

# **PGCPS LED Lighting Retrofit**

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## **Abstract:**

Initially, our project was to do a data analysis of Prince George's County Public Schools buildings that had lights retrofitted. The goal was to compare the energy consumption before and after the lights were retrofitted, a cost analysis report, and create visuals and showcased our findings. Then, we were to provide support whether or not it would be more cost effective for PGCPs to continue retrofitting these lights. Our client, Jamee Alston, also specified that she was interested in software that would easily allow her to access the data visualizations herself, at a later time. Ms. Alston's responsibility on the project was to provide the utility data, oracle reports and other data necessary for the data analysis. Unfortunately, there were issues on the client end, so we were not able to complete this project. We needed to find another project we were interested in, and also kept a similar topic, an analysis of energy.

Our updated project was the analysis of energy consumption from different states within the United States. As we mentioned earlier, despite our project changing, we wanted to keep a similar topic, energy. We focused specifically on the energy cost and energy consumption change over the years in Maryland, DC and Virginia. Our final goal was to provide recommendations, based on our data analysis findings, of what these different states could do to use energy more efficiently.

## **Methods:**

To fulfill the original project's goal of comparing energy consumption, creating a cost analysis report, and visualizing the PGCPs schools data we first performed some initial research. This was done to familiarize ourselves with energy consumption, energy costs, and how these data points would be used in order to decide whether or not retrofitting the schools would be worth the effort made. After gaining that background information, before we received the school's data we began to consider different coding languages and visualization tools to achieve our goals of creating a non-technical way for our client to receive a strong understanding of the analysis and visualizations we were going to complete. Our deliberations led us to using the python language in the open-source app framework that is Streamlit. This allowed us to display interactive visualizations and our analysis in a convenient way to deliver to our client.

Eventually after we never received the school's data we used our background knowledge and Streamlit to pivot our project's direction to focusing on DMV area energy consumption and cost. This preparation allowed us to overcome the obstacle of having to switch the project mid-semester. From there, we gathered publicly available data on the DMV area. We cleaned the data by merging together multiple datasets, removing missing values, changing column names, etc.. Then we began creating the visualizations, performing our analysis, and making recommendations.

## **Description of Deliverables:**

The DMV Energy Efficiency Analysis details the current energy status of the DMV region, in regards to energy consumption and cost, while also providing programs and policies. States within the region can implement it to improve energy efficiency. Our deliverable is a web app where the user can explore the data. The technology we use is Python and Streamlit which is a Python library for creating data-driven interactive web apps. Streamlit is more organized and emphasizes simplicity. The apps serve entirely secure communications with HTTPS. Streamlit is a full data dashboarding solution. Streamlit builds dashboards for non- technical users. It is a visually appealing framework using Python and the users can interact with the dashboard. In addition, when we made the web application, we thought about the user experience (UX). So, we made an interactive dashboard. It's easy to navigate, aesthetically pleasing, and it dynamically updates. From our initial meeting with our clients, the overall product of the project involved getting creative and budget-appropriate deliverables. Our team's initial idea is based on providing a creative and efficient way to show data to the organization. The client expected something similar as well, so we created a simple data science web app with a dataset.

## **Workflows**

Our team's project management workflow has been streamlined through tasks. Small, repetitive tasks can be time-consuming and costly. However, customizable templates allowed us to focus on managing and delivering team projects and are very efficient by automating certain tasks. For example, our team found Streamlit to be a good fit for using dashboards to streamline automation processes and scale efficiently on demand.

The highlights of our team's selection of automated workflows:

- To suit the client's budget requirements
- Provides easy customizable workflows and templates
- User friendly
- Safe security

## **Data Visualizations**

We created data visualizations for 1960-2019 energy consumption sectors and 1990-2020 energy usage price sectors. The features we have are a choropleth map, line plot, scatter plot, machine learning, download data, data analysis, and recommendations. The users can choose years and sectors, so the web app dynamically updates depending on what the user selects. If the user wants to, they can look at the data table and download the data as a CSV file. We also added DMV plots with the different sectors, so the user can zoom in to the area. If the user has a hard time reading the choropleth map, they can see the comparison between the different values with a line plot. Since the dataset is limited, we can use machine learning to predict future values. The

web app displays an equation, and there is a prediction feature where the user can enter a year. For instance, our app will calculate and display the dataset for the specific and will be able to predict future values of the dataset. In addition, DMV energy efficiency analysis was also conducted in depth using Tableau and R. Tableau was connected to the Streamlit early in the project, and users can select and view additional data sets if they wish, but it was excluded from the final deliverable web app because the output was not displaying properly.

### **Project goals**

The project's objectives include generating creative, user-friendly, and cost-effective results. The primary project goal for our team was to create an engaging, innovative, and efficient approach to offer solutions to organizations with user-centered concepts. Streamlit helped deliver on-time project deliverables while providing a faster and more effective way to achieve and complete goals. It made it easy for users to navigate, was aesthetically pleasing, and dynamically updated.

### **Findings:**

The analysis and visualization of the data clearly show that the overall energy consumption and the energy usage price in the DMV area has increased over the past years. This gives us a glimpse of what might happen in the future. Based on the trend observed, we can predict that these values might continue to increase if nothing is done.

### **Recommendations:**

After doing our analysis we have looked into programs and policies that could allow for better energy efficiency and cutting cost of energy for each state. For Maryland, we recommend looking into PEPCO's Commercial and Industrial Energy Efficiency Rebate Programs, as well as, PEPCO's Residential Energy Efficiency Rebate Program. For Virginia, we recommend looking into Washington Gas' Commercial Energy Efficiency Rebate Program and their Residential Energy Efficiency Rebate Program. And for DC we recommend looking into FirstEnergy's Commercial Energy Efficiency Rebate Program and their Residential Energy Efficiency Rebate Program.

We also encourage retro-commissioning when it comes to developing and building public and private buildings. As well as implementing state-wide energy performance building codes for the numerous commercial and residential buildings constructed or in the process of construction. Another good idea might be to provide educational classes and materials that help state citizens adjust their lifestyle to be more energy conscious and follow energy-efficient methods. Something else worth looking into is implementing energy efficiency standards and codes for household appliances, like washing machines and refrigerators, to encourage more energy-efficient appliances. And lastly we recommend monitoring the state's ongoing energy

consumption and cost analysis to curate energy efficiency programs and policies for the state's current energy status.

## **Conclusions:**

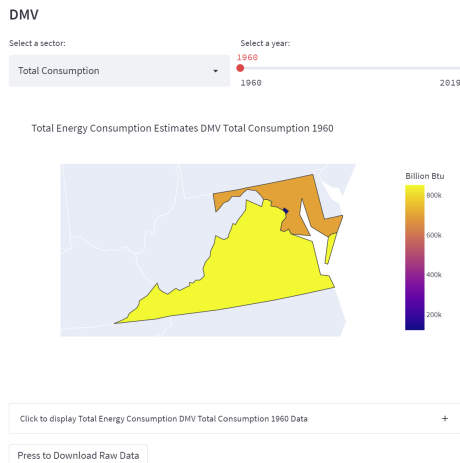
Throughout the course of our analysis project, our team has completed essential components that help shift and further the central purpose of providing individuals and locations with vital analysis and recommendations surrounding energy efficiency. While we have accomplished the final phase of our project, our client's implementation of the recommendations and future project teams' conduction of further analysis/research of the project scope are future work plans that will help build and advance the efforts of our analysis project's goal.

If you have any further questions surrounding the project, here is our team contact information:

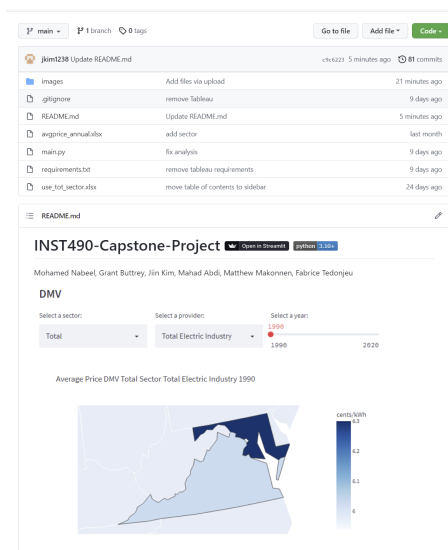
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## Deliverables:

- Web App link for DMV Energy Efficiency:
  - <https://share.streamlit.io/jkim1238/inst490-final-project/main/main.py>



- GitHub link INST490 - Capstone - Project
  - <https://github.com/jkim1238/INST490-Capstone-Project>



- Miro link for Team Manifesto and Communication Plan & Project Management Structure (Before Mid-semester)
  - <https://miro.com/app/board/uXjVOQHEGrU=?fromRedirect=1>
- Online link for Final presentation:

- [https://www.canva.com/design/DAE-2i5hOU0/ITsrm8js0A0wiWDTVyxdGw/view?utm\\_content=DAE-2i5hOU0&utm\\_campaign=designshare&utm\\_medium=link&utm\\_source=publishsharelink](https://www.canva.com/design/DAE-2i5hOU0/ITsrm8js0A0wiWDTVyxdGw/view?utm_content=DAE-2i5hOU0&utm_campaign=designshare&utm_medium=link&utm_source=publishsharelink)