

Report According to CVPR

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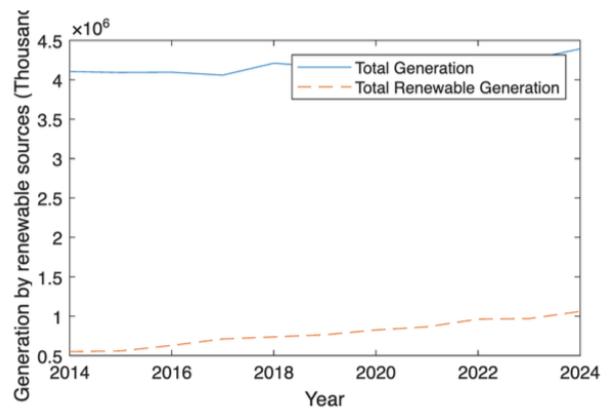
Introduction

I want to explore the changes in electricity generation methods, amounts, emissions, and efficiency in the United States over the years. I want to do a project of comparing the change in ways electricity is generated over the years. Different generation methods and different fuels such as solar, nuclear, wind, coal, petroleum, and hydro can lead to different environmental effects. I want to look at the generation amount and the environmental effects such as emissions. I want to investigate whether the proportions of electricity generation by renewable sources have increased over the years and whether the use of fossil fuels have decreased. I also want to see whether the emissions such as carbon dioxide, sulfur dioxide, and nitrogen oxide due to electricity generation has been decreasing both in terms of emissions per unit of electricity generation and emissions overall/total. I also want to look at the useful thermal output produced throughout the years during electricity generation and see which sources are the best at producing both electricity and useful heat that can be used for heating/cooling at the same time. I also want to see if they have been getting better and more efficient at capturing and reusing heat created during electricity generation over the past 11 years.

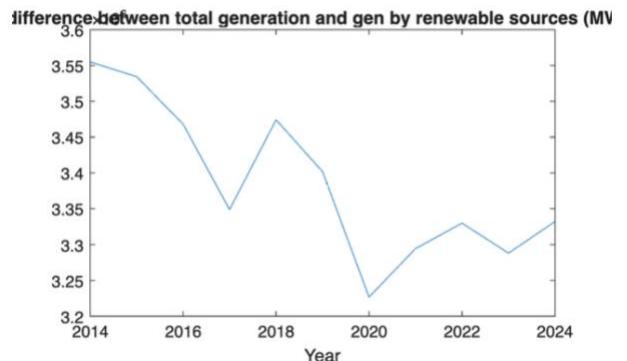
Method and Results

To calculate the total electricity generation in the United States each year from 2014 to 2024, first we must extract/save the yearly totals of electricity generation at utility scale facilities as a vector. Next, we must extract/save the yearly totals of electricity generation at small scale facilities as a vector. Next, we add up the 2 vectors to get a vector containing the total electricity generation in the United States for each year. I will need to create a vector containing the years for plotting. I want to compare the electricity generation using renewable sources to the total generation over the years. Electricity generation using renewable sources is more sustainable and has a positive impact on the environment. It can reduce long term energy expenses and reduce fossil fuel usage. It can require less consumption of resources and produce less pollution and emissions. To find the total electricity generation using renewable sources for each year we first must extract /save the yearly totals of electricity generation using renewable sources at utility scale facilities as a vector. Next, we must

extract the yearly totals of electricity generation using renewable sources at small scale facilities as a vector. Next, we add them together. I want to make a plot to compare electricity generation by renewable sources and total generation.

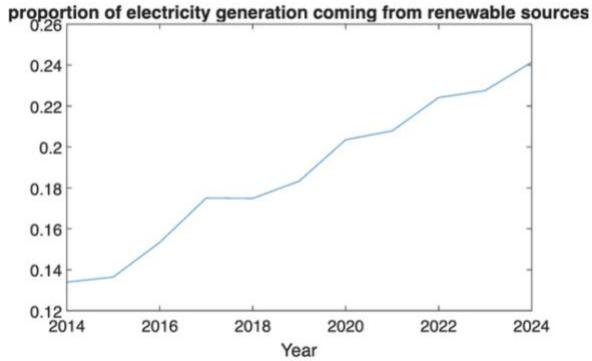


It seems that generation by renewable sources has only been a small part of the total electricity generation. We can also see from the graph that electricity usage has been increasing steadily over the years. I want to find and compare the gap between electricity generation by renewable sources and total generation by finding the difference for each year and plotting. Do subtraction to find the gap for each year.

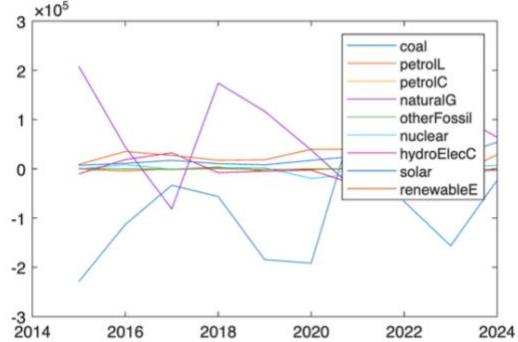


It seems from the plot that the difference between total electricity generation and generation by renewable sources has fluctuated over the past ten years but has greatly decreased and is generally decreasing. This is supposed to

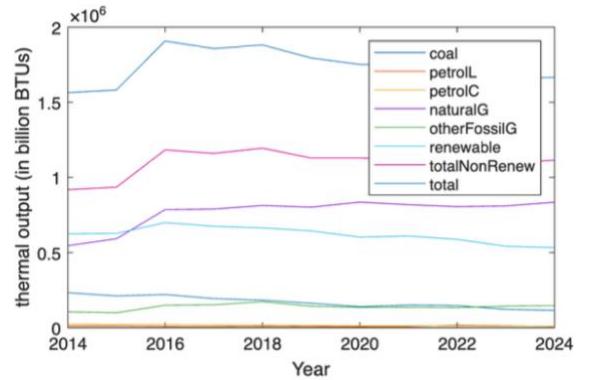
benefit the environment. I want to find and compare the ratio of renewable generation to total generation over the years and make a plot. Divide to find the ratio for each year



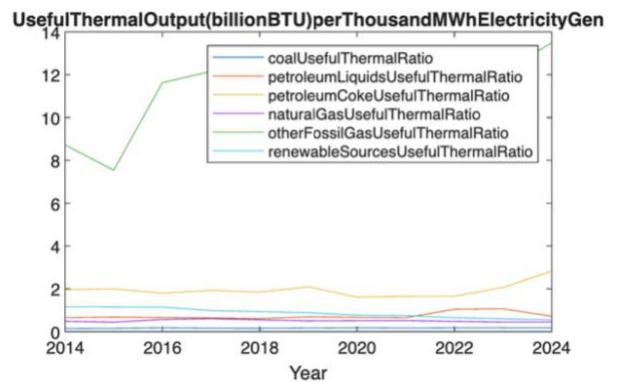
It seems from the plot that the percentage of total electricity generation by renewable sources has greatly increased over the past 10 years and has been on a steady increasing trend. This is supposed to be good for the environment. For the next part, I have to first extract/save the total electricity generation by each type of resource for the past 10 years. We want to find and compare the change (in amount) of both renewable generation of each type and non renewable generation of each type for each year compared to the previous year. We need to use the diff function.



It seems that coal has the biggest increases and decrease, fluctuating between positive change and negative change. It seems that other fossil fuels have been consistently decreasing from year to year but fluctuating greatly by the amount of decrease. Generation and useful thermal output Useful thermal output during electricity production is when the heat created during some processes required for electricity generation is reused for many purposes. We need to first extract/save the useful thermal outputs produced by each type of resource for each year during electricity production. We plot it.

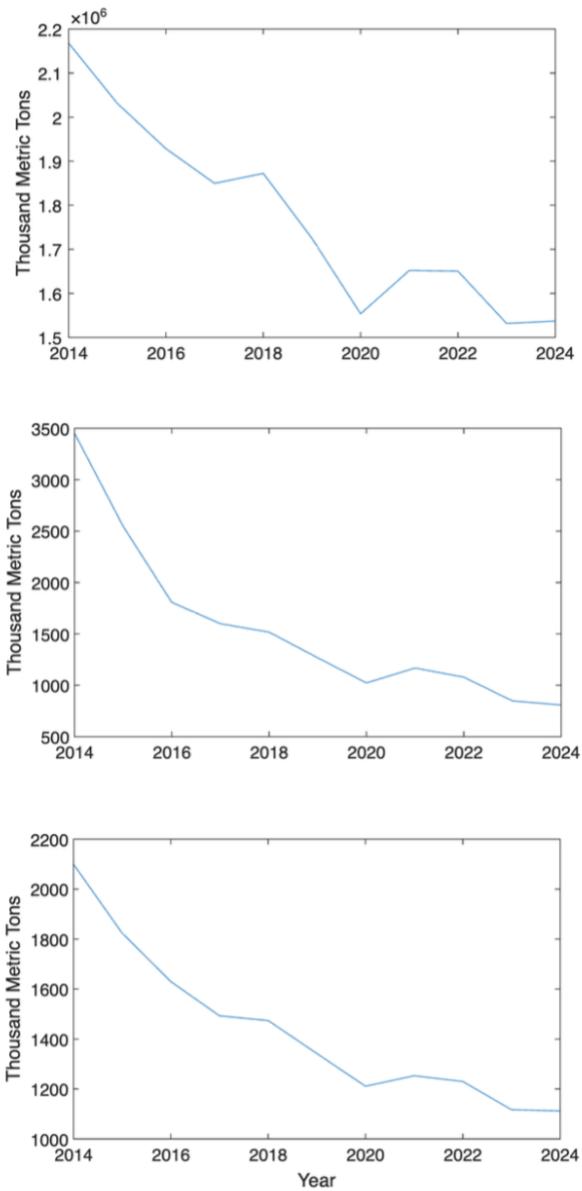


Combined heat and power systems can be more efficient than generating power and heat separately. The heat created during electricity generation can be used for steam production, which can then be used for heating. The waste heat can also be used to produce chilled water for cooling systems. We want find the ratio of useful thermal output to amount of electricity generation using different sources. We need to use ./ to do division between the values of the useful thermal output vector of each type and the electricity generation vector of each type. I need to plot.

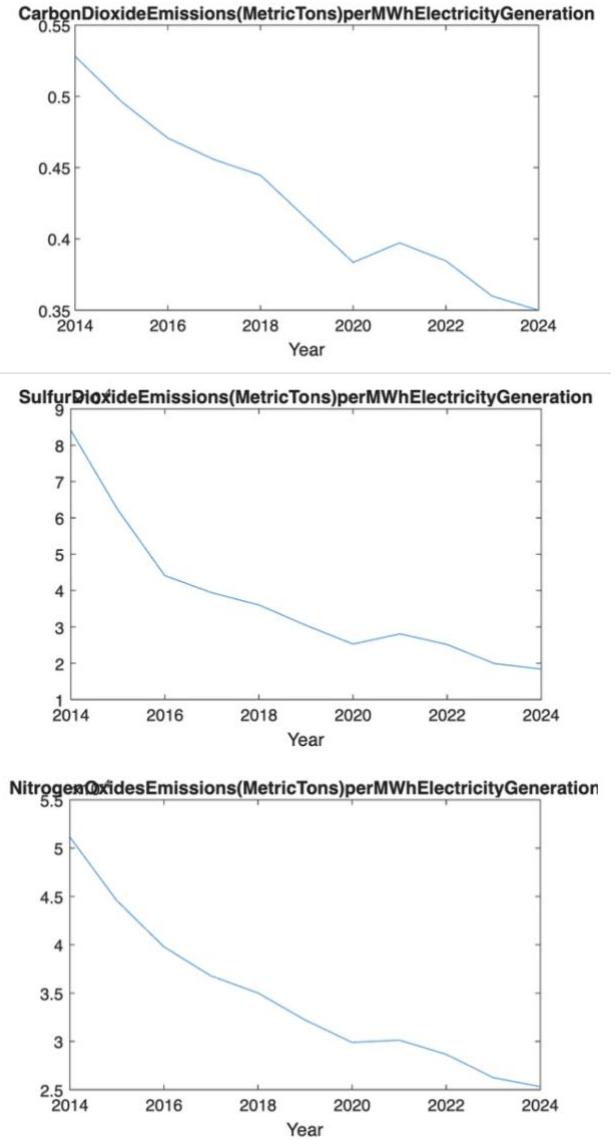


I think that having a higher useful thermal output for each thousand MWh of electricity production can mean that a higher percentage of waste heat produced is being captured and used which is means greater efficiency. The graph seems to show that other fossil gases have the highest ratio of waste heat reuse for each unit of electricity generation. This could mean that it is easier to capture heat during electricity generation using this resource, or maybe it just generates more heat than all the other resources. Emissions from energy consumption at power plants First, we need to save the emission amounts over the years for each type of emissions in separate variables. Carbon dioxide emissions can cause climate change and many negative effects, so it is best to reduce it as much as possible. Sulfur dioxide can be emitted during burning fossil fuels for electricity generation. This sulfur dioxide can irritate people's breathing systems, cause acid rain, and do much damage. Increasing nitrogen oxide can also make breathing

problems and acid rain.



We want to compare the emissions from year to year with the amount of generation. I want to do ratio of emissions to generation for each year. Which one increases faster? is the emissions of each unit of electricity generation decreasing over the years? I need to use ./ to divide the elements of the emissions vectors by elements of the total generation vector. Then I need to plot or graph.



Not only is each emissions decreasing over the years, but it also decreasing as the total electricity generated is actually increasing, and so there is we see the emissions per MWh generated is massively decreasing This means that the environmental harm may be getting less. It is becoming more efficient.