Clean Energy Usage Across the United States

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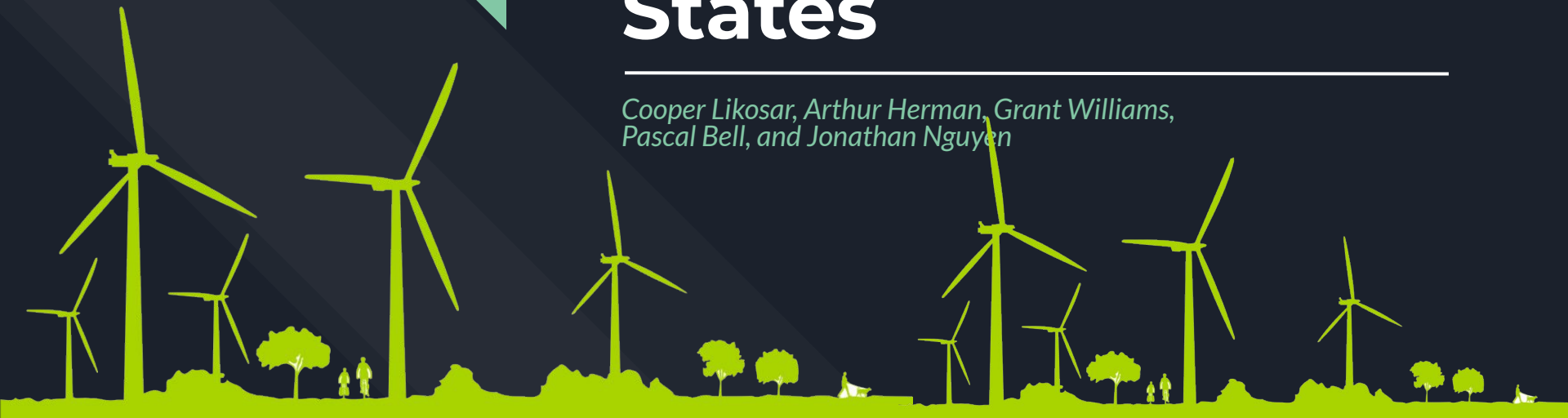
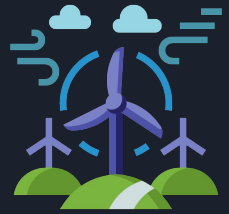


Clean Energy to Tackle Climate Change

As **climate change** continues to progress rapidly, it is important to move towards **clean technology and renewable energy sources** in order to save our earth while ensuring innovation.

Analyzing the energy usage of different states can show how our country is progressing toward the goal of **slowing global warming on a local level**.

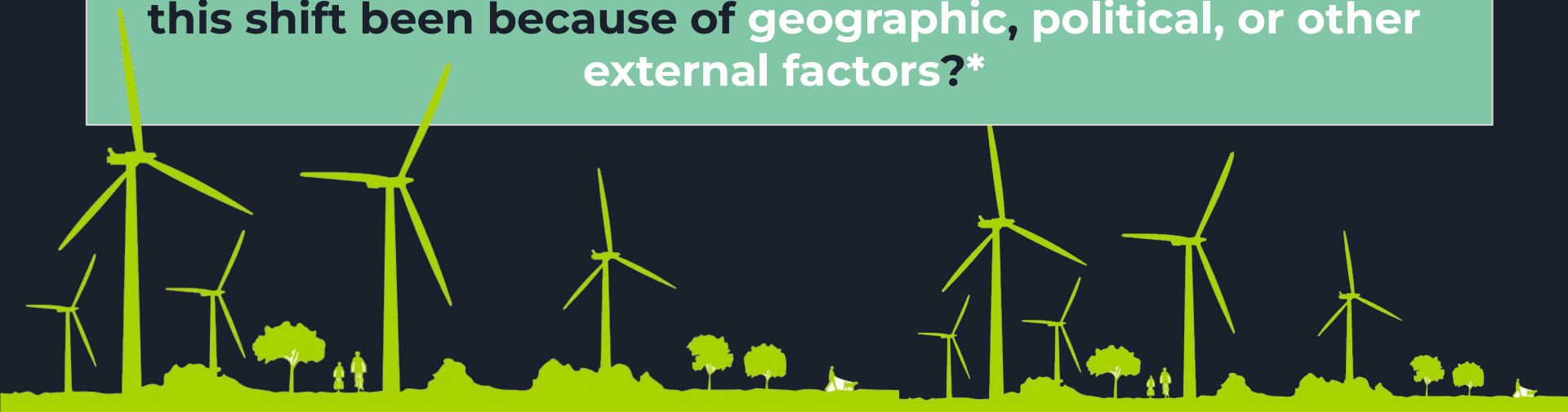


Utilizing these analyses to **inform policy-making, sustainable business decisions, and clean technology innovation**.

Research Question

*For our project, energy is considered renewable if it is derived from a naturally occurring source and is naturally replenished at a higher rate than it is consumed.

On both a regional and national level, how has the proportion of *renewable energy* consumption relative to overall energy consumption changed over time, and has this shift been because of geographic, political, or other external factors?*



Energy Usage Data

Observations: different states in different years.

Variables: energy sources, consumption, production, and expenditures.

Our data comes from the **CORGIS Dataset Project**, who got this data from the **US Energy Information Administration**, a part of the US Government.

U.S. Energy in the 21st Century

Ratner, M., Bracmort, K., Brown, P., Campbell, R. J., Holt, M., Humphries, M., Pirog, R., & Yacobucci, B. D. (2018, November 5). U.S. Energy in the 21st Century: A Primer. The Congressional Research Service. Retrieved March 10, 2023, from https://crsreports.congress.gov/product/pdf/R/R46723

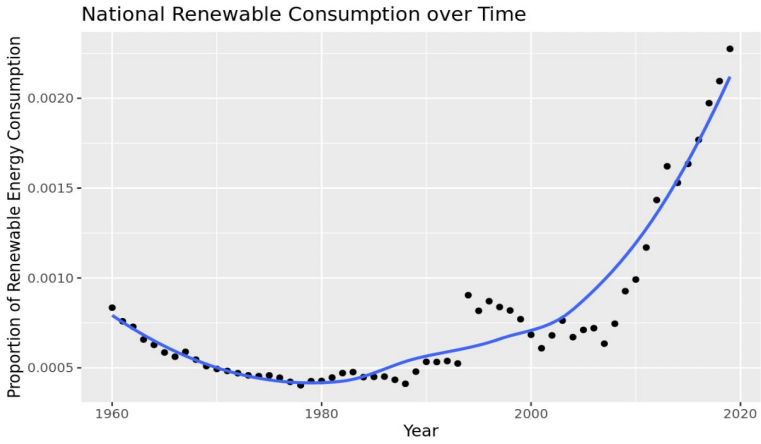
- Natural gas and renewable energy consumption has increased, oil and nuclear power consumption didn't change and coal decreased.
- In the 21st century, renewable energy consumption has almost doubled, making its increasing importance obvious. Despite this, renewable energy still only makes up 11% of U.S. energy consumption.

Discussed general energy trends in the U.S. **but did not touch on costs and factors that could provide reasoning for differences in renewable energy usage by states.**

Methodology

- **Create variables**
  - Total energy
  - Total renewable energy
  - Proportion of renewable energy consumption
- **Graphs**
  - National renewable energy consumption over time
  - Regional renewable energy consumption consumption over time
    - S, NE, W, MW
  - Regional renewable energy consumption over time by political party
- **Interaction model**
  - Proportion of renewable energy vs national, region, or political affiliation and time to predict future proportion of renewable energy
    - R-squared, adj. R-squared, AIC

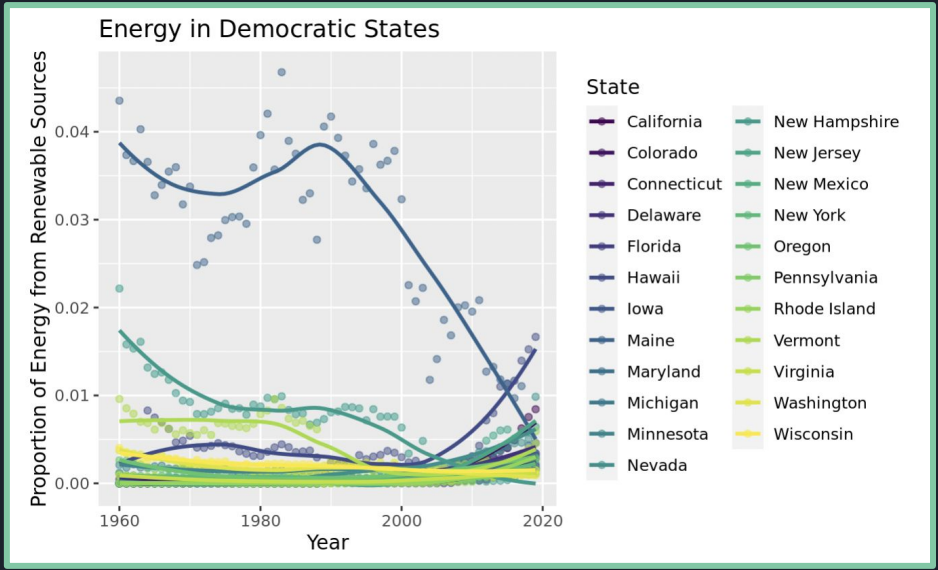
```
  mutate(total_renewable = Consumption.Commercial.Geothermal +
                           Consumption.Commercial.Hydropower +
                           Consumption.Commercial.Solar +
                           Consumption.Commercial.Wind +
                           Consumption.Industrial.Geothermal +
                           Consumption.Industrial.Hydropower +
                           Consumption.Industrial.Solar +
                           Consumption.Industrial.Wind +
                           Consumption.Residential.Geothermal,
         .after = total_energy) |>
  mutate(prop_renewable = (total_renewable / total_energy),
         .after = total_renewable)
```

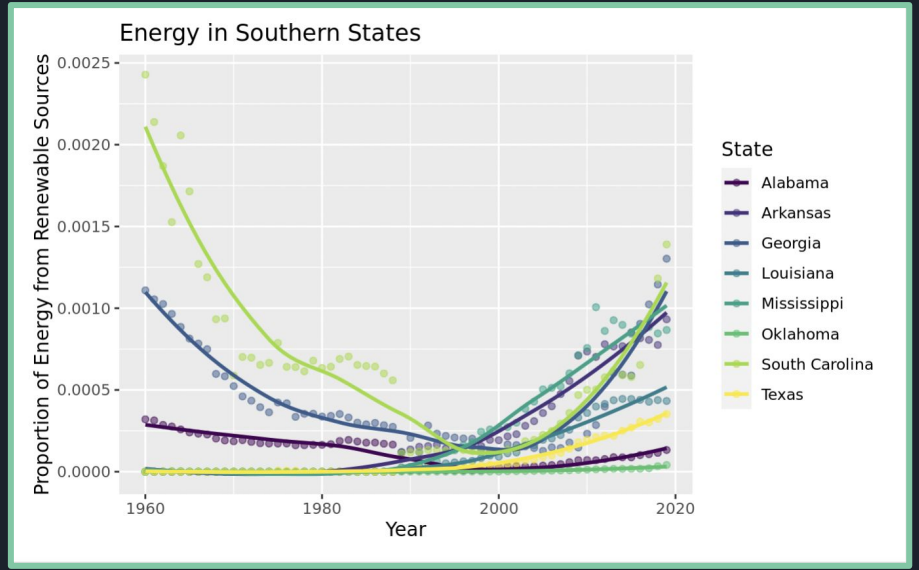



```
model <- linear_reg() |>
  set_engine("lm") |>
  fit(prop_renewable ~ Year * region, data = data)

tidy(model)
```

Visualizations





Interactive Model

- **Holding region constant**, we estimate the proportion of renewable energy a state uses to increase **0.0000257 every year**.
- **Holding year constant**, we estimate the proportion of renewable energy a state uses to increase **0.07808661 for the Northeast region**.
- **Holding year constant**, we estimate the proportion of renewable energy a state uses to decrease **0.04503337 for the South region**.
- **Holding year constant**, we estimate the proportion of renewable energy a state uses to decrease **0.05 for the West region**.
- **Holding year constant**, we estimate the proportion of renewable energy a state uses to decrease **0.05054079 for the Midwest region**.

Interactive Model

- R squared
  - 0.09329481
- Adjusted R Squared
  - 0.09026091
- AIC
  - -16233.92

```
# A tibble: 8 × 5
  term                    estimate
  <chr>                      <dbl>
1 (Intercept)             -0.0562
2 Year                     0.0000288
3 regionnortheast          0.134
4 regionsouth              0.0518
5 regionwest               0.00656
6 Year:regionnortheast    -0.0000662
7 Year:regionsouth        -0.0000265
8 Year:regionwest         -0.00000340
```

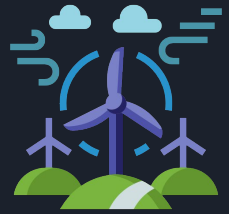
Geographical Factors

The projected increase of renewable energy is highest in the Northeast, followed by the Midwest, then the South, then West.

Geographical Factors

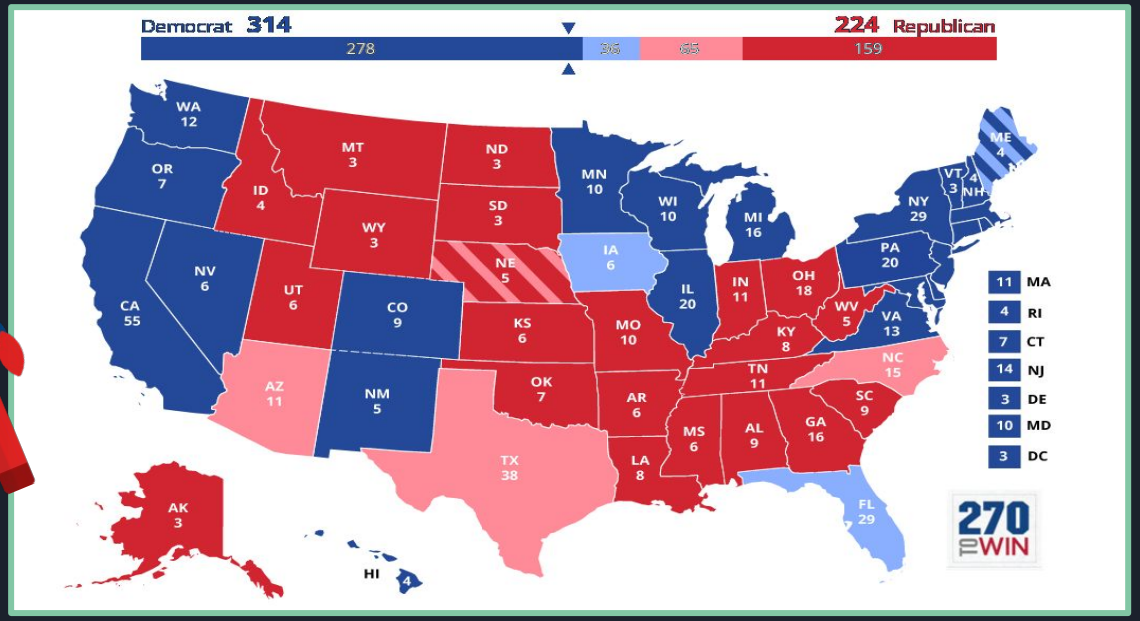
The **Northeast** has the current **highest, and the most increasing usage of renewable energy**. The other regions have decreasing usage of renewable energy based on our model.

The model had a very **low R squared value (0.09329481)**, so there are many other variables impacting these effects.



Since the Northeast is not the highest producing region of renewable energy but it is the highest using region, **it is unlikely that accessibility is the largest factor** in renewable energy in the U.S.

Political Factors



The states were separated by political party based on elections held in 2018 because the data used in this dataset ranged from 1970-2019.

Political Factors

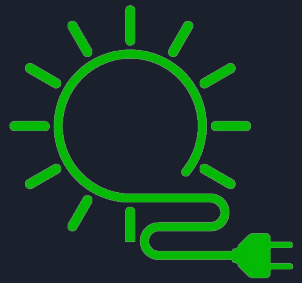
Democratic states had a slightly higher average proportion of renewable energy, at about 0.03 compared to **Republican states** 0.01.

Our model also predicts that the **Democratic states** will increase their proportion of renewable energy usage by 0.018 per year while the **Republican states** will decrease by 0.014 every year.

However, our **R squared value** (0.00103) **and AIC** (-16038) showed that **our model had a lot of variability**. Therefore, democratic states do slightly better with renewable energy, but there are many other factors that affect each state's usage.

Conclusions & Key Takeaways

Both geographic location and political affiliation have an observable effect, so policy and energy accessibility need to both be improved.



There are countless other factors contributing to a lack of usage in the US, such as current events and the economy.

Climate change needs to be brought more towards the forefront of people's minds as an essential problem in all political, economic, and lifestyle choices.

WE CANNOT DO THIS ALONE!