

# EV Power - Lab 4 Project Report

## Example Solution 1

### 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 become
```

## Part 1: Defining Research Question

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

## 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()
```

