The Value of Carbon Capture, Utilization, and Storage

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"Suppose you are in charge of the Breakthrough Energy Ventures Fund," speaker Cuicui Chen suggested in Monday's energy policy seminar. "How do you think about what to fund?" Chen, a postdoctoral fellow at the Belfer Center for Science and International Affairs, went on to outline a theoretical framework for thinking about how to prioritize research and development (R&D) spending, using her method to tease out some conclusions about potential R&D funding for carbon capture and storage.

Chen's presentation traced her development of a "simple economic-theoretic model" for thinking about when investment in a given energy technology makes sense and for analyzing potential trade-offs between investments in multiple technologies. Key parameters in her model were the R&D effectiveness (which affects the probability of R&D success), the cost and benefit of technology deployment, and whether the outcomes of R&D for multiple technologies were likely to be correlated or independent of each other.

Aiming for a model that would be "as simple as possible, but no simpler," Chen looked for optimal R&D investment for one and two technologies, with and without learning effects. After working through optimizing outcomes via a series of equations, Chen noted that certain key lessons emerged. First, Chen found, the value of R&D investment in any given technology increases with the likely effectiveness of the technology, but decreases when an alternative, highly effective technology is available. Second, Chen noted, there are advantages in diversifying the R&D portfolio. Thirdly, she said, in many cases we cannot afford to postpone R&D investment until the uncertainty about the benefit of technology deployment is resolved—even if we don't know for sure how adversely climate change would affect our well-being, it may still make sense to invest in carbon emissions reducing technologies today, Chen found.

Chen went on to tease out some of the implications of her framework for R&D investment in carbon capture in storage—a technology that might be thought of as "competing" for R&D dollars with renewable energy technologies. Chen focused on several key questions. Does CCS bring additional value to research on renewables? Does CCS lose its value if it results in increased consumption of fossil fuels? What is the relationship between public support and private investment in CCS?

Chen applied her theoretical model to these and other questions, reaching three key conclusions. First, she found that CCS R&D investment may well be worthwhile, even if there is some "rebound" impact on fossil fuel use. It would take a large increase in fossil fuel use linked to CCS to cancel out the benefits of a very effective R&D program in CCS, Chen noted. Second, Chen found that, even if some CCS projects are very expensive (e.g., a new gas power plant with CCS), investment in those expensive CCS projects can still be worthwhile if their R&D success is quite independent of other CCS projects. Finally, Chen compared likely outcomes of unconditional government R&D subsidies for CCS with "conditional" subsidies, intended to provide incentives for private sector R&D and deployment investment. Unconditional government subsidies, Chen found, would tend to crowd out private R&D efforts and result in little improvement in social welfare. However, Chen noted that government subsidies that came with "strings attached," in the form of requirement for additional private spending on R&D and/or deployment, would incentivize socially optimal private R&D and deployment without overburdening government budgets.

Chen spoke as part of the Kennedy School's Energy Policy Seminar Series, which is sponsored by the Consortium for Energy Policy Research of the Mossavar-Rahmani Center on Business and Government.