure. Energy security is non-negotiable.
        - The Fukushima accident has brought trust in government and nuclear to an all-time low
- Most important in transitioning to low carbon: pragmatism. No one solution will be able to achieve a carbon-neutral energy system
    - It's less about "clean" and more about "cleaner". Nuclear is part of getting us out of the funk we're in. We need to move to getting it used.
- Would consumers be willing to pay extra per kilowatt hour to ensure resilience and safety? These costs add up. Willingness may vary by community.
    - Disadvantaged people need electricity now, and they need it to be cheap.
    - Affluent communities can afford to pay more for resilience.
- With many small micro-grids, do we expect communities to build their own grids? How are these resources passed along to the next generation? How do we reimplement all the pre-existing systems into a new system?

<u>Grid policies and best practices</u>

- For most of history, we had decentralized energy. Everything is getting more centralized with time.
    - Centralized energy is more easily disrupted
        - We saw this in Texas recently — every energy type had a failure in that event
    - If we want to go to a more decentralized system that is more resilient, that could be interconnected microgrids, so if you have an outage, it doesn't cascade.
        - Large nuclear may not be part of this approach. It might be too legacy. Nuclear may need to be more flexible, and only supply power when it's needed, not when it's not needed.
    - There must be some balance between a highly distributed set of systems and a highly centralized system for resilience. The question becomes which systems are cheapest and which must be on standby, who will provide what electricity when?
        - Not mutually exclusive — can have centralized regulations but promote micro-grids and decentralization. More regulation with modular systems can be done together.
- Weather is a common system shock that communities are recognizing. It seems that in some areas we've already experienced those challenges and are now prepared to deal with them (power line undergrounding, etc.). Geopolitical shocks don't seem to be an issue in the US, but certainly in areas where countries are heavily dependent for fuel supply from outside their nation. The options for how to address any of these as dependent on local resources and values for human health, the environment
- At what scale of governance responsible for grid safety and resilience?
- Role of markets and institutions in incentivizing resilience?

Defining resilience and related terms

- Resilience in social sciences started as a concept to shift focus from vulnerable populations to positive aspects — how these populations might overcome the odds.
    - They're not victims and have their own agency in this model. Resilience is the capacity to deal with daily wear and tear.
        - Resilience as an ideal might be forced on populations though, rather than a responsibility of systems.
            - In post Fukushima, resilience is imposed on the community as an ideal and burden to the community.
- Cost benefit analysis is problematic because who is bearing the costs and who is getting the benefit?
    - Who is collecting, interpreting, and using the data? Who benefits and is at risk in risk-benefit analysis? A LOT OF TRANSPARENCY needed.
- Energy equity is one of the most difficult things to address, there are not easy models for it. It will take a big paradigm shift, and models must account for equity issues at the beginning.
    - One of the big deficits of energy equity is that it's not doable to really sprinkle equity on top of pre-existing systems; it may be easier to have those questions and measures baked in.
- Sometimes we impose our western views on other parts of the world, how to integrate thoughts and different views can be complicated. Important to keep in mind when thinking about who gets to decide what

Session 3: Economics

How do the economic dimensions of advanced nuclear energy technology affect energy equity, energy access, and public trust?

The last conversation session explored nuclear power's influence on the economy and the economy's influence on nuclear power. Panelists Lisa Marshall (NCSU, Nuclear Engineering), Basak Sarac-Lesavre (Department of Social Anthropology, The Beam, University of Manchester), and Paul Wilson (University of Wisconsin, Madison).

Major talking points

How do the economics of energy systems impact equity, access, and public trust?

- How *should* energy equity and public trust impact economic systems? These energy systems are part of the extracted economy. Energy justice as a paradigm shifts us to problematize clean energy.
- When you look at energy equity, equity involves distributing resources based on the needs of recipients. Energy access begs the question of who decides? Public trust comes back to relationship building, and this takes time. There is context and history that always should be considered.
- Prioritize humans in getting us to shape technology.
    - Energy economics must be coupled with other factors, such as health, safety, food.

- We need to work towards affordable cleaner energy; efficiency so lower costs; homes that are comfortable and cheaper to power; active engagement in decision making; working with legislators, policy makers and power providers to make it happen; workforce development and job opportunities. So we're supporting families with good wages and benefits. Also work towards diversity with policies that promote ownership by people of color.
- A quote: "The solution to poverty is not wealth, it's justice". Distributive justice, procedural justice (governance), recognition justice (respect, diversity). Empathy is necessary in our decision making process, knowing full well that there are people not at the table and there are communities that we don't even know of
- The framing that there's scarcity and unlimited need is one that's imposed by the markets we live in. We just have an unequal distribution of resources, meeting some people's wants and not meeting others' needs. Meeting those needs is a priority, and after that we can assess whether there's real scarcity.
- The nuclear industry has a long legacy and the technology has not changed very much. It follows that many of the equity issues have not been resolved either. Whatever the industry needs in terms of handling waste and decommissioning plants, these are hanging issues that need to be addressed.
    - We tend to compartmentalize, like the "nuclear lifecycle" or the "uranium lifecycle". It's important we have these conversations across technologies, collaboratively.

<u>Advanced nuclear's impact on energy prices and access to energy</u>

- Costs are nebulous and require judgements about what is valuable. Is it the carbon emissions, the financial costs, the waste generated, etc, that matters most?
    - We need to create technologies of assessment to produce technical expertise about nuclear technologies and their impacts.
    - First school of thought: looks at carbon emissions and sustainable vs. non sustainable technology.
    - Second style, rely on lowest costs.
    - Over the last two decades with deregulation of markets and private investment, we've seen a third style, which values efficiency — generation of most energy in the shortest time scale.
    - In all three styles, assessments have been placeless. The local communities affected by this technology are barely accounted for.
- There ARE emissions in the nuclear fuel cycle, but you see that those emissions are similar to that of renewables. Pricing the negative externalities is able to be applied clearly across most technologies. A price on carbon is a good starting point.

<u>Important economic barriers to nuclear's viability</u>

- Nuclear is a big financial risk due to the costs: will a plant last for 20 years? 40? Early shutdown? Hydrocarbons and renewables do not have that same risk
- Large new nuclear seems too expensive in the US because of large construction costs. SMR manufacturing seems like it may solve that but they are taking so long and we need to reduce carbon emissions at scale by 2035.
    - The danger of becoming irrelevant before you produce any energy is a very real one. Our energy system will always be evolving. Beyond 2035, we'll have globally growing energy systems.
- Small modular reactors may make nuclear more widely accessible, both economically and otherwise

    - But there's a lot of learning involved the first time you build something. We can't say too much about the costs of SMRs until we actually are building them. Is cost the main metric we should be choosing which energy technologies to build?
- The idea of placing a price on carbon. If we were to have a society that placed a price on pollutants like carbon, that would have a big impact on the economic viability of nuclear.
    - Arguably a political barrier as much as an economic barrier, but if we had a society that placed a price on carbon and other impacts, it would have a big impact on the economic viability of nuclear energy.
    - Problem with carbon pricing. Great idea, but energy value chains go beyond this. Some countries' economies depend on fossil fuels.
- Can, and should, the risk to industry of investment in nuclear power be mitigated by the government?
    - Prioritizing public utilities, non-profit models; energy as a public good. Profits shouldn't be made from people's basic needs.

Conclusion

The Critical Conversation wrapped up with several breakout rooms dedicated to various topics of interest, where participants could share advancements and considerations they'd like to see in nuclear's future. The following is a summary of some of the suggestions that were shared.

<u>Research</u>

- Request engineers, STS, humanities working together. More funding for research that goes beyond engineering.
- What does it mean for interdisciplinary research to be done in a good and authentic way? How to create funding opportunities for meaningful research?
- Learning humanities approaches from the beginning changes the way engineers frame problems. Discouraging engineers from pursuing social science training and vice-versa doesn't seem to accomplish change?

<u>Community</u>

- What is the role of the expert? Once you bring in more diverse perspectives, how do you carry the conversation forward?
- Origins of problem — can't disentangle distrust of experts with pervasive corporate influence
- Experts need to be willing to be challenged, willing to address questions. As with a doctor-patient.

<u>Industry</u>

- Address clear issues/challenges/demands; don't innovate or design in a bubble.
- The timing of these projects: Nu-scale plan was 15 years ago, not adaptable.
- Making output more diverse/flexible — not just electrons
- We implement, react, update. But you can't update a 1950s reactor with micronuclear. We have to build the next gen and be willing to adapt.

Policy

- Veto power for Indigenous communities for energy infrastructure projects (beyond just treating them as “stakeholders”) because they are sovereign nations
- EPA/whole-of-govt approach mining cleanup ASAP (center restorative justice principles)
- Long-term funding for academic-community partnerships and transdisciplinary projects.
- If the federal government could issue block grants. (Here's money, a timeline, a simple framework, and a direction — like decarbonization) . Provide structure/resources, but give communities some agency.

Regulation

- Need for regulators to adapt procedures to aid in development of new technologies and decommissioning
- Introduce regulation for all energy sources that require them to account for their entire life-cycle. Align stakeholders and restructure markets to shift from prioritizing low-price to "something else" — involve communities in deciding what new priorities are (low emissions? land disruption)?
- Need to truly, earnestly engage with communities. Universities can play a role in this. Ties into the NEPA NRC review wherein consultation with tribes, communities takes place. But the responsibility really falls on the shoulders of the plant operator/licensee. Lacks cohesion.