United States House of Representatives
Select Committee on the Climate Crisis

Hearing on August 1, 2019
"Colorado's Roadmap for Clean Energy Action: Lessons from State and Local Leaders"

Questions for the Record

Heidi VanGenderen
Chief Sustainability Officer
University of Colorado-Boulder

The Honorable Kathy Castor

1. **In your testimony, you mentioned that public-private partnerships are needed to gather the capital required to facilitate a transition to clean energy. What types of partnerships with the public and private sector would help universities like yours achieve their climate and clean energy goals? What Federal policies could help facilitate these partnerships?**[1]

There remain a large number of technologies requiring discovery and development to fully realize clean energy goals. These are not only in clean energy generation, but also in transmission, storage, distribution, usage, monitoring, etc. Additionally, these needed technologies span numerous disciplines. While the private sector has commercial interest in the clean energy economy, industry's ability to fund this necessary technology development is insufficient for all that is needed to realize the clean energy future. The public sector can support development of these technologies by encouraging and funding partnerships where government, industry, and academia come together to investigate and solve the hard problems and help these technologies "cross the chasm" from lab to commercialization. Additionally, the Federal Government could support these partnerships by driving a system-level approach for all of the technologies and systems that will be required to realize the clean energy future. Silo'd development will result in incremental change, but revolutionary change requires system-level requirements, development, and interoperability. Individual technologies can be powerful, but engaging all of the required disciplines together in these partnerships will drive realization of these goals more quickly.

The October 2018 IPCC report that focused, in part, on the investment required to keep warming under 1.5 degrees C noted that the transformation to a world powered almost entirely by clean energy will require a global investment in clean energy and infrastructure of $1.6 trillion to $3.8

[1] My responses to these QFRs represent views stemming from my professional background in energy and sustainability policy, and do not represent the official positions of the University of Colorado Boulder.

trillion a year (in 2010 U.S. dollars) with an average of about $3 to $3.5 trillion per year from 2016 to 2050. (This is compared to an estimated $2.4 trillion a year that would otherwise be invested in energy systems).

Unleashing private sector capital in this investment need is vital to achieve sufficient scale. However, the private investors have learned over the past decade that investment in clean energy will not be simple given technological, economic, and political uncertainties. Public-private partnerships are one strategy that, when designed well, can attract greater net investment, unlock new management expertise and efficiencies, and, importantly can help strike the balance between protection of the public interest and generating strong return on investment (for both the public and private partners). Public policy and endorsement of emerging clean energy technology can drastically reduce the uncertainty of private investment. We witnessed this in Colorado through multiple city and state-level endorsements of the emerging wind and solar industries.

Universities are distinctly positioned to provide a platform for innovation and to serve as a test bed of both individual technology demonstration, and more broadly, through the integration of new and existing technologies at a systems level. The resources that exist to do either or both of these rarely, if ever, exists within a university alone. Universities can effectively collaborate with the municipalities in which they are embedded to demonstrate the feasibility and scalability of clean energy and energy efficiency solutions. Further, universities are often the source of innovations that need the support of both local and federal policy in order to gain access to funding. A cross-fertilization between private sector and university partners toward research (theoretical and applied), financial capacity, implementation capacity, and data tracking and analytics between the private sector and university partners can help facilitate the required array of assets to achieve adequate clean energy and climate goals. Because universities often house faculty studying the economic, policy, and technological impediments, and inducements, to clean energy adoption, they can provide a natural facilitation role between early stage technology, public entities, and private investors.

Many, such as the National Conference on State Legislatures, have noted that policies governing Public Private Partnerships (P3's) should remain largely at the state level, with the federal government providing overarching guidance. The federal government, however, importantly, can forge policies that will result in expanded funding for the development of technologies, its deployment and financing of low carbon strategies. A federal tax on carbon emissions, or the reduction of subsidies for fossil fuel production are two of the simplest potential policies that would fuel innovation and adoption in clean energy. Recent research has shown that both federal regulation of coal-fired emissions, and policies encouraging adoption of clean energy have had a significant impact on accelerated coal-fired electricity unit retirements. There are a number of current bills before Congress that address strategies to expand the "seed" and partnership capital that could be devoted to effective public/private/university partnerships working to achieve a sufficiently low-carbon economy. Federal endorsement can change the economic calculus of private investment through not only tax incentives, but also through creating a sense of support for new, cleaner energy technologies, sowing the seeds from more localized state, county, and city-level P3s.

Well-structured, transparent, and focused partnerships between universities, the public sector and the private sector are imperative if we are to achieve our climate and energy goals. In the university world, expanded funding for research, and demonstration of that research on the university campuses and in the communities in which those universities reside is a critical element. Our ability to harness emerging research into economically sustainable industries is critical not only to addressing climate change, but to our nation's economic future.

2. **You referenced some examples of innovative new technologies developed by CU Boulder researchers that could improve monitoring of CO2 emissions and create opportunities to re-use CO2. How should Federal R&D investments be expanded to maximize these opportunities?**

Federal R&D investments shape the research landscape. To fully leverage the game-changing tools and methods that can emerge from university labs, the government can consider:

- **Additional investment in ARPA-E and DARPA-style funding for high risk/high reward projects** in clean energy, resilience, and decarbonization. For instance, an ARPA-E grant funded a team of researchers from CU Boulder, CIRES, NOAA, and NIST to adapt Nobel Prize-winning laser technology developed at CU Boulder into an inexpensive, portable, robust instrument that can detect methane and other gas leaks from oil and gas operations as they occur, allowing operators to catch and control leaks. A startup company is now commercializing the technology. (https://cires.colorado.edu/news/detecting-methane-miles-away)

- **Robust funding of NSF, NASA, NOAA, DOE, and other federal funding sources** that invest in R&D, paired with a recognition that multidisciplinary research can often yield the most innovative results. Federally funded research is transforming every aspect of the energy landscape, including emissions detection, carbon and methane capture, reuse of carbon in fuels and building materials, battery storage, grid optimization, and many others. For example, CU Boulder researchers have developed nanobio-hybrid organisms that capture CO2 and nitrogen from the air to produce fuels and plastics (https://www.colorado.edu/today/2019/06/11/these-nano-bugs-eat-co2-and-make-eco-friendly-fuel). Another CU Boulder team developed an innovative wastewater treatment process called Microbial Electrolytic Carbon Capture (MECC), which purifies water in a way that absorbs more CO2 than it releases while creating renewable energy, all in a potentially lower-carbon, lower-cost way than that provided by existing carbon capture technology (https://www.colorado.edu/today/2015/08/03/cu-boulder-researchers-use-wastewater-treatment-capture-co2-emissions-and-produce-energy). Adequate funding—in a stable funding environment—can maximize the potential of this type of research.

- **Secure, sustainable funding for baseline monitoring projects in federal agencies** on which our university research often depends. For example, CU Boulder laboratories are part of the Global Greenhouse Gas Reference Network within the NOAA framework (https://www.esrl.noaa.gov/gmd/ccgg/index.html). The program collects air samples from locations around the world to measure the distribution and trends of the three main long-term drivers of climate change (carbon dioxide, methane, and nitrous oxide) and

carbon monoxide that is an indicator of air pollution. Samples are regular, not random; and that steady collection of data is what makes these long term records of Earth's atmospheric composition so fundamentally important. It provides critical diagnostic information on sources and sinks of greenhouse gases. It is already becoming a valuable tool to validate carbon emission targets across continental and national boundaries, which may play an important role for enforcement of agreements. (For example: https://news.agu.org/press-release/new-monitoring-system-identifies-carbon-dioxide-from-fossil-fuel-burning/) Many of our federally funded scientists conduct innovative research on emissions detection, monitoring, and modeling based on this ground truthed data. Yet, many years of flat or decreased funding have translated to significant virtual cuts, as rents and operational costs continue to rise unmatched by funding. Similar Congressional cuts have been made to virtually every baseline monitoring project in the environmental sciences.

By setting a priority on funding decarbonization, resiliency, and clean energy efforts, expanded Federal R&D investments can unlock the discoveries and innovation that can help move us forward to a clean, resilient future.