**Syracuse Reviewer #1**

1. *What is your view as to the qualifications of the PIs? How likely is it that the PIs will be able to accomplish their goals in the timeframe outlined?*

The two PIs on this project are very well qualified for the proposed research project. Popp has conducted ground-breaking economic studies of how incentives for innovation play out in the energy sector. His subject-matter expertise is without question, and he has a clear ability to generate economic models of innovation that are tractable while still based in an understanding of real-world processes. Popp’s economic expertise is complemented by Acuna’s skills of manipulating non-traditional data sources (e.g., scientific abstracts, research paper citation networks). One of the major reasons that progress on the research questions posed has been limited is because answering them requires skills from both the information sciences (to generate standardized data sets from highly un-standardized data sources) and economics discipline (to analyze the resulting data and inform public policy). It is clear that this duo is well suited to do both.

1. *What will be the value of the proposed research work to the field? How significant, unique, or worthwhile a contribution would this project make?*

It has been more than 50 years since economists first appreciated that managing innovation in the economy requires an understanding of how market forces and public policies influence the both the “rate and direction” of innovation.[[1]](#footnote-1) Until only recently, most research was focused on understanding what drives the “rate” we observe; how can public policies help develop *any invention*. But now that society begins to face more specific challenges – climate change – we must improve our understanding of how public policies can help develop *specific inventions*.

As the PIs point out, most of the little work in this space to date has been conducted in the biomedical sector. It is encouraging to see the PIs pursue these questions in the energy sector context, and that alone is a worthwhile contribution. But even beyond that, the PIs plan to compare the relative advantages of different policy structures – as outlined in Figure 1 – is encouraging. Sharpening our understanding of how scientists respond to these sorts of targeted interventions has immediate policy relevance and would be a significant contribution to the field of science policy.

1. *What are the strengths and weaknesses of the project and the proposed work plan?*

All of the PIs’ research questions are about the causal effect of certain policies (e.g., do highly-targeted or open-ended research programs attract higher quality scientists?). It appears that for each research question, the PIs will be relying on identification strategies centered on using observable characteristics of scientists to assign treatment and control statuses. Certainly, their plan to leverage modern machine-learning techniques to select relevant covariates is a step forward from older observational study methods. But the fact that the PIs do not have a clear path towards some kind of observable exogenous shock in any of their research designs is not ideal. The advantage of studying the energy sector is its clear policy relevance, but this also means that the PI’s research designs may be susceptible to attributing effects to policies that in truth are due to any of the many unobservable shocks to the supply of and demand for energy science that have occurred in the past decade. Thus, I am concerned that the impact of any research outputs from this project may be limited in their impact because of the modern standards for identification strategies in policy evaluation work.

But despite this concern about the rigor of the research design, it still may very well be the case that (1) in the process of work the PIs identify a useful source of exogeneity, or (2) that with their highly-detailed data, the PIs are able to make a convincing case that concerns over certain sources of endogeneity are not warranted. Furthermore, I am particularly excited by the prospect of even having observational-based estimates of the relative impact of the different program structures outlined in Figure 1. Generating a coherent understanding of the traditional vs. high-risk/high-reward and Open vs. Targeted structures is the largest strength of this proposal and would be a terrific contribution.

The PIs workplan appears very reasonable, especially given the PIs’ experience.

1. *What is your evaluation of the appropriateness of the budget? Are there any elements that you would add, eliminate, or change?*

The budget seems appropriate for the type and amount of work proposed.

1. *What additional suggestions or recommendations for improvement, if any, do you have on the overall project that might make the proposal stronger?*

Returning to the earlier comment on identification strategy, my only suggestion is that the PIs devote a significant amount of their time to pursue some potential source(s) of exogeneity. For example, there may have been specific policy changes at these agencies that shifted priorities for reasons unrelated to the clearly growing demand for certain types of energy technologies. For instance, in the context of politically-influenced funding agencies, some researchers have had success leveraging data on lobbying and corresponding regulations to generate instrumental variables.[[2]](#footnote-2) Or, since the PIs clearly could access a large set of historical data on the direction of energy research, perhaps there might be some way to leverage “very old” policies that, for path dependent reasons, are still influencing the particulars of how the Department of Energy is structured, or how its different programs operate. All this to say, I am very supportive of the research questions posed, and while answering them with the methods proposed would be a significant contribution, I think their findings would be much more impactful if they were grounded in a more rigorous identification strategy.

1. Richard Nelson. *The Rate and Direction of Inventive Activity: Economic and Social Factors*, (1962). [↑](#footnote-ref-1)
2. See: Hegde, Deepak, and Bhaven Sampat. "Can private money buy public science? Disease group lobbying and federal funding for biomedical research." *Management Science* 61.10 (2015): 2281-2298. [↑](#footnote-ref-2)