The Economic Impact Of Public Policy In Carbon Emissions

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BE AWARE Research Area

This project focuses on the negative impacts coal power plants have on the environment, as well as the policy implications designated at reducing greenhouse gas emissions.

Background

Under the Nixon Administration the EPA began regulating greenhouse gases (GHGs) under the **Clean Air Act of 1970** (CAA) from mobile and stationary sources of air pollution for the first time. The **American Clean Energy and Security Act of 2009**, increased energy efficiency, reduced global warming pollution, and drive forth a transition to a clean energy economy by, requiring a strategic plan to improve overall U.S. energy productivity by at least 2.5% per year, requiring retail electricity suppliers to meet 20% of their demand through renewable electricity and electricity savings, and establishing a cap-and-trade system for the total amount of GHGs emissions. The **Cross-State Air Pollution Rule of 2011** (CSAPR), required member states to reduce power plant emissions that contribute to Ozone and/or fine particle pollution in other states in order to attain clean air standards. The **Climate Action Plan (2013)**, have as the ultimate goal, to cut domestic carbon emission, preparing the U.S. for impending effects of climate change, and working internationally to address climate change. Finally, the **Clean Power Plan (2015)** is focused on reducing emissions from coal-burning power plants, as well as increasing the use of renewable energy, and energy conservation. The goal of this project is to look at major policy changes across the U.S. and see the impact it has on the coal industry as well as the environment. Extensive data on the coal industry is available for the years 2008 to 2016, with limited data from 2017. Using these resources, policy impact was determined by calculating the CO_2 output of coal power plants across the country. A time series analysis was developed to perceive if there is a trend in the data due to policy implications. Due to the short time period available, the previously mentioned policies were be reviewed and assessed for impact such as the Cross-State Air Pollution Rule (2011), Climate Action Plan (2013), and the Clean Power Plan (2015).

Objectives

1. Find national public policy implications targeted at preventing climate change and reducing GHG's.
2. Calculate the CO_2 emitted by different power plants across the state of Texas.
3. Use social cost of carbon models to detect the economic impact of implementing a policy enforcing or discouraging the reduction of emissions.

Methodology

The U.S. Energy Information Administration (EIA) possesses a database on coal powerplants around the nation. Data from the state of Texas was obtained and analyzed to determine the social cost of carbon, and total emissions for all the powerplants. This data was formatted and transcribed in Excel spreadsheets from Microsoft Office 2017 by using Macros. Afterwards, computer software R programming was used to extract points of interest from the coal power plants in Texas and around the nation. Data included short tons purchased, price, heat content and computing the CO_2 output while compiling it into a category by year. This data was used to produce graphs in the resulting page.
In order to determine the social cost of carbon, two economic models were analyzed and used in this project:
The DICE model was created by Yale economics professor Dr. William Nordhaus in 1992 and has been in continued development and use ever since. It is a simplified analytical and empirical model used to represent various social components of climate change, such as policies, economics, and scientific aspects. It is one of the most used and referenced models concerning the relationship between economics and climate change. By factoring in various markets and including an annual discount rate, the DICE model generates a numerical dollar value for the social cost of carbon(SCC) for every five years.
The PAGE09 model is an economic model of climate change developed by Chris Hope from the University of Cambridge. This model analyzes the Social Cost of CO_2 (SCCO2), calculates the impact of climate change and the costs of abatement and adaptation policies under uncertainty for eight world regions and ten time periods. It includes a range of climate sensitivities, and the possibility of catastrophic damages if the global temperature rise were to exceed an uncertain threshold.

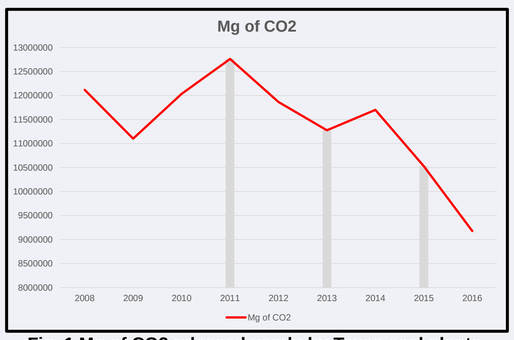

Fig. 1 Mg of CO2 released yearly by Texas coal plants.
Using mine/plant data from the EIA, the mean of Texas yearly consumption of coal was calculated.

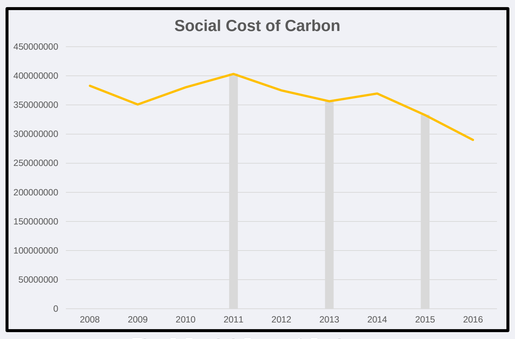

Fig. 2 Social Cost of Carbon
Using the DICE model's calculated social cost of carbon(SCC) value, and mean coal consumption data from the EIA, the yearly SCC mean was found.

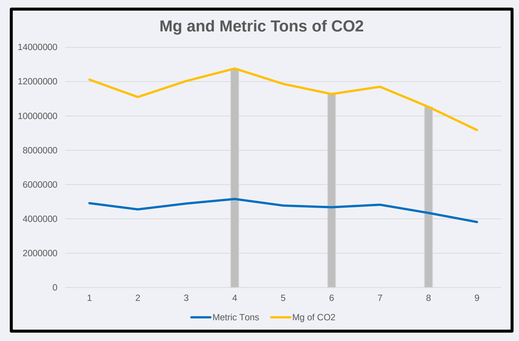

Fig. 3 Mg and Metric Tons of CO2 released yearly by Texas coal plants.

Results

After looking at a Two-way ANOVA, there was a statistically significant difference between the amount of coal short metric tons purchased between 2008 and 2016. There was a paired t-test run between a variety of paired groups, but was found insignificant between most years, but was found significant between 2011 and 2013.(Fig. 7) Due to CO2 reduction, 17149122.08 USD was saved between 2013 and 2011.
A time series was looked at over the course of 2008 and 2016 for national level data. Data on this chart was at the national average, instead of state level and was at monthly intervals. There was a noticed decreasing trend. When the trend was adjusted for, the time series still exhibited a declining slope. This means that regardless of regular trend, there was a sharp decrease in coal being purchased around the United States.(Fig. 6) Seasonality was also removed, but was not seen as a big influence in the graph. Public policy could be a direct impact in this area. Consumers could be switching to renewables during this transition. Public policy was implemented at 1970, 2009, 2011, 2013, and 2015.

Fig. 4 Coal Firing Power Stations in Texas

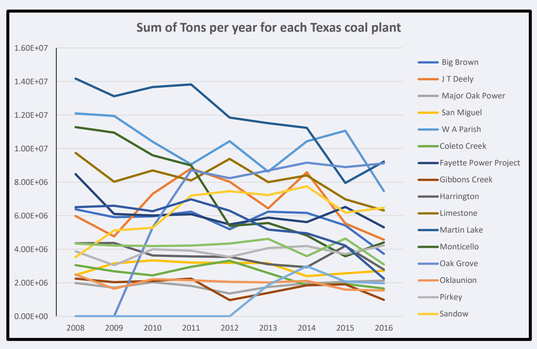

Fig. 5 Sum of Tons per year for each Texas coal plant

	2011	2013
Mean	5696223.421	5153529.684
Variance	1.18381E+13	7.968E+12
Pearson Correlation	0.946558995	
Hypothesized Mean Difference	0	
df	18	
t Stat	1.985232514	
P(T<=t) two-tail	0.06257064	
t Critical two-tail	2.10092204	

Fig. 6 United States Coal Purchases

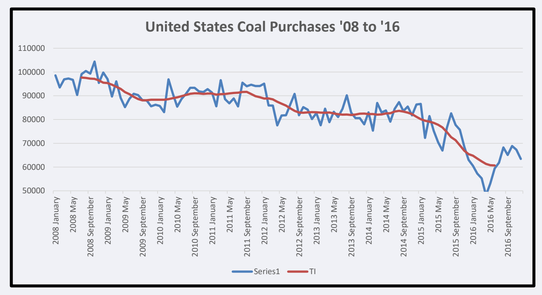

Fig. 7 t-Test: Paired Two Sample for Means

Skills and Experience

The skills used and learned during this research project consisted of various forms of data collection, manipulation, and analysis. For data collection, automated and manual mining and scraping of data from websites was done. The task automating program UIPath, a visual basic based software, was used to collect information for the power plants.

What I Learned

From the analysis of the power station data, policy enactment dates, and DICE and PAGE models, it can be stated that the establishment of policies has a crucial impact on CO_2 production in the coal plants in the state of Texas, and thus economic and social impacts in the surrounding communities as well.

Future Plans

Future research will be aimed at continuing the analysis by widening the scope of the data collection to more states within the region, assessing a dollar value for the difference attributed by policy, considering the change in coal type popularity over time, and associating the analysis with a county population size.

Acknowledgments

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