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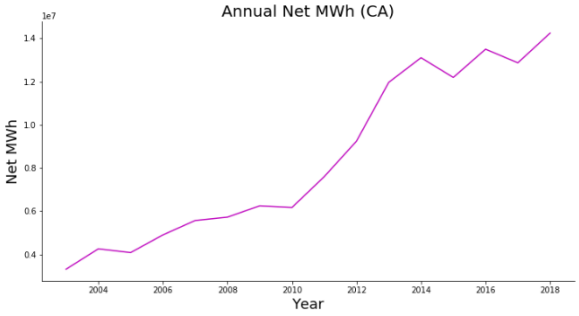
Intro to Programming for Public Policy
Final Project

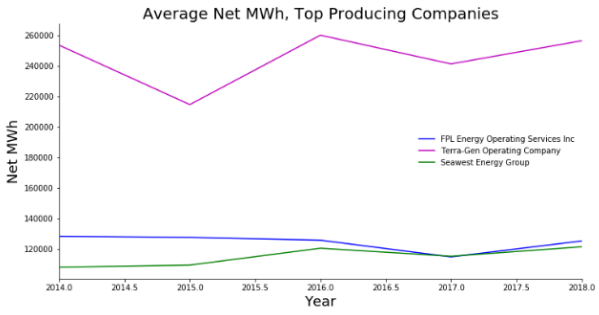
An Exploration of Wind Energy Production in California

According to the U.S. Energy Information Administration (EIA), in 2016, five Heartland states – Iowa, South Dakota, Kansas, Oklahoma and North Dakota – sourced over 20% of their electricity generation from wind power. It was also stated in this year that wind energy supplied over 5.5% of electricity nationally. In the wake of climate change, renewable energy sources like wind power are vital. This inspired by project, where I explored wind energy production, as well as electric generation from other fuel types, in California using energy data from the California Energy Commission.

For the first half of my project I explored wind energy data. The data included annual net energy production in megawatt hours by companies and plants in California. As simple exploration of the data, I plotted the total annual production of wind energy across all companies by year to visualize the increase in wind energy production over time. This is shown by the table below titled 'Annual Net MWh (CA)'. For further research, I would want to load in further data on energy consumption in California in order to determine whether the rise of wind energy production is a result of an increase in demand, rather than just a proportional response to an overall increase in consumption.

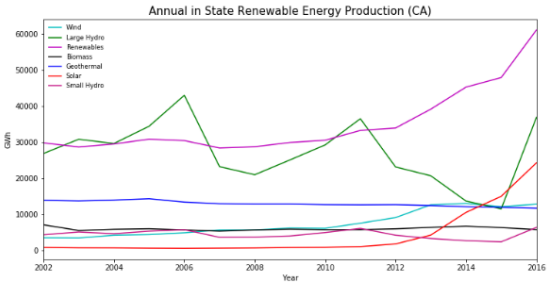


Then, I explored the data further to determine the highest producing wind energy companies in California. I found that the companies Terra-Gen Operating Company, FPL Energy Operating Services, Inc. and Seawest Energy Group were the highest production companies in the data set. I created a plot visualizing the annual production of each of these companies, which is below titled 'Average Net MWh, Top Production Companies'. In 2016, Terra-Gen Operating Company produced at its highest, 3,124,645 MWh. In 2014, FPL Energy Operating Services, Inc. produced at its highest, 899,831 MWh. In 2015, Seawest Energy Group produced at its highest, 767,515 MWh. I generated a function that divides the production for each company annually, by the total annual production in California to derive the percent of total production that each company individually produces. Terra-Gen remains the top producing company between 2014-2018, producing between 21.1% to 23.2% of total wind energy production all four years.

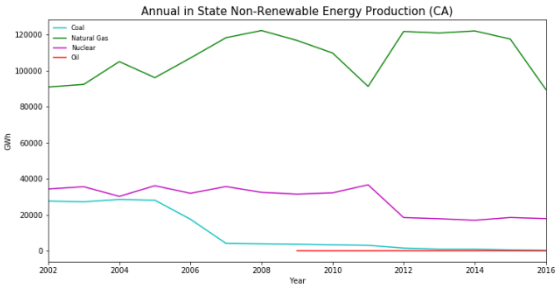


For the second half of my project, I explored electricity production data that included additional fuel sources. I calculated the annual generation of all fuel types, which seem to remain relatively constant through time with the highest level of production at 260616 GWh in 2006 and the lowest level of production at 233107 GWh in 2012. Then, I comparatively explored the wind fuel energy data from both data sets to see if they were similar. Barring minor divergences, I found this to be the case.

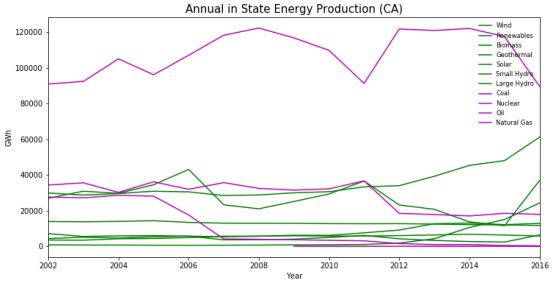
Then, I plotted annual production by fuel types. The first map I created plots only renewable fuel sources. This plot is interesting because it visualizes the overall increase in renewable energy production through time. From 2015 to 2016, except for biomass, all renewable energy sources have increased. This is visualized by the graph below titled 'Annual in State Renewable Energy Production (CA)'.



I also plotted the annual energy production of non-renewable fuel types in California. The graph shows that non-renewable fuel types have remained relatively constant or have decreased since 2012 to 2016. This is shown in the graph below titled 'Annual in State Non-Renewable Energy Production (CA)'.



For my final plot, I plotted all fuel types together in one graph with renewable energy fuels in green and non-renewable energy fuels in magenta. It looks like natural gas has historically been the largest producing fuel source, but has been converging with renewables in the past few years, particularly after 2012. This is shown in the plot below titled 'Annual in State Energy Production (CA)'. In light of the stark developments of climate change, these findings are somewhat optimistic. However, this is energy data only in California. It would be interesting to expand this research across the rest of the United States.



I also regressed electricity production on year controlling for fuel type. According to the regression, an increase in year is associated with a 17 GWh increase in production, controlling for fuel type. The coefficient on wind fuel is 1442 GWh of production, implying an increase in 1442 GWh of production for a year increase. The results are to the right.

	Fuel Type	P Values	Coefficient
0	Intercept	9.714501e-01	9395.833004
1	Coal	1.242597e-01	4102.466667
2	Geothermal	9.566144e-03	6963.600000
3	Large Hydro	3.519405e-13	21079.866667
4	Natural Gas	4.365886e-82	102040.600000
5	Nuclear	1.875005e-14	22414.800000
6	Oil	6.505928e-02	-5973.663618
7	Other	3.112245e-02	-5993.165532
8	Renewables	2.908909e-21	29208.800000
9	Small Hydro	5.586579e-01	-1555.866667
10	Solar	5.067416e-01	-1766.533333
11	Wind	5.877660e-01	1442.000000
12	Year	9.897748e-01	-1.674680