EV Power - Lab 4 Project Report

Part 0: libraries

```
library(ggplot2)
library(stringr)
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(maps)
library(readr)
library(tidyverse)
```

```
-- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
v forcats   1.0.1     v tibble    3.3.0
v lubridate 1.9.4     v tidyr     1.3.1
v purrr     1.1.0

-- Conflicts ------------------------------------------ tidyverse_conflicts() --
x dplyr::filter() masks stats::filter()
x dplyr::lag()    masks stats::lag()
x purrr::map()    masks maps::map()
i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to beco
```

Part 1: Defining Research Question

Chosen Question: How does renewable energy usage changed from 2021–2023 across states?

In this report, I will analyze trends in renewable energy usage across US states from 2021 to 2023.

Part 2: Data Preparation and Cleaning

```
eu_21 <- read_csv("data/total-use-2021.csv")
```

```
Rows: 5 Columns: 53
-- Column specification --------------------------------------------------------
Delimiter: ","
chr  (1): Energy_Source
dbl (52): AK, AL, AR, AZ, CA, CO, CT, DC, DE, FL, GA, HI, IA, ID, IL, IN, KS...

i Use `spec()` to retrieve the full column specification for this data.
i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
eu_22 <- read_csv("data/total-use-2022.csv")
```

```
Rows: 5 Columns: 53
-- Column specification --------------------------------------------------------
Delimiter: ","
chr  (1): Energy_Source
dbl (52): AK, AL, AR, AZ, CA, CO, CT, DC, DE, FL, GA, HI, IA, ID, IL, IN, KS...

i Use `spec()` to retrieve the full column specification for this data.
i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
eu_23 <- read_csv("data/total-use-2023.csv")
```

```
Rows: 5 Columns: 53
-- Column specification --------------------------------------------------------
Delimiter: ","
chr  (1): Energy_Source
dbl (52): AK, AL, AR, AZ, CA, CO, CT, DC, DE, FL, GA, HI, IA, ID, IL, IN, KS...

i Use `spec()` to retrieve the full column specification for this data.
i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
eu_21 <- eu_21 |> mutate(Energy_Source = recode(Energy_Source, "Coal" = "Coal",
            "Natural Gas†" = "Natural Gas",
            "Petroleum (BTU)" = "Petroleum",
            "nuclear" = "Nuclear",
            "total_renewable_energy" = "Total renewable energy"
            ))

eu_22 <- eu_22 |> mutate(Energy_Source = recode(Energy_Source, "coal Consumption" = "Coal",
            "Natural-Gas" = "Natural Gas",
            "petroleum (btu)" = "Petroleum",
            "Nuclear Energy†" = "Nuclear",
            "total_renewables" = "Total renewable energy"
            ))

eu_23 <- eu_23|> mutate(Energy_Source = recode(Energy_Source, "coal_usage" = "Coal",
            "NaturalGas" = "Natural Gas",
            "petroleum (BTU)" = "Petroleum",
            "nuclear-energy †" = "Nuclear",
            "total renewable-energy" = "Total renewable energy"
            ))
```

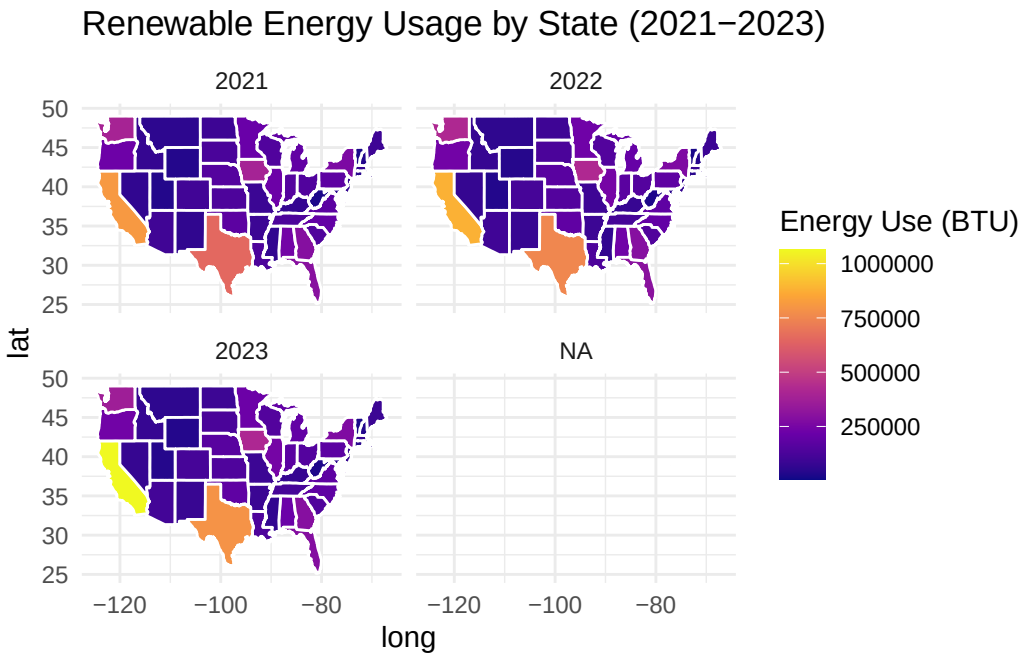
Part 3: Joining / Pivoting Datasets for Analysis

```
energy_long_21 <- eu_21 |>
  pivot_longer(
    cols = -Energy_Source,
    names_to = "State",
    values_to = "2021"
  )

energy_long_22 <- eu_22 |>
  pivot_longer(
    cols = -Energy_Source,
    names_to = "State",
    values_to = "2022"
  )

energy_long_23 <- eu_23 |>
  pivot_longer(
    cols = -Energy_Source,
```

```
    names_to = "State",
    values_to = "2023"
  )

combined <- energy_long_21 |>
  left_join(energy_long_22, by = c("Energy_Source", "State")) |>
  left_join(energy_long_23, by = c("Energy_Source", "State"))

renewable_energy <- combined |> filter(Energy_Source == "Total renewable energy")
renewable_long <- renewable_energy |>
  pivot_longer(
    cols = c("2021","2022","2023"),
    names_to = "Year",
    values_to = "Energy_Use"
  ) |> select(-c(1))

  state_map <- data.frame(
  Abbrev = state.abb,
  State_Full = tolower(state.name)
)

renewable_long <- renewable_long |>
  left_join(state_map, by = c("State" = "Abbrev"))
```

Part 4: Mapping Visualization

```
us_map <- map_data("state")

map_data_ready <- us_map |>
  left_join(renewable_long, by = c("region" = "State_Full"), relationship = "many-to-many")

ggplot(map_data_ready) +
  geom_polygon(aes(x = long, y = lat, group = group, fill = Energy_Use), color = "white") +
  facet_wrap(~Year) +
  scale_fill_viridis_c(option = "plasma") +
  labs(title = "Renewable Energy Usage by State (2021-2023)",
       fill = "Energy Use (BTU)") +
  theme_minimal()
```



Part 5: Analysis

Renewable energy usage differs widely by state, with some states like California and New York have very high usage. Comparing 2021 to 2023, most states show an increasing trend in renewable energy usage. These patterns help us understand potential correlations with electric vehicle adoption, states with higher renewable energy may support EV infrastructure better.