EV Power - Lab 4 Project Report

Renewable Energy Use & EV Registrations Across US States

I am broadly exploring if the electricity used to charge EV vehicles comes from clean sources. As a sub-investigation, I want to learn how clean energy and EV registrations are distributed across the US.

I am investigating whether states with higher renewable energy usage have more EV registrations.

Part 0: libraries

```
library(dplyr)
```

```

Attaching package: 'dplyr'
```

```
The following objects are masked from 'package:stats':

    filter, lag
```

```
The following objects are masked from 'package:base':

    intersect, setdiff, setequal, union
```

```
library(tidyr)
library(stringr)
library(ggplot2)
library(sf)
```

```
Linking to GEOS 3.13.0, GDAL 3.8.5, PROJ 9.5.1; sf_use_s2() is TRUE
```

```
library(rnaturalearth)
library(maps)
```

Part 2: Data

```
#clean ev registrations table
ev_reg_2023 <- read.csv("/Users/ellakaufman/Desktop/Classes/133/ev-power-
EllaKaufman/data/ev-registrations-by-state-2023.csv")
ev_reg_2023 <- ev_reg_2023[-1,] #remove empty first row
ev_reg_2023 <- ev_reg_2023[-1,]

#rename columns
names(ev_reg_2023)
```

```
[1] "electric.vehicle.registrations_by_state..2023."
[2] "X"
```

```
ev_reg_2023 <- ev_reg_2023 |> rename(State =
electric.vehicle.registrations_by_state..2023., EV_Count =X)
View(ev_reg_2023)

#remove extra characters from Count-EVs column
ev_reg_2023 <- ev_reg_2023 |> mutate(EV_Count= str_remove_all(string =
EV_Count, pattern = "#|~|EVs") )
View(ev_reg_2023)

#convert Count-EVs column to class numeric
ev_reg_2023 <- ev_reg_2023 |> mutate(EV_Count = as.numeric(EV_Count))

#clean total renewable energy use table
tot_ren_use23 <- read.csv("/Users/ellakaufman/Desktop/Classes/133/ev-power-
EllaKaufman/data/total-use-2023.csv")
tot_ren_use23 <- tot_ren_use23 |> slice_tail() #select only renewable energy
row
tot_ren_use23 <- tot_ren_use23[,-1] #remove first column
View(tot_ren_use23)
tot_ren_use23 <- tot_ren_use23 |> mutate(across(-1, as.numeric)) #convert all
state columns to dbl (same as count-EV), although not certain I needed to do
that
#got help finding across function from Gemini
```

Part 3: Methods

```
#pivot tot_ren_use23 state columns to one state column and one total renewable
energy column
tot_ren_use23 <- tot_ren_use23 |> pivot_longer(cols=everything(),names_to =
"State", values_to = "Total_Renewable_Energy_Use")

#tot_ren_use23 State column uses abbreviations, ev_reg_2023 State column uses
the full state name. With the help of Gemini, I made a reference table to use
for joining
```

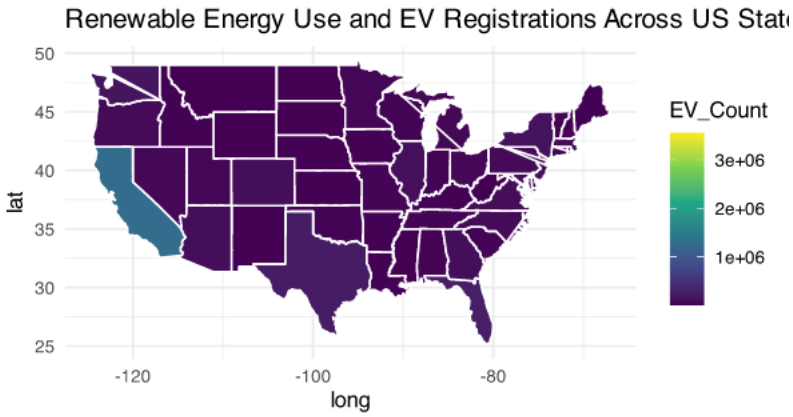
```r
state_ref <- data.frame(State_Full = state.name, State_Ab = state.abb)
View(state_ref)
state_ref <- rbind(state_ref, data.frame(State_Full = "District of Columbia",
State_Ab= "DC"))

#join the reference table and tot_ren_use23 by state abbreviation
jointable1<- full_join(state_ref, tot_ren_use23, join_by(State_Ab==State))
View(jointable1)

#join jointable1 and ev_reg_2023 by full state name
Ren_use_EV_reg <- full_join(jointable1,ev_reg_2023,
join_by(State_Full==State))
View(Ren_use_EV_reg)

Ren_use_EV_reg <- Ren_use_EV_reg[,-2] #delete state abbreviation column

#create object for base map data
us_map <- map_data("state")
View(us_map)

#standardize state columns
us_map <- us_map|> mutate(State = toupper(region))
us_map <- us_map[,-6]
us_map <- us_map[,-5]
Ren_use_EV_reg <- Ren_use_EV_reg|> mutate(State = toupper(State_Full))
Ren_use_EV_reg <- Ren_use_EV_reg[,-1]

#join us_map and Ren_use_EV_reg
state_and_RevEV <- full_join(us_map, Ren_use_EV_reg, join_by(State==State))
View(state_and_RevEV)
head(state_and_RevEV)
```

```
       long      lat group order   State Total_Renewable_Energy_Use EV_Count
1 -87.46201 30.38968     1     1 ALABAMA                     222189    13047
2 -87.48493 30.37249     1     2 ALABAMA                     222189    13047
3 -87.52503 30.37249     1     3 ALABAMA                     222189    13047
4 -87.53076 30.33239     1     4 ALABAMA                     222189    13047
5 -87.57087 30.32665     1     5 ALABAMA                     222189    13047
6 -87.58806 30.32665     1     6 ALABAMA                     222189    13047
```

Part 4: Mapping Visualization

```r
ggplot(state_and_RevEV, aes(long, lat, group = Total_Renewable_Energy_Use,
fill = EV_Count)) +
  geom_polygon(color = "white") +
  coord_fixed(1.3) +
  theme_minimal() +
```

```
  scale_fill_viridis_c() +
  labs(title = "Renewable Energy Use and EV Registrations Across US States")
```



Analysis

#EV registration is highest in California. Unfortunately I was only able to conclude this from the map. #I ran out of time to correctly plot renewable energy use and draw conclusions about my research question.