HW2 Report
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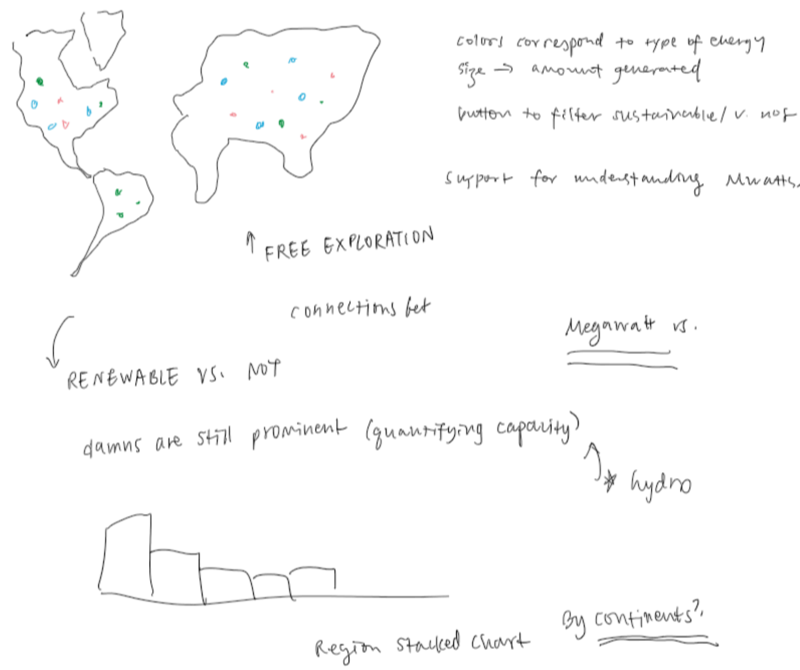
Introduction

We explored the global power plant database from World Resources Institute, which contains information on plant locations (country), max capacities in megawatts, primary fuels and estimated energy production by year. Specific insights we aimed to convey include geographic distribution of plants by primary fuel type, top countries and plants by capacity, and making energy capacity more understandable. We focused on enabling users to explore overall summaries as well as details on demand. We attempted to unveil different patterns between geographic location (countries/ continents) and power plant energy production. We highlighted the number of energy plants across countries, the amount of renewable vs nonrenewable energy production, and attempted to power plant capacities in a more approachable way by visualizing the amount of homes a certain amount of energy can power.

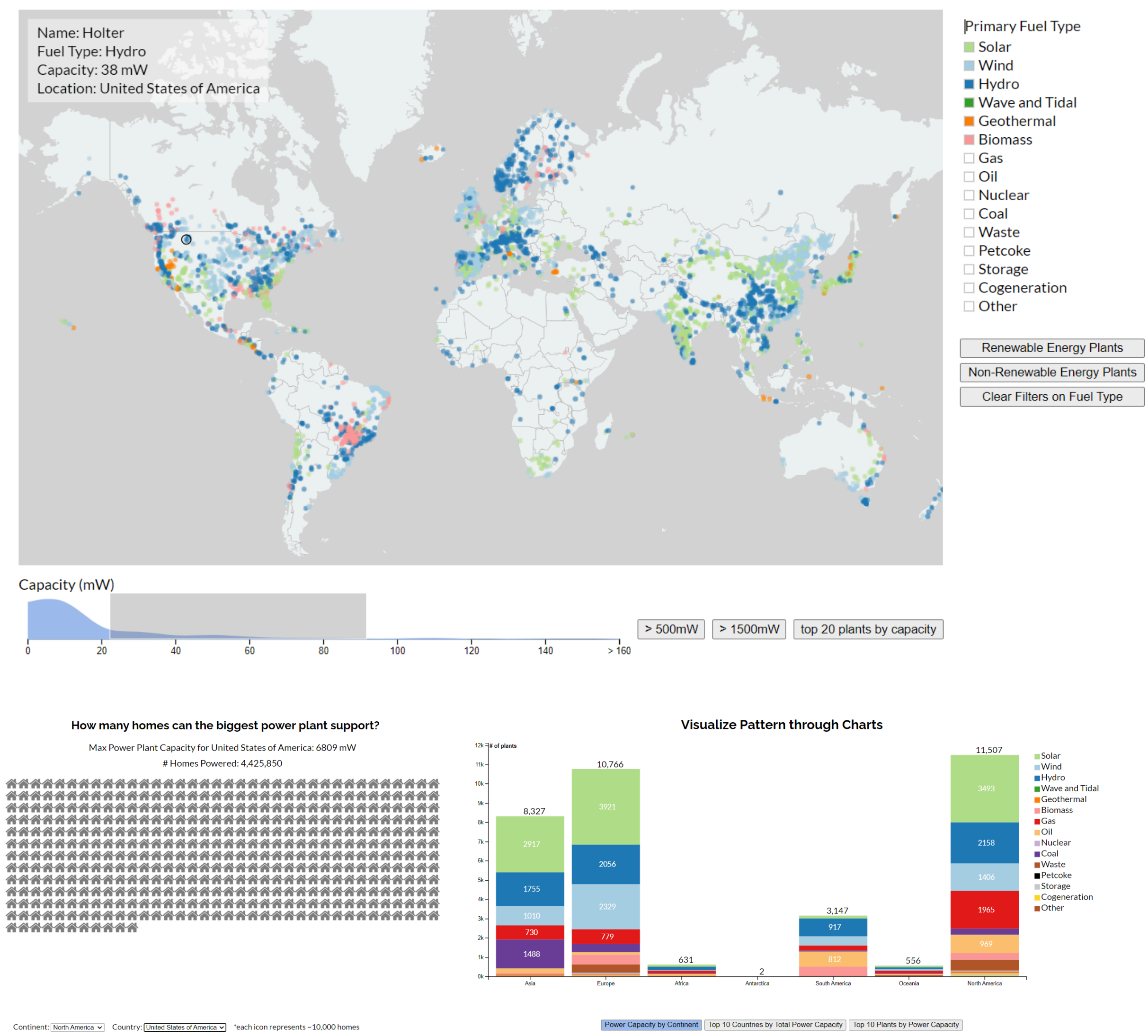


storyboard sketches

Outline of Interactions

We followed Shneiderman's mantra of "overview first, zoom and filter, then details on demand" in organizing our visualizations. Our first map gives an overview of all power plants around the world, and aims to highlight macro trends across regions (for example, the south/west parts of the US have a lot of coal plants while the coasts have more wind/solar power plants). Given that there are nearly 35,000 data points, we wanted to focus on the smoothness of zooming and panning, as well as dynamic filtering to help users explore data quickly and meaningfully. We created a graph that shows the distribution of the capacity of power plants, and from a quick data exploration in python, we realized there are a lot of outliers (power plants with production capacity much higher than median), so we also created some buttons that would allow users to quickly locate the outliers. We created checkboxes that filter the power plants by category, which can be combined with filters on capacity for further exploration of the data. Down the page, we focus on highlighting aspects of the data we found interesting. We use 3 charts to show patterns we discovered: bigger countries have more power plants; while quantity-wise there are a lot of renewable energy power plants, capacity wise coal and gas power plants still play a major role; the biggest power plants are largely hydro plants. The stacked bar chart of energy capacity per country allows users to highlight energy type across all countries. Lastly, we zoomed in to focus on only the largest power plant in each country, and visualized its capacity in terms of how many homes it can support. 1 MegaWatt (MW) can power 400-900 homes depending on energy usage.

Final Visualization Overview



The final visualization allows users to explore power plant data through interactive global maps, top country/plant charts, and icon translations. Different fuel types and capacities are visualized across geospatial and categorical representations. The tool provides both summary and detailed perspectives of the dataset.

Discussion of Tradeoffs

Many of our tradeoffs involved balancing complexity of data shown with approachability of the visualization dashboards.

For the global map, we wanted to give users the ability to explore freely while also guiding them in this process. Since the extent of capacity was around [0, 22,500], but the median is under 20mW, we debated between showing the entire range, or to cut off the range slider at 160mW. We chose the latter, because we felt it offers more granularity in the lower ranges where there is lots of data. However, to compensate for the lack of ability to filter in the higher ranges, we provide some buttons that show power stations with capacity above 500mW, 1500mW, and also the top 20 power stations around the world. We also debated whether to give the user complete control over filtering by primary fuel types, or to just allow filtering between renewable/non-renewable. We thought the first one gives users more freedom, but weakens the contrast between the two types of primary fuels. However, we were able to compensate for this by adding buttons that allow quick toggle between the two types. We also organize the primary fuel types such that the renewable ones are all at the top, and the rest are on the bottom. These buttons are individually interactable.

Another tradeoff we encountered was the size of the houses within the final visualization. There is again a wide range of capacities, and thus a wide range of number of houses we needed to display. We decided each icon to represent 10,000 houses, which makes the comparisons less overwhelming (as opposed to a range of 0 and 1 million+ houses).

Development Process and Design Choices

For the global map, we wanted the zooming and panning to feel smooth while maintaining hover and highlight functionalities. This proved to be much harder than expected, as when we converted the power plant circles into a rasterized canvas element we realized that the base country geometries were also slowing down the speed. In the end, we implemented map tiling with MapBox api in addition to rasterization. To allow for dynamic filters, we recalculate the Delaunay triangulation for nearest points when data is added/removed to the map. We also implemented limits on zoom extent, and if had more time would like to implement pan extent (this was a bit difficult to do since we were using tiled base maps).

We also consolidated all three charts into one svg, and buttons control which one is shown at any time. We decided this was better than showing all three at once, as it could easily overwhelm the user. We kept colors that correspond to primary fuels consistent across the three charts and the global map above. If we had more time, we would like to implement animations, so that there is no blankness when switching charts.

For displaying homes that are powered by a power plant, we created a fixed size svg. We intentionally chose to place the dropdowns at the bottom of the page, so it would not compete with the text overview at the top that are dynamically populated. We added a helper text upon launch, so that users are aware of the dropdowns at the bottom.

Group Work Summary

We met first to choose a database we both were excited to work with, during this meeting we also established an idea on what to present and divided work accordingly. We created separate branches in github to work simultaneously and often communicated when stuck or completed our task. Natalia worked on creating the various barcharts to visualize the types of primary fuels for each continent and for the top 10 countries with the highest capacities. She also worked on the creation of the interactive Max Capacity energy quantifier. This included creating dynamic drop down menus and displaying the information and amount of houses for the corresponding selection. This work involved creating various new data objects to obtain the correct datasets to display desired information and visualizations. This work took around a total of ~10 hours spread out over the course of a couple days. Desai worked on implementing the interactive global map, as well as the dynamic filters that can be applied to it. She spent around 12 hours over the course of a week. Most of her time was spent figuring out how to combine rasterization, tiling, dynamic queries and hovering actions into one. She also helped with combining all elements together into one page, and standardizing color and styles across different visualizations.

Conclusion

In summary, this interactive visualization explores patterns between geographic locations (countries/continents) and their energy production. We incorporate thoughtful design to allow open-ended data exploration as well as detailed views that target specific patterns and relationships.