Carbon Capture and Sequestration

Ben Jensen, Dhivya Manickam, Kyle Blazer

Abstract

- Carbon Capture and Storage (CCS) is one of the most promising climate crisis solutions.
- An optimized tax plan could fund carbon capture.
  - Rate of **$50 per ton** with a **5% growth rate**
- Provides a basis for an economic plan that would support the funding and development of CCS facilities.
- **Revenue results in the emissions captured exceeding the estimated emissions emitted in approximately 23 years**.
- **US map** with emission hot zones as well as a USGS map of ground storage to identify **promising locations** for the infrastructure of **Carbon Capture and Storage facilities**.
  - Ventura Basin
  - Appalachian Basin
  - Atlantic Coastal Plain
  - US Gulf Coast.
- The interdisciplinary approach of science, economics, and public policy will be integral to implementing carbon capture on a national and global scale. The map and tax models presented provide a realistic proposal to address the climate crisis that acknowledges scientific and economic limitations.

Introduction

- The climate crisis is one of the largest issues the world is currently facing. One main contributor to this crisis are CO_2 emissions, whose concentration has risen from 300 ppm to over 400 ppm (Dismukes 2018). If CO_2 emissions could be cancelled out while we transition to clean energy, global warming could be lowered by up to 2°C (Rogelj 2016).
- For past emissions, **Direct Air Carbon Capture** (DACC) is used to filter CO_2 from air. For current and future emission,: **Post-Combustion Capture** (PCC) can be implemented in polluting power plants to reduce the amount of CO_2 released into the atmosphere.
- For storage, **geological sequestration** traps CO_2 underground in porous rock formations.

Methods

- After an initial survey of the state of CCS, and consultation with an expert in the field, we decided to pursue its implementation with a **tax plan proposal**.
- **Tax Modeling**: An optimized tax plan of $50/ton of carbon w/ 5% increase/year (Caron et. al. 2018) was used to model capture in a 40 year timeframe in an Excel spreadsheet.
- Our model assumes 20% of revenues redistributed to carbon dividends, costs of capture of PCC being $20/ton and DACC being $238/ton (with 1% decrease in costs each year as technology improves), and 40% emissions capture potential with PCC
- The modeled capture is compared to predicted emissions trends to determine when capture under the tax plan is greater than emissions, described in our model as Excess Yearly Capture.
- Predicted emissions data was collected from a research paper which used the National Renewable Energy Laboratory's (NREL) Regional Energy Deployment System (ReEDS) and uses a time scale of 2010 to 2050

Results

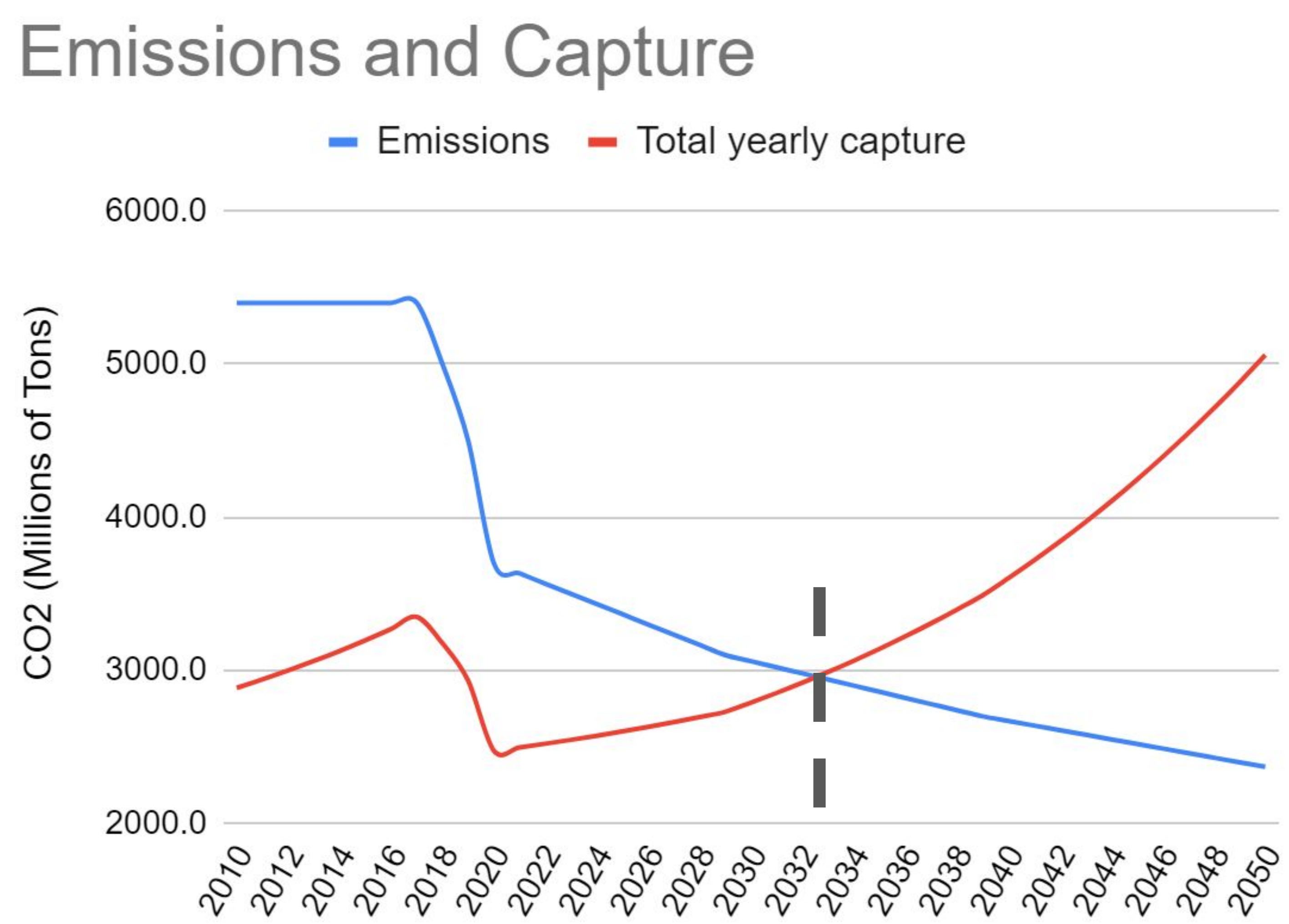
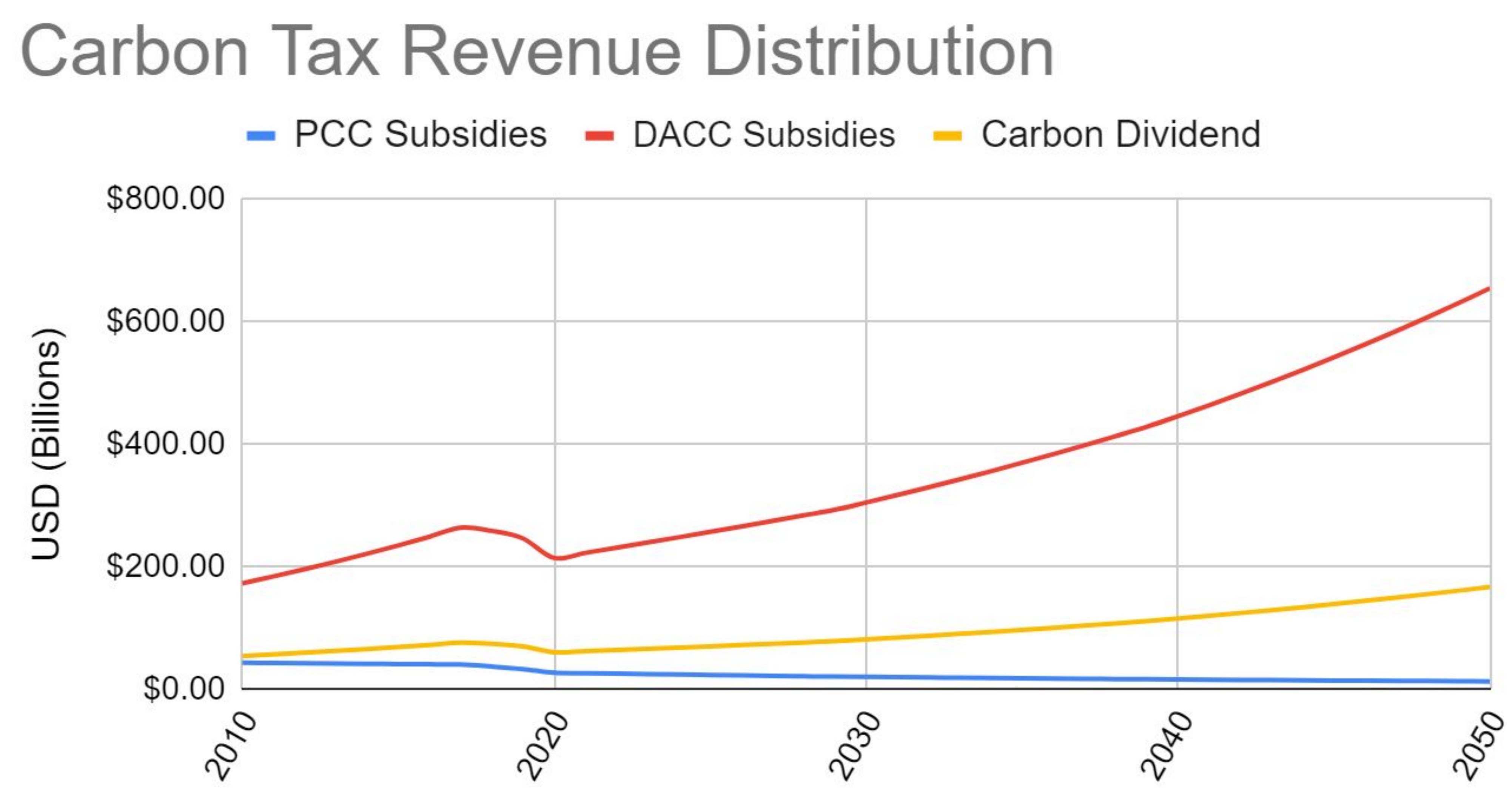


Figure 1: (Left) The line chart depicts the amount of emissions in millions of tons that are emitted and captured each year over time. Emissions decrease as capture increases, and their rates intersect ***22 years*** *into the tax plan. **

Figure 2: (Below) The line chart depicts the amount of money that can be distributed to Carbon Capture each year over time. Post dividend revenues from the tax are distributed with a ***priority to PCC***, *as calculated from the efficiency and the cost of running the system. The remained of the funds would be used for DACC*



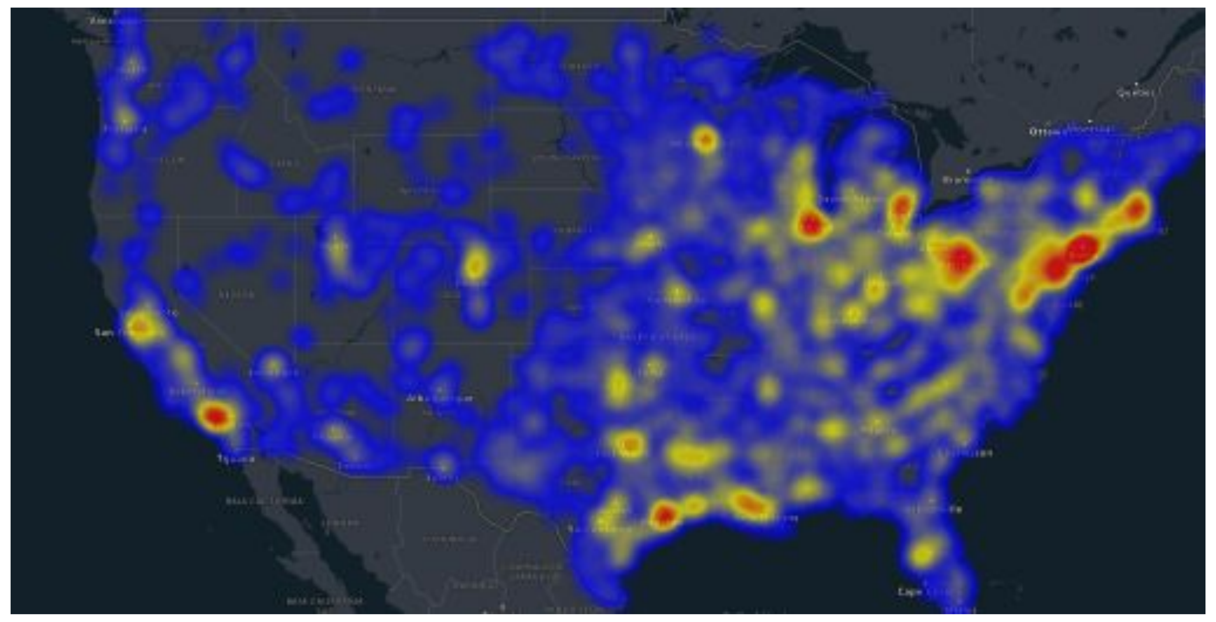


Figure 3: (Left) ***map of emissions by US ZIP code***. *Areas in red are high emission zones (Right)* ***Map of porous rock basins*** *(USGS) that can be used/ are being used for Carbon Storage:* ***Appalachian Basin, Atlantic Coastal Plain, US Gulf Coast, Ventura Basin***. *These regions are identified as ideal for PCC and storage by the USGS, with high emissions and storage potential*

Methods continued

- **Location Criteria**: PCC near large emitter clusters (cities, industry); Storage at porous geological formations (ideal rock for geological sequestration; heat map made using mapline.com
- *Plateau in emissions and then a large dip appears in modeling data under our proposed carbon tax.
  - Represents the **challenge that firms face in shifting from polluting energy sources** and **consumers' relatively inelastic demand** for energy intensive goods and services.
  - Once energy production methods and consumer expectations shift, the model predicts a considerable decrease in emissions.

Conclusion

- A $50 per ton carbon tax growing at a 5% annual rate could have a large impact on mitigating and reverting the current climate disaster.
- The models account for the tax regressivity, PCC's capture potential, and decreasing cost of capture technologies over time to give us a realistic proposal of tax revenue redistribution. We believe that the revenues generated by a carbon tax should be **spent in 2 ways**.
  - Firstly, we support redistributing 20% of the revenues to homes which are adversely affected by a carbon tax in the form of carbon dividends.
  - With the remaining funds, we should maximize investment in the cheaper and effective Post Combustion Capture.
- An estimated 40% of total emissions can be captured at the source with PCC. All remaining revenues should be invested in DACC.
- Our models suggest that this policy would result in excess carbon capture (capturing more than emitted in the given year) in under 23 years. This demonstrates a realistic proposal plan for CCS that will help solve the climate crisis.

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Sources

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