EV Power - Lab 4 Project Report

> This project explores how electricity prices and renewable energy use relate to electric vehicle adoption across USA's states in 2023.

Example Solution 1

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(tidyverse)
```

```
-- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
v forcats   1.0.0     v readr     2.1.5
v ggplot2   4.0.0     v stringr   1.5.2
v lubridate 1.9.4     v tibble    3.3.0
v purrr     1.1.0     v tidyr     1.3.1
```

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

```
library(readr)
library(ggplot2)
```

Part 1: Defining Research Question

Chosen Question: Do cheaper electricity prices make people more likely to buy electric vehicles in 2023?

Part 2: Data Preparation and Cleaning

```
library(tidyverse)
num <- readr::parse_number
key <- tibble(abbr=c(state.abb,"DC","PR"),name=c(state.name,"District of Columbia","Puerto Ri
fix_state <- \(x) str_to_title(replace(x,!x%in%key$name,key$name[match(toupper(x),key$abbr)])

lines <- readLines("data/av-energy-price-2021-2023.csv")
```

```
Warning in readLines("data/av-energy-price-2021-2023.csv"): incomplete final
line found on 'data/av-energy-price-2021-2023.csv'
```

```
lines <- gsub('"', '', lines)
lines <- lines[grepl(",", lines)]
lines <- lines[!grepl("Total|,,", lines)]
tmp <- tempfile(fileext = ".csv")
writeLines(lines, tmp)

price <- read_csv(tmp, show_col_types = FALSE) |>
  set_names(c("state","price_2021","price_2022","price_2023")) |>
  mutate(state = fix_state(state), price_2023 = num(price_2023)) |>
  filter(!is.na(state)) |>
  select(state, price_2023)

ev <- read_csv("data/ev-registrations-by-state-2023.csv",
               col_names = FALSE, show_col_types = FALSE) |>
```

```
  set_names(c("state","ev_2023")) |> slice(-1) |>
  mutate(state = fix_state(state), ev_2023 = num(ev_2023))
```

```
Warning: There were 2 warnings in `mutate()`.
The first warning was:
i In argument: `state = fix_state(state)`.
Caused by warning in `x[list] <- values`:
! number of items to replace is not a multiple of replacement length
i Run `dplyr::last_dplyr_warnings()` to see the 1 remaining warning.
```

```
renew <- read_csv("data/renew-use-2023.csv", show_col_types = FALSE) |>
  rename(state=1,source=2,val=3) |>
  mutate(state = fix_state(state), val = num(val)) |>
  group_by(state) |> summarise(renew_2023 = sum(val,na.rm=TRUE), .groups="drop")

total <- read_csv("data/total-use-2023.csv", show_col_types = FALSE) |>
  rename(source=1) |> pivot_longer(-source,names_to="abbr",values_to="val") |>
  mutate(state = fix_state(abbr), val = as.double(val)) |>
  group_by(state) |> summarise(total_2023 = sum(val,na.rm=TRUE), .groups="drop")

clean_2023 <- ev |> full_join(price,by="state") |>
  full_join(renew,by="state") |>
  full_join(total,by="state")

fix_state <- \(x) {
  x <- str_to_title(x)
  replace(x, !x %in% key$name,
          key$name[match(toupper(x), key$abbr)])
}

head(clean_2023)
```

```
# A tibble: 6 x 5
  state    ev_2023 price_2023 renew_2023 total_2023
  <chr>      <dbl>      <dbl>      <dbl>      <dbl>
1 <NA>          NA         NA    8187317   93525424
2 <NA>          NA         NA    8187317   93525424
3 Alabama    13047       21.1     222189    2265008
4 Alaska      2697       23.8      10088     746979
5 Arizona    89798       30.3     108445    1712667
6 Arkansas    7108       21.8      87277    1151062
```

Part 3: Joining / Pivoting Datasets for Analysis

```
joined_2023 <- clean_2023 |>
  mutate(
    renew_pct = (renew_2023 / total_2023) * 100,
    ev_per_energy = ev_2023 / total_2023
  ) |>
  select(state, ev_2023, price_2023, renew_pct, ev_per_energy)

head(joined_2023)
```

```
# A tibble: 6 x 5
  state    ev_2023 price_2023 renew_pct ev_per_energy
  <chr>      <dbl>      <dbl>     <dbl>         <dbl>
1 <NA>          NA         NA      8.75            NA
2 <NA>          NA         NA      8.75            NA
3 Alabama    13047       21.1      9.81       0.00576
4 Alaska      2697       23.8      1.35       0.00361
5 Arizona    89798       30.3      6.33       0.0524
6 Arkansas    7108       21.8      7.58       0.00618
```

> I picked to use full_join() because it keeps all states consistent for all of the datasets, which we really need for these comparisons. Then, I created renew_pct so that we coudl calculate the proportion of renewables in total energy and ev_per_energy to display EV registrations in relation to energy consumption. All of these characteristics help us see whether states with cleaner of cheaper energy also have higher electrical vehicle use/purchases.

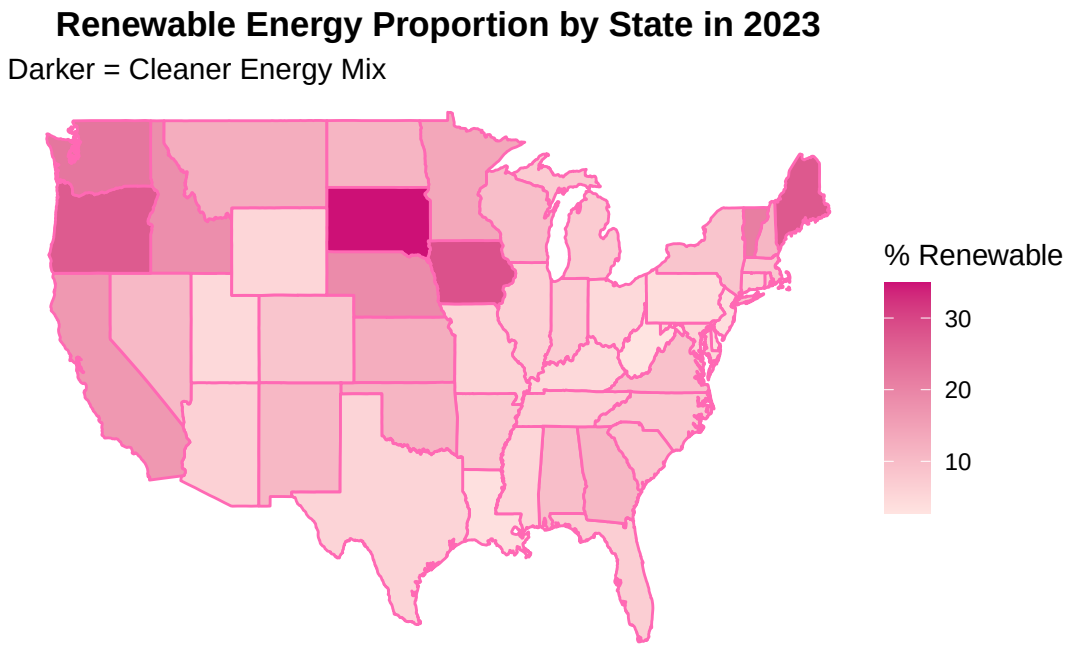
Part 4: Mapping Visualization

```
library(ggplot2)

states <- ggplot2::map_data("state")
map_2023 <- joined_2023 |>
  mutate(region = tolower(state)) |>
  right_join(states, by = "region")

ggplot(map_2023, aes(long, lat, group = group, fill = renew_pct)) +
```

```
  geom_polygon(color = "hotpink") +
  scale_fill_gradient(low = "mistyrose", high = "deeppink3", name = "% Renewable") +
  labs(title = "Renewable Energy Proportion by State in 2023",
       subtitle = "Darker = Cleaner Energy Mix") +
  theme_void() +
  theme(legend.position = "right",
        plot.title = element_text(hjust = 0.5, face = "bold"))
```



The map makes it pretty clear which states are leading in clean energy with darker pink spots like Oregon, Maine, and North Dakota standing out with higher renewable use. The lighter pink states (mostly in the South and Midwest) are still relying more on non-renewables. Overall, this helps answer the main question we came up with because states with stronger renewable mixes mostly correspond with higher electricle vehicle use. It suggests that having cleaner, cheaper energy sources might actually make people more likely to go electric.