

Thesis Project Portfolio

Quantifying the Socio-Economic Impacts of Decarbonization Policy using Integrated Assessment Modeling

(Technical Report)

Finding Closure for Climate Economy Models

(STS Research Paper)

An Undergraduate Thesis

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My technical work and STS research are both within the realm of climate economy models. Climate economy models are models that attempt to either discover pathways to achieve specific climate goals or extrapolate the impact of specific policies on the economy. My technical project involves adapting a current model for use in the context of the United States, while my STS research focuses on understanding how these models have impacted legislation.

There are many global models available that are used in Intergovernmental Panel on Climate Change Reports, but there has been less development on a national and regional scale. Our technical project was to create a regional computable general equilibrium (CGE) model for the US, based on the CHEER CGE model which is geared towards examining the employment impacts of renewable energy policies in China. As we continued to work on this project, we discovered that there was a significant lack of data in the regional context. Due to time constraints, we had to use US national data for the model instead, which allowed us to observe trends in the US economy in response to the implementation of a carbon tax. CGE models are often used as a tool for analyzing the response of an economy to policy, technology, or other shocks, but CGE models are not capable of techno-economic modeling of the renewable energy and carbon dioxide removal technologies that will need to be deployed to achieve climate goals. Integrated models, in contrast, such as the Global Change Analysis Model (GCAM) are able to simulate emerging technologies but lack the resolution and regional fidelity of CGE models. In our project, we linked the CGE and GCAM models to analyze the effect of implementing high, low, and zero carbon taxes on electricity generation technologies and labor demand for these technologies by 2060. We

found that the implementation of a carbon tax results in significant growth in labor and investment in the electricity sector, with a large proportion of this growth in the wind and solar industries.

My STS research paper seeks to understand the current state of climate economy models and their hand in policymaking. Using the social construction of technology (SCOT) framework, I defined two groups of shareholders whose views must be investigated to get a deeper understanding of these models. SCOT looks to the social world in order to justify the success or failure of technology. I performed a SCOT analysis by reviewing academic journals and articles to gain an understanding of the history of environmental models and what factors are important for the development of climate economy models. I interviewed a senior research scientist of the Joint Global Change Research Institute at Pacific Northwest National Laboratory, a leading organization in climate science and the development of climate economy models, about the difficulties they've encountered in creating decarbonization models and the impacts their models have had on policy. I also talked with a legislative correspondent for a Virginia senator to understand how and to what extent climate economy models are used to inform environmental policy and what other considerations are taken into account when creating environmental legislation. I discovered that although these models are widely used to inform policy there is a complicated web of factors that create a disparity between the outputs and proposals of these models and their usage in policymaking. One factor that is difficult for models to capture is the will and mindset of the legislators, climate policy is surprisingly polarized along party lines, which impedes the development of necessary climate legislation. Some recommendations I developed to bridge the gap between models and legislation include narrowing down the scope of these models to find solutions at the regional or local level that could be easier to implement than global or

national initiatives and shifting the mindset of the general public and reluctant legislators towards supporting climate change mitigation policies.

I believe that by working on both of these projects, I have seen both the macroscopic and microscopic view of the making and usage of climate economy models. In my technical project, I was able to experience firsthand the struggles of developing a large-scale model. I was then able to better comprehend and contextualize the viewpoint of the model developers I spoke with for my research project. Additionally, the intimate knowledge of modeling I gained allowed me to have a comprehensive conversation with a legislative correspondent about the role of climate economy models in policymaking. Without that knowledge, I would not have been able to ask questions outside of my scripted questions continuously to carry on the conversation.

I think that the focus of my technical work was relatively narrow and very data-driven. Hence, the research project allowed me to expand my view to encompass the climate economy modeling field as a whole. My STS research also put the outcomes of my technical project into perspective in terms of understanding the impact that our model could have.