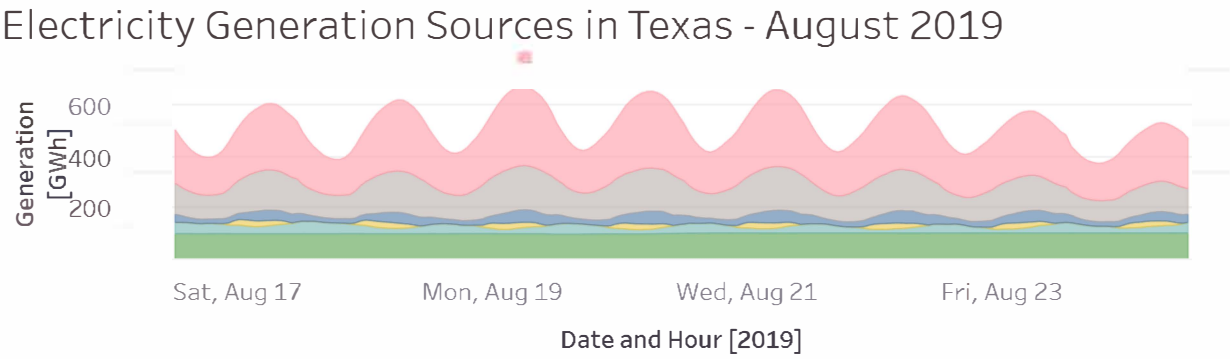
https://public.tableau.com/views/ElectricityDemandandSupply_16600892409840/Electricity?:language=en-US&publish=yes&:display_count=n&:origin=viz_share_link

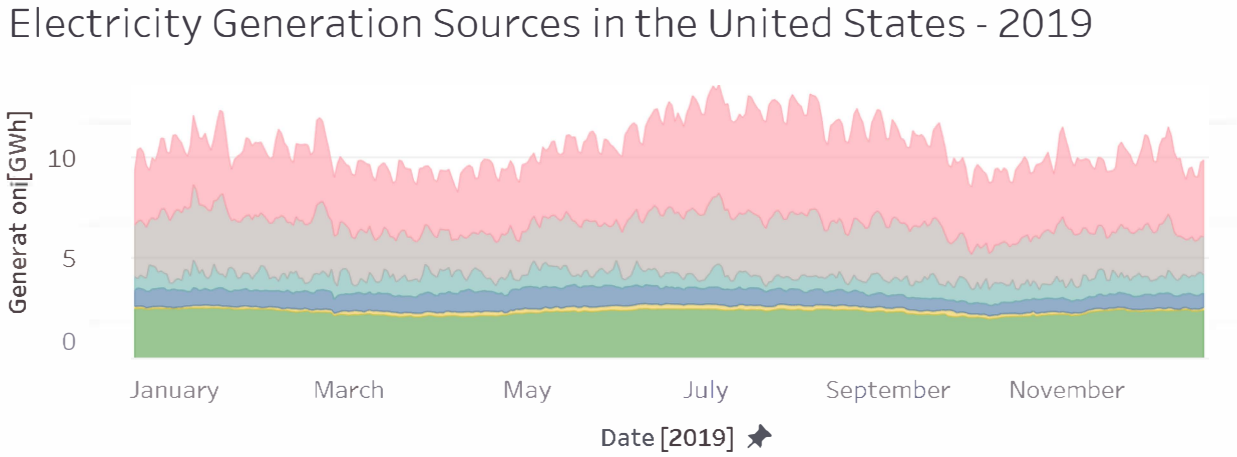
Electricity Supply and Demand in the United States

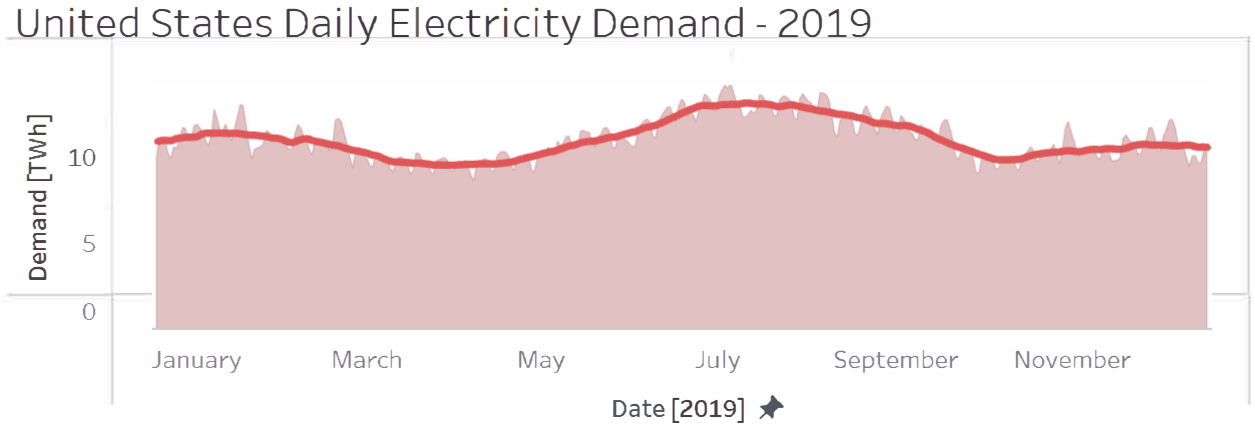
Avery Jan

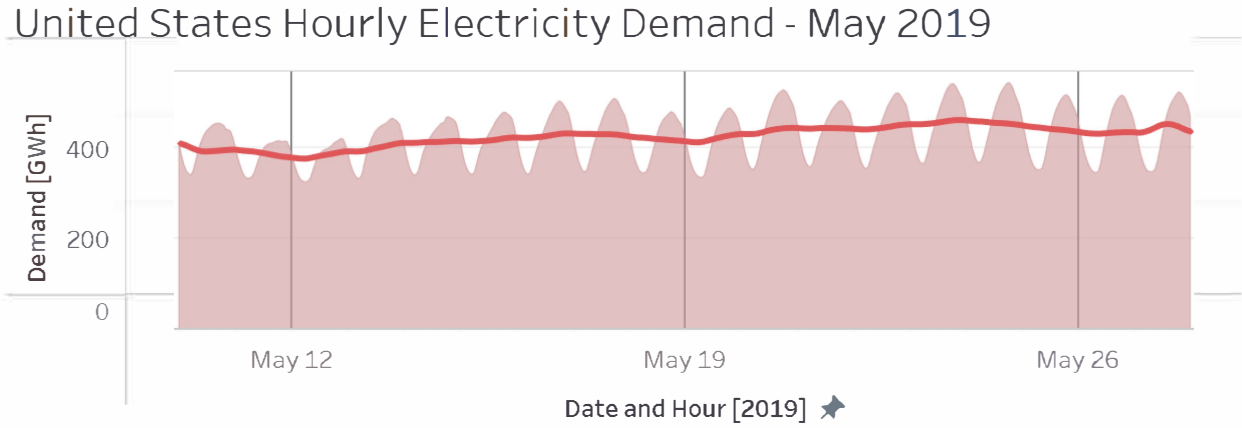
9-16-2022

Tableau Story









A Note from the Author

- This project showcases a Tableau story about the demand and supply of electricity in the United States in 2019. The types of sources used to generate electricity and the trend in moving toward renewable and flexible sources are discussed.

Outline

- Introduction
  - Goal of the study
  - Audience
  - Data Sources
  - Methodology
- Visualizations (charts and findings)
  - Fluctuating demand
  - Electricity generation
  - Supply matching demand
  - Changes in electricity generation sources
- Conclusions

Introduction

Goal: To provide an overview of the demand and supply of electricity and the trend of electricity sources in the United States

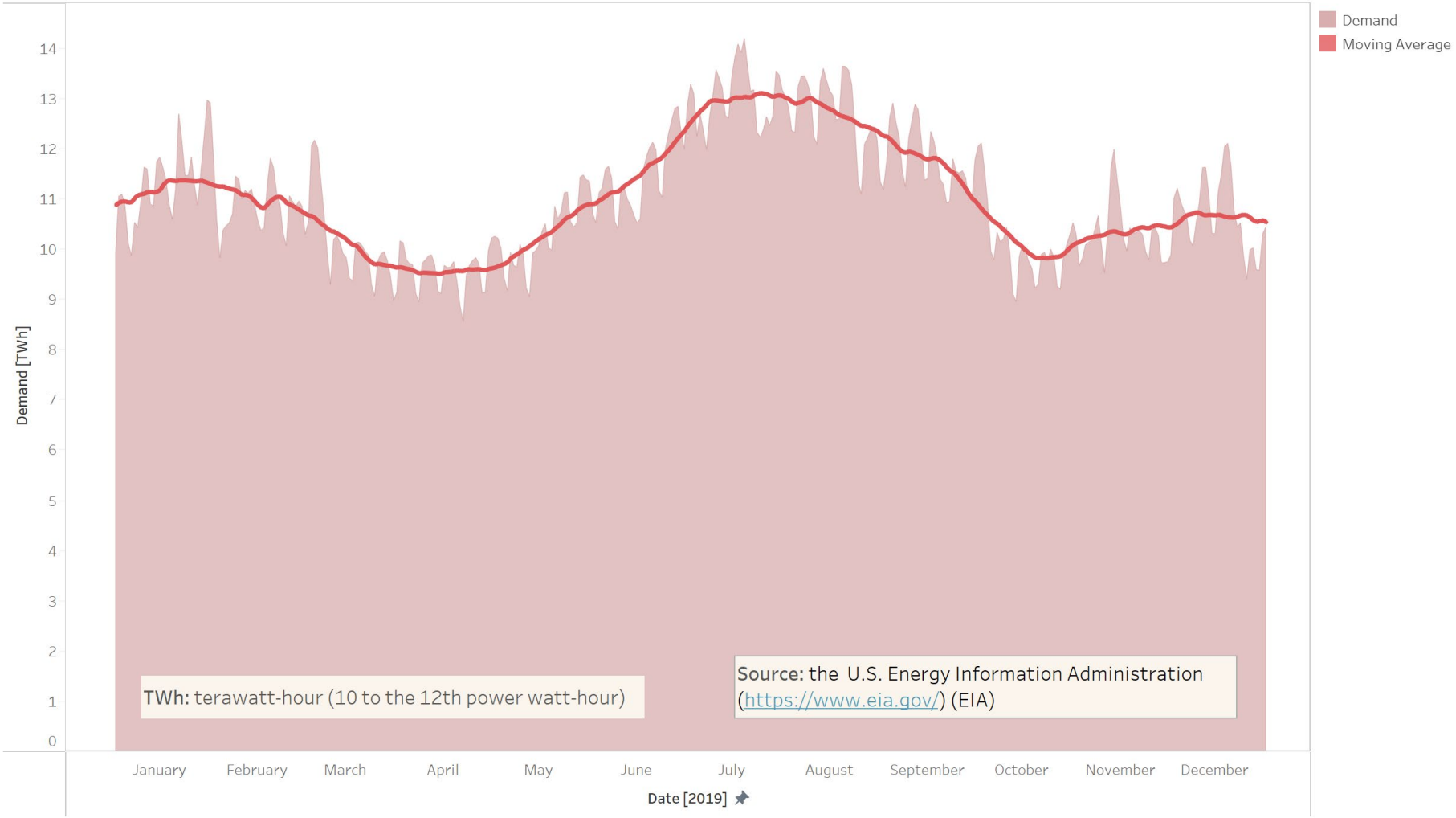
Audiences: Government policy makers, electricity suppliers, educators, and prospective professionals in electricity industries

Methodology: Tableau Public, the Story format.

Data Sources:
Electricity Reliability Council of Texas (http://www.ercot.com/) (ERCOT)
U.S. Energy Information Administration (https://www.eia.gov/) (EIA)

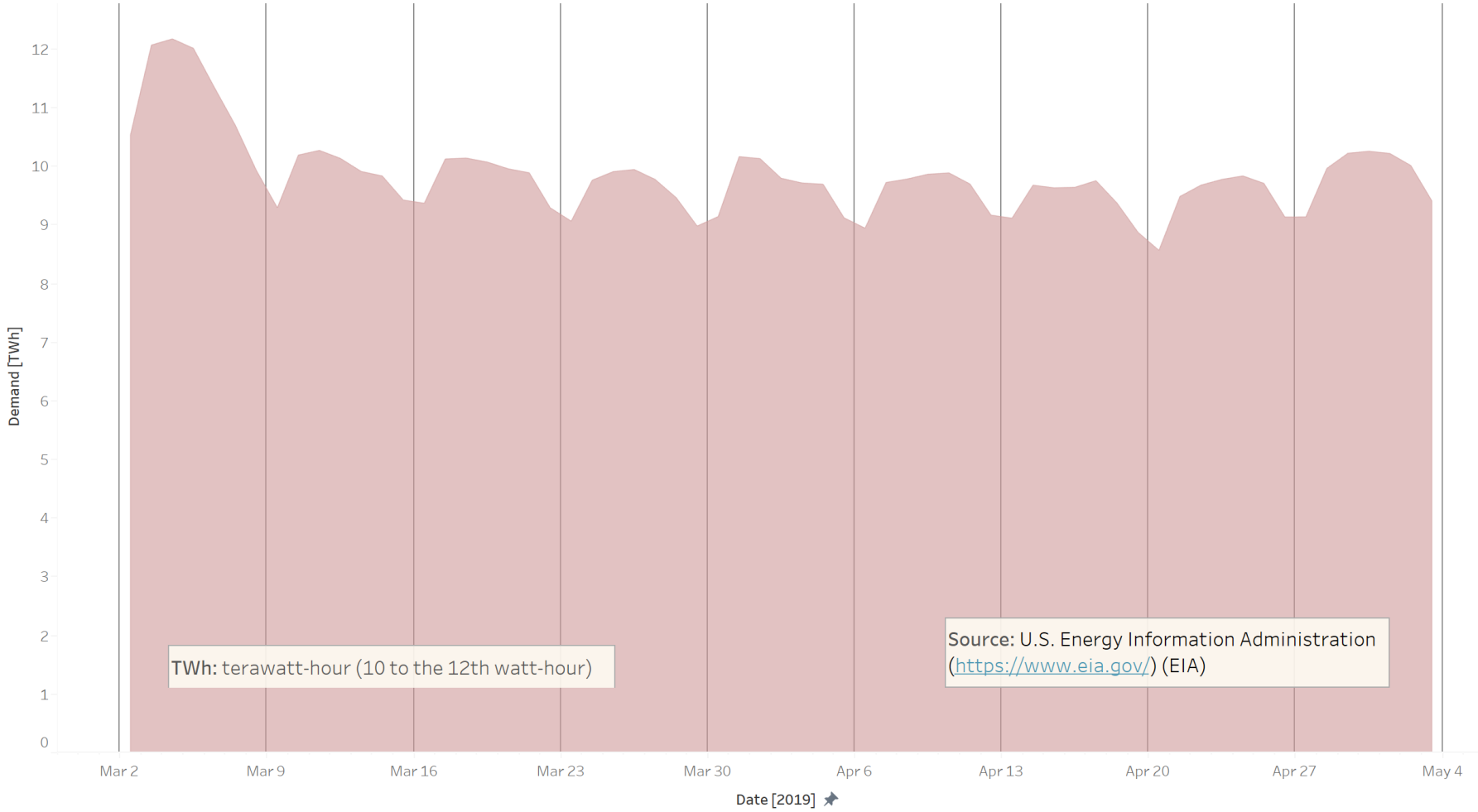
Electricity Demand Fluctuates at Multiple Scales (Year, Week, Day, Region)

United States Daily Electricity Demand - 2019



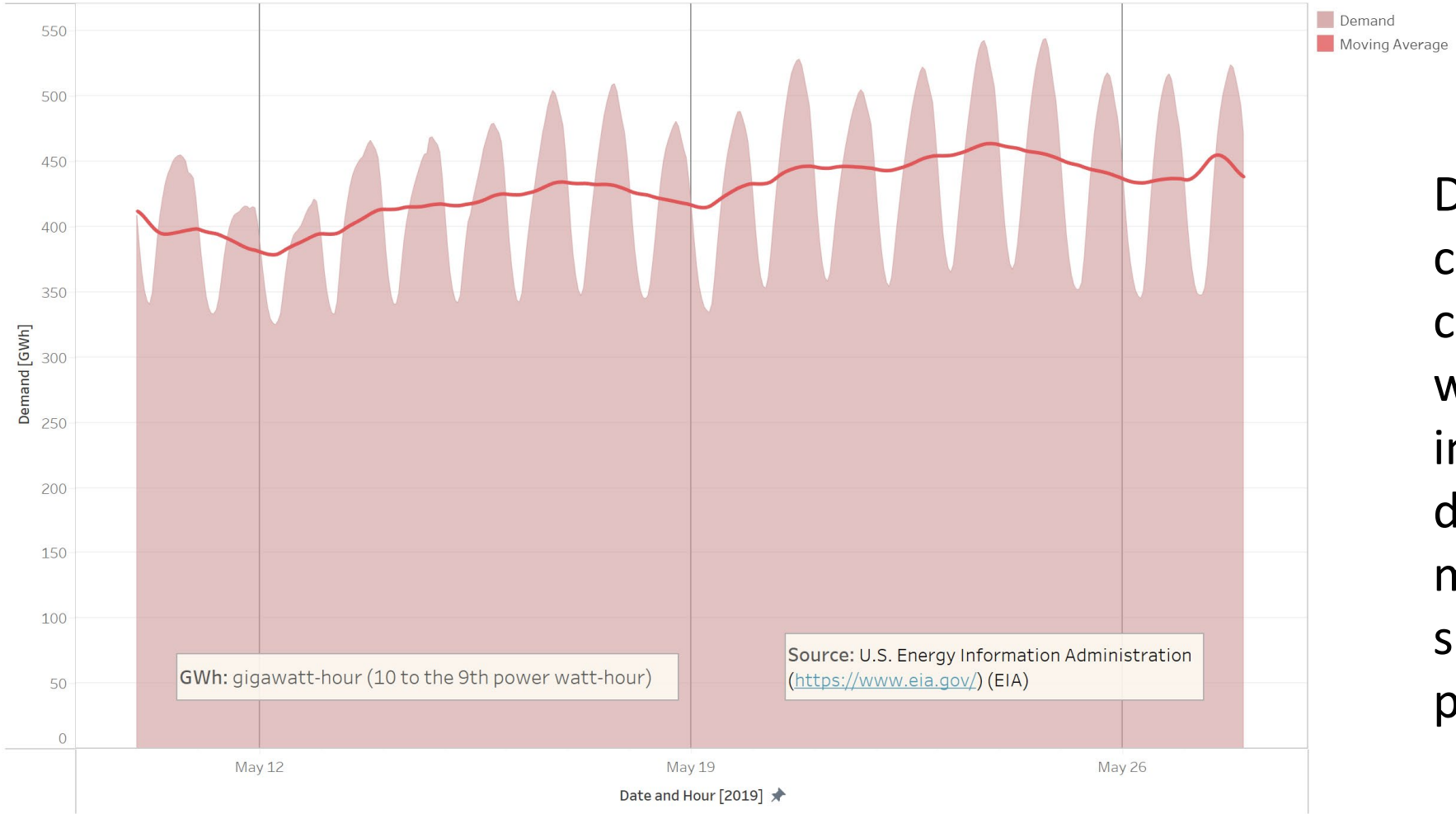
Demand changes over the course of a year due to heating and cooling needs. Notice the peaks in July and January.

United States Daily Electricity Demand - March through April 2019



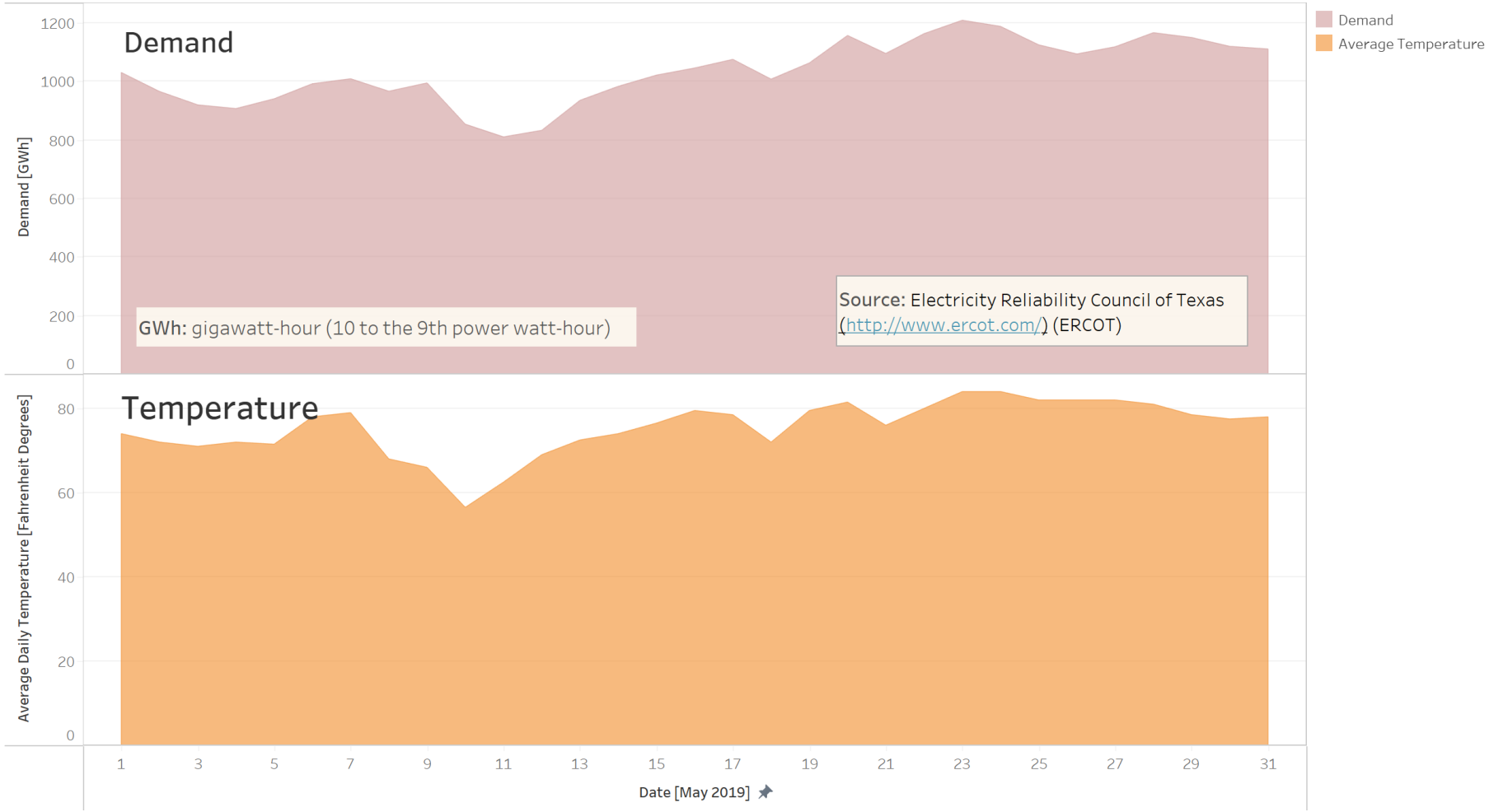
Demand also changes over the course of each week, with lower demand on the weekends.

United States Hourly Electricity Demand - May 2019



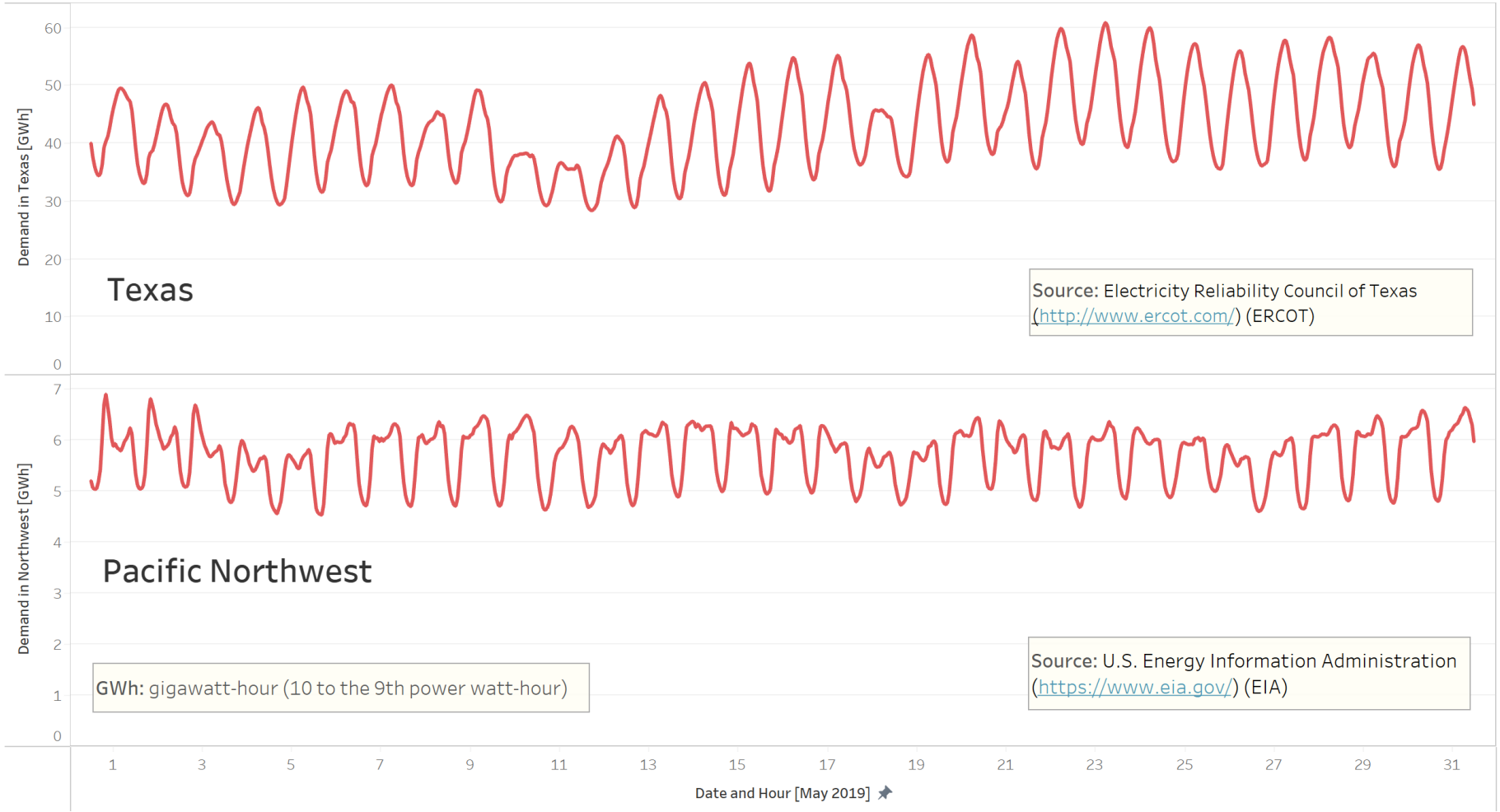
Demand also changes over the course of a day, with the peak being in the middle of the day. Notice that the moving average shows the weekly pattern.

Daily Electricity Demand vs Average Temperature - Texas, May 2019



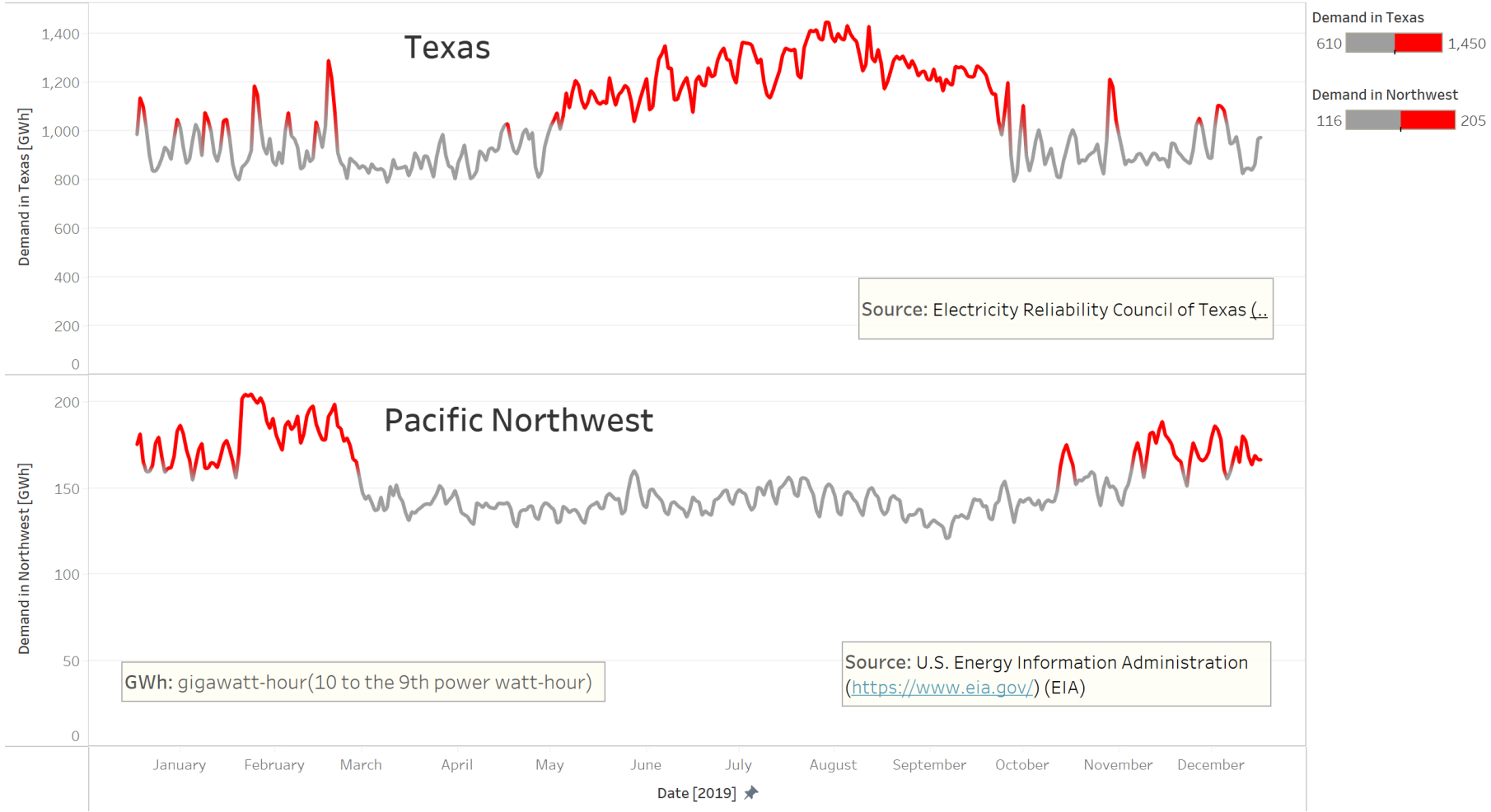
In Texas, the electricity demand correlates strongly with the average temperature for the day.

Daily Electricity Demand Pattern, Texas vs the Pacific Northwest - May 2019



The daily demand peaks are more pronounced in Texas than they are in the Pacific Northwest, where there is less need for air conditioning.

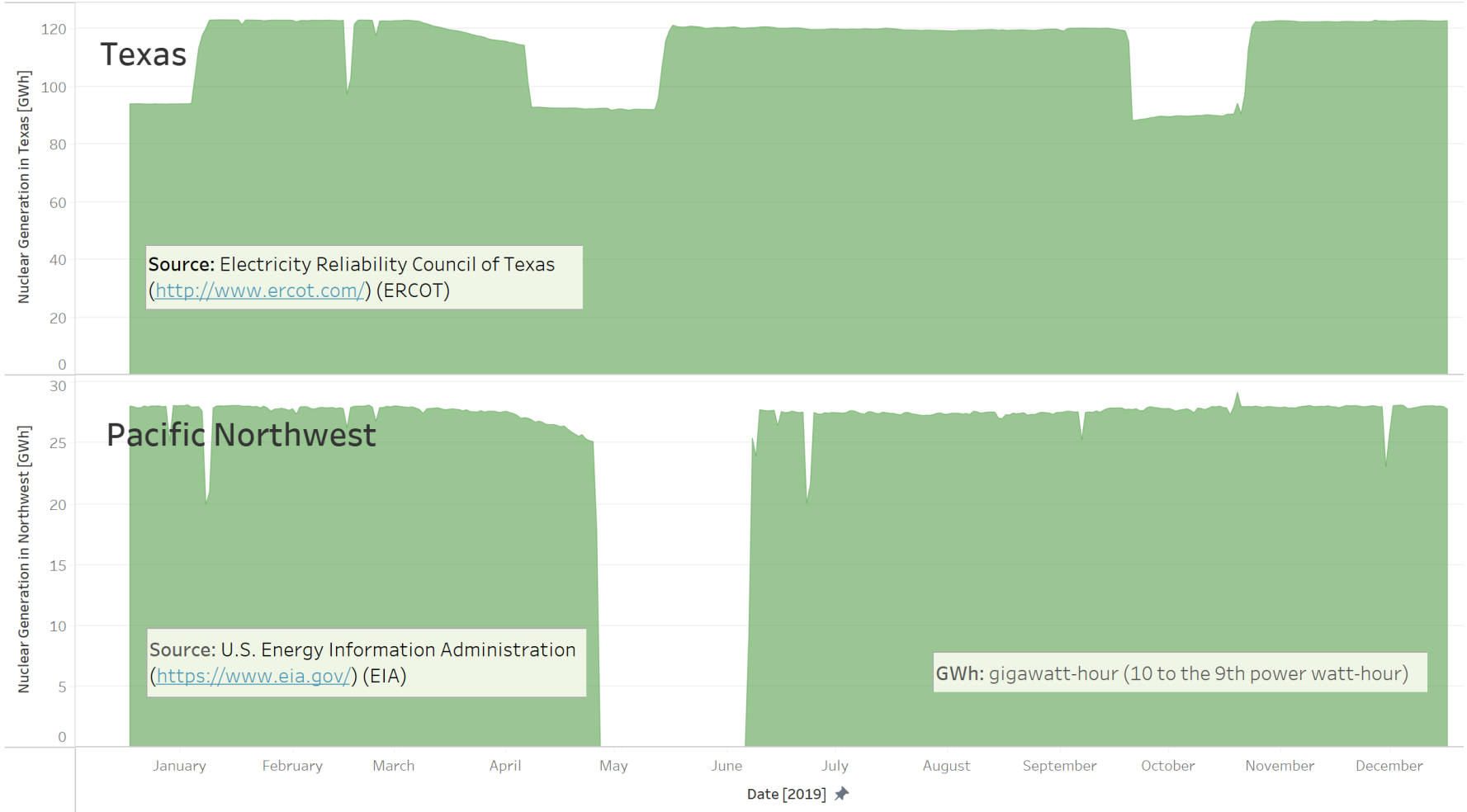
Annual Electricity Demand Pattern, Texas vs the Pacific Northwest - 2019



Annual demand patterns also differ by region. In Texas, the peak demand is in summer while in the Pacific Northwest, the peak demand is in winter.

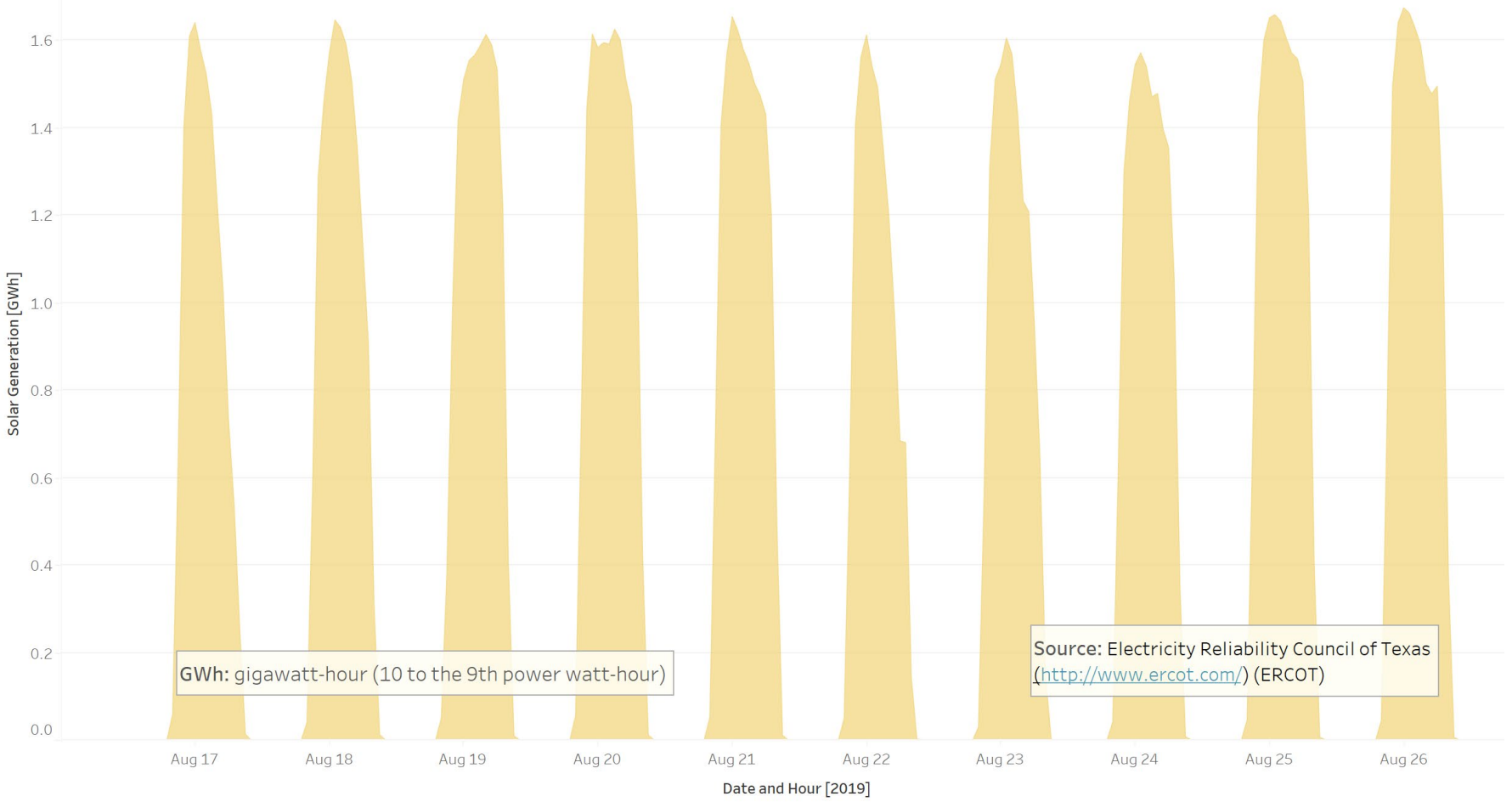
Electricity Generation Fluctuates by Source (Nuclear, Solar, Wind, Hydro)

Nuclear Electricity Generation, Texas vs the Northwest - 2019



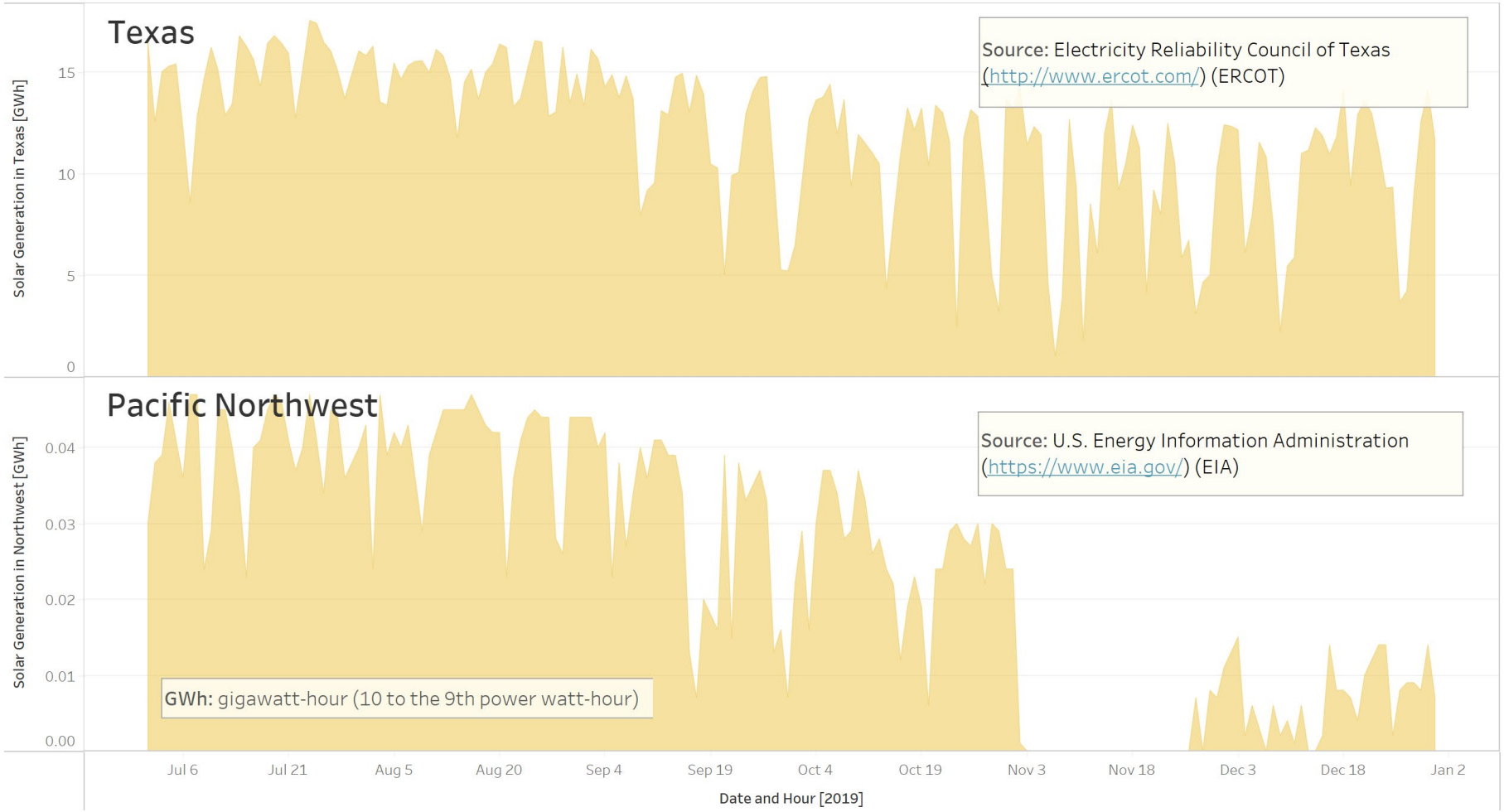
Nuclear electricity generation is very steady, with sharp changes. Each reactor core is either on or off.

Hourly Solar Electricity Generation Pattern in Texas - August 2019



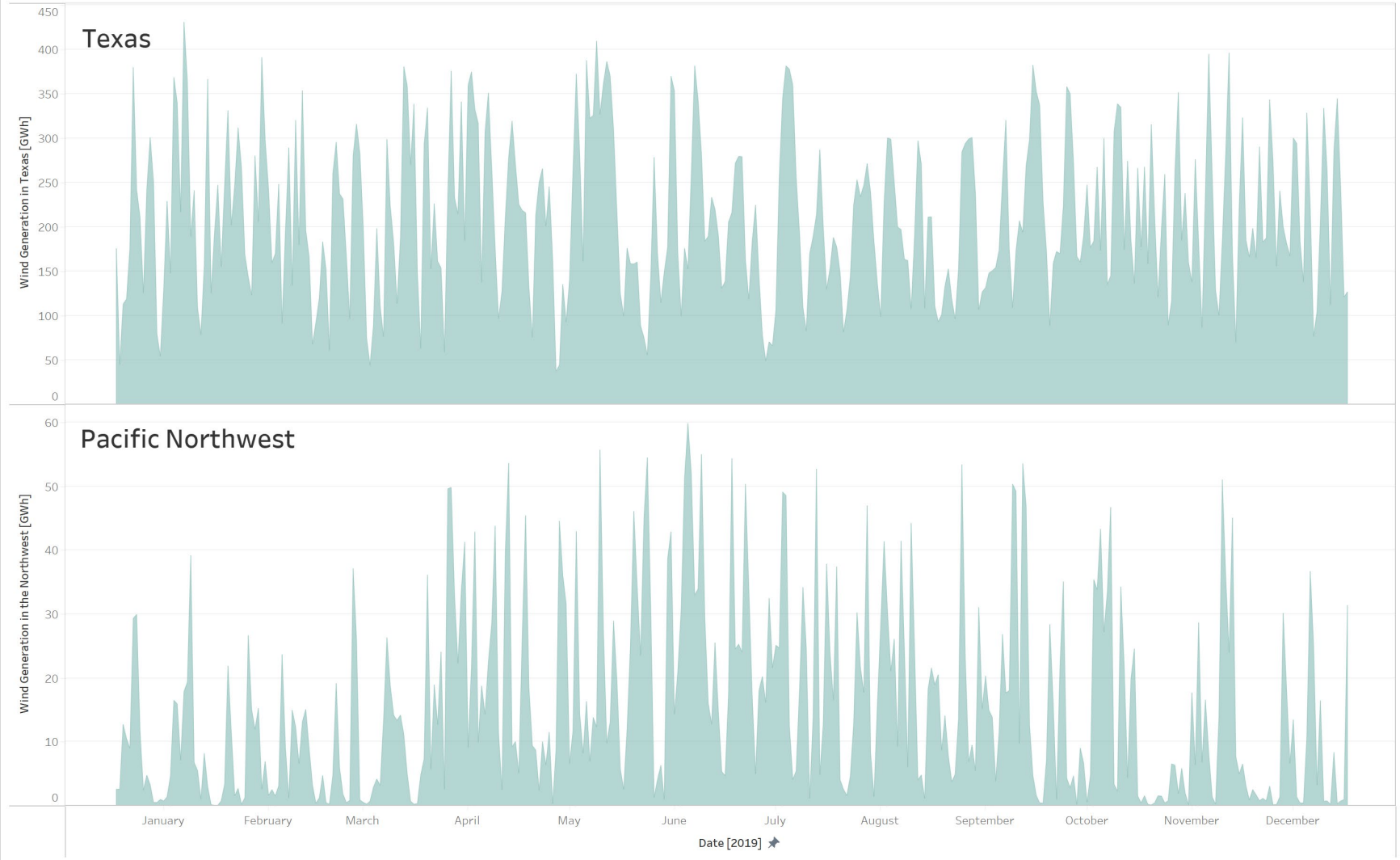
Solar electricity generation varies over the course of a day, stopping when the sun goes down.

Daily Solar Electricity Generation in Texas vs the Pacific Northwest - 2019



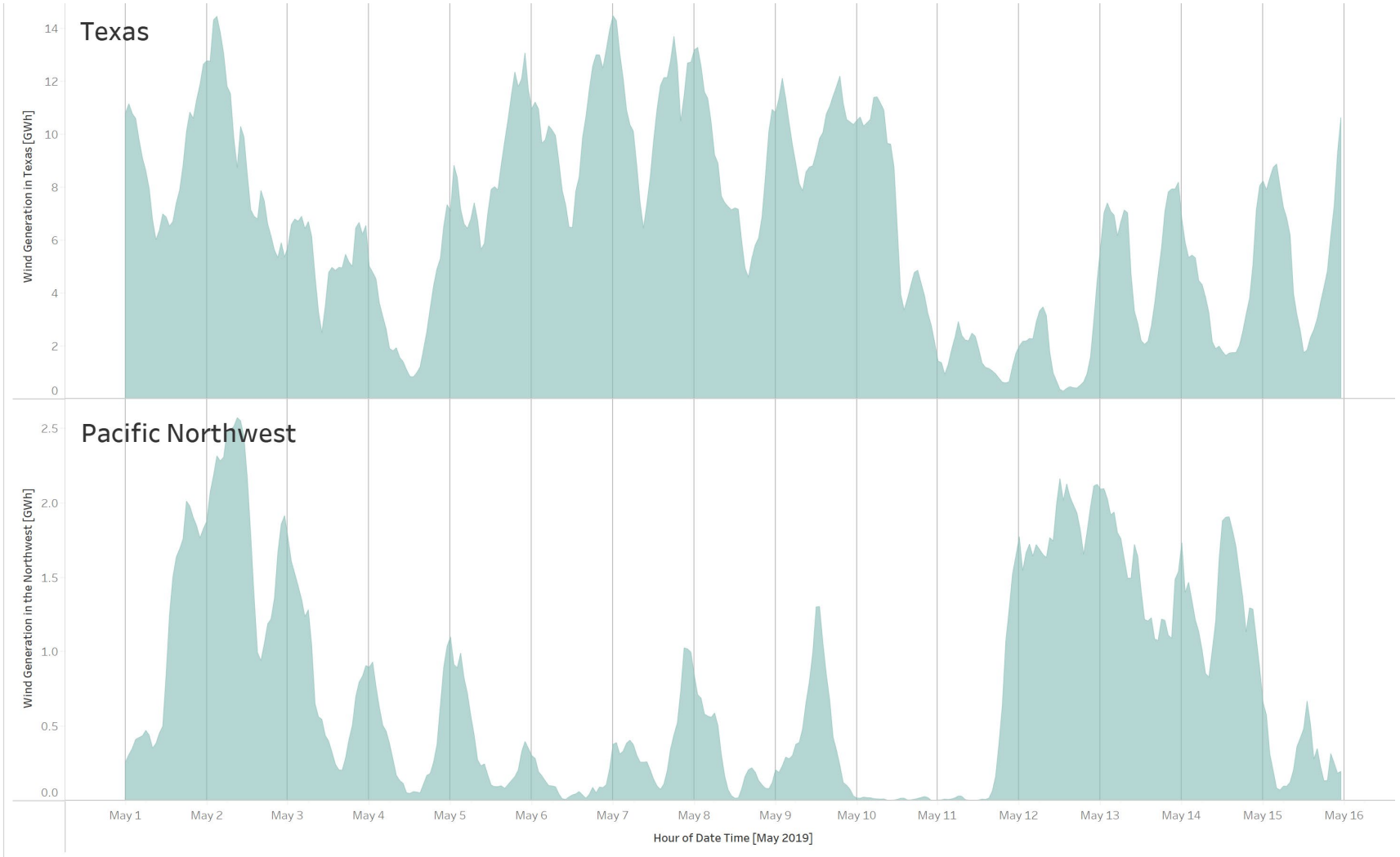
Solar electricity generation also varies throughout the year, producing less in winter, especially in more northern areas like the Pacific Northwest.

Daily Wind Electricity Generation in Texas vs the Pacific Northwest - 2019



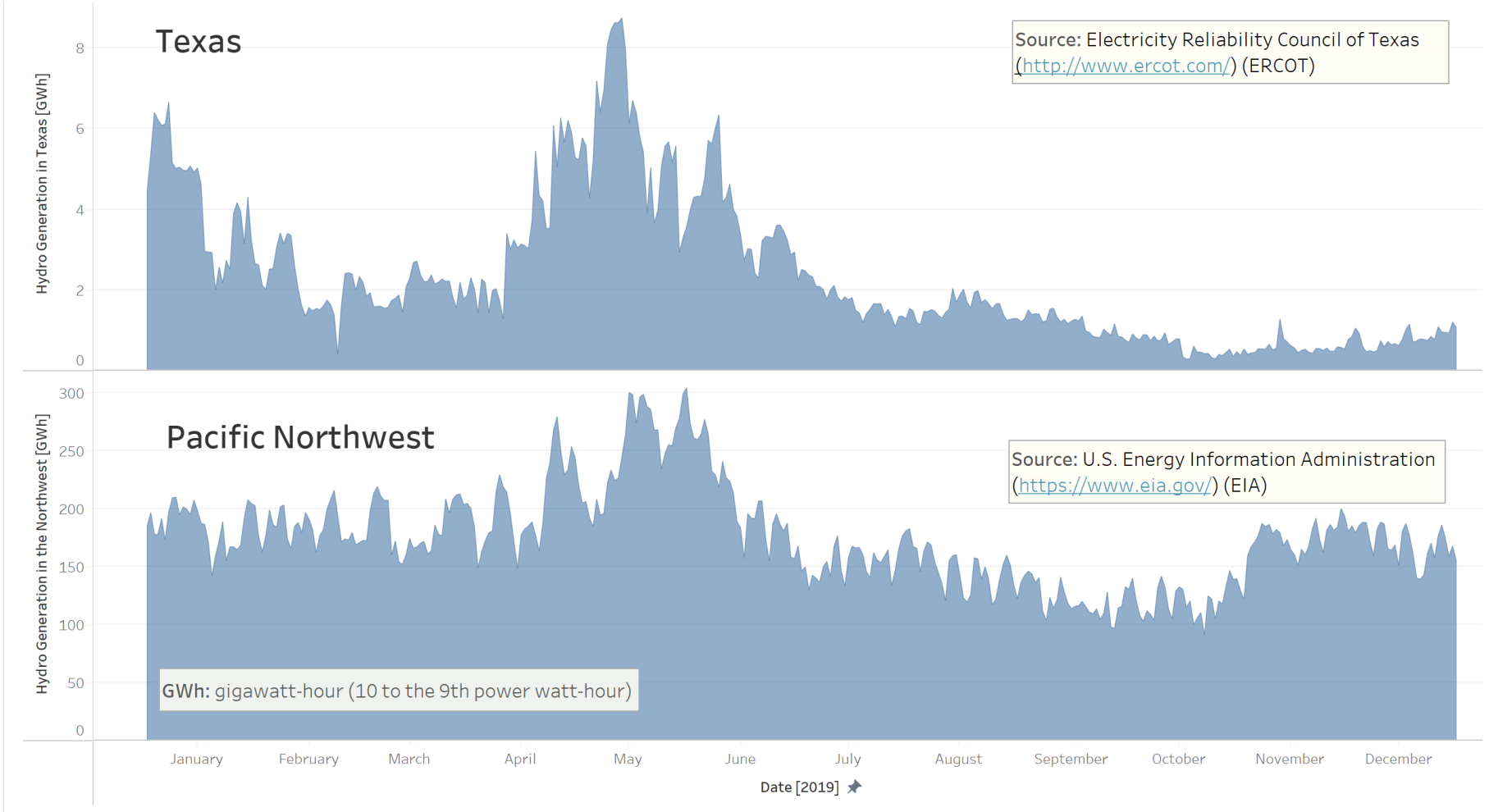
Wind electricity generation is inconsistent from day to day.

Hourly Wind Electricity Generation in Texas vs the Pacific Northwest - 2019



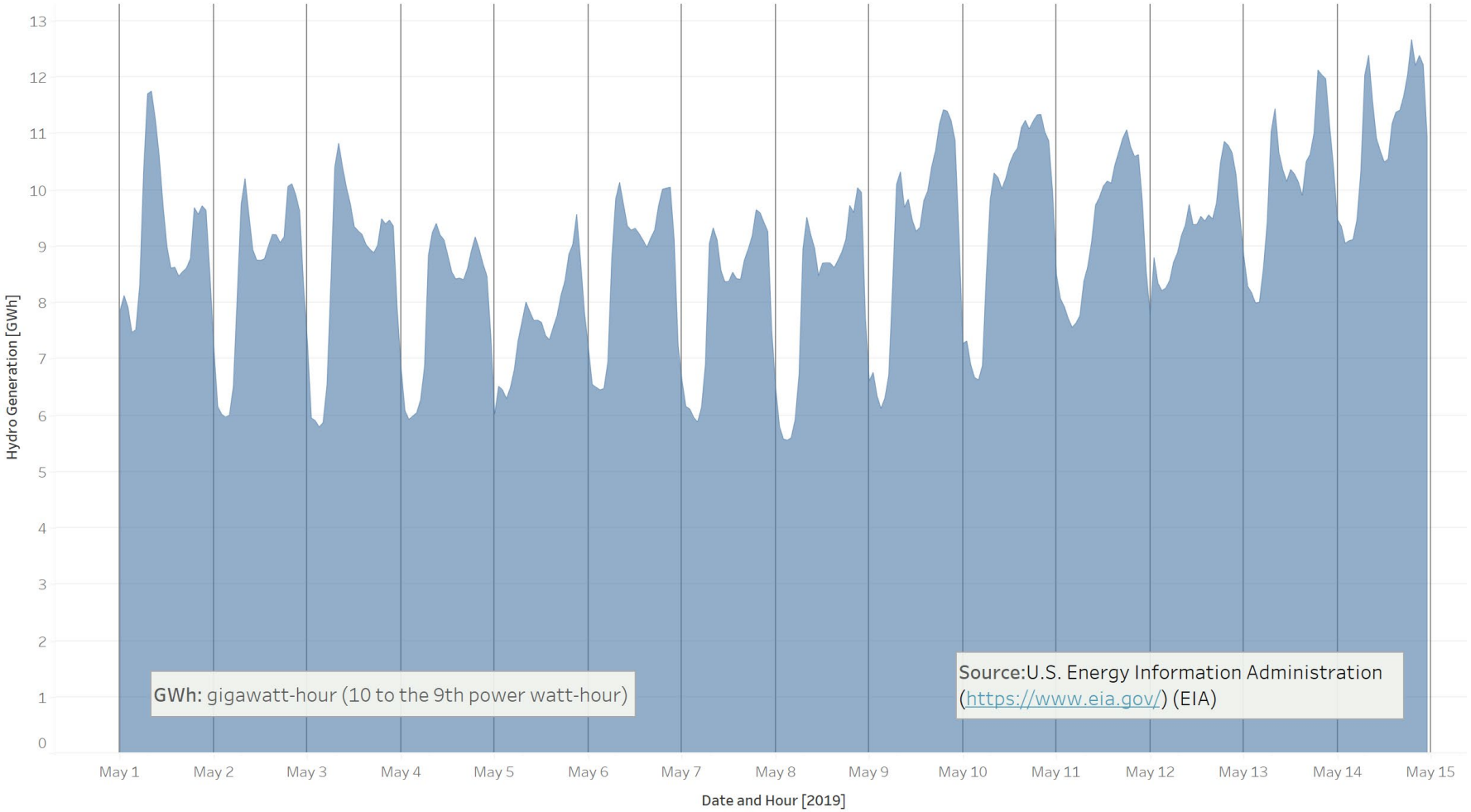
In some regions, wind electricity generation peaks at predictable times of the day. In these regions, peaks are more frequent at night.

Daily Hydro Electricity Generation in Texas vs the Pacific Northwest - 2019



Hydroelectric generation varies over the year due to the rate of snow melt. In places like Texas, it can get very low in the winter.

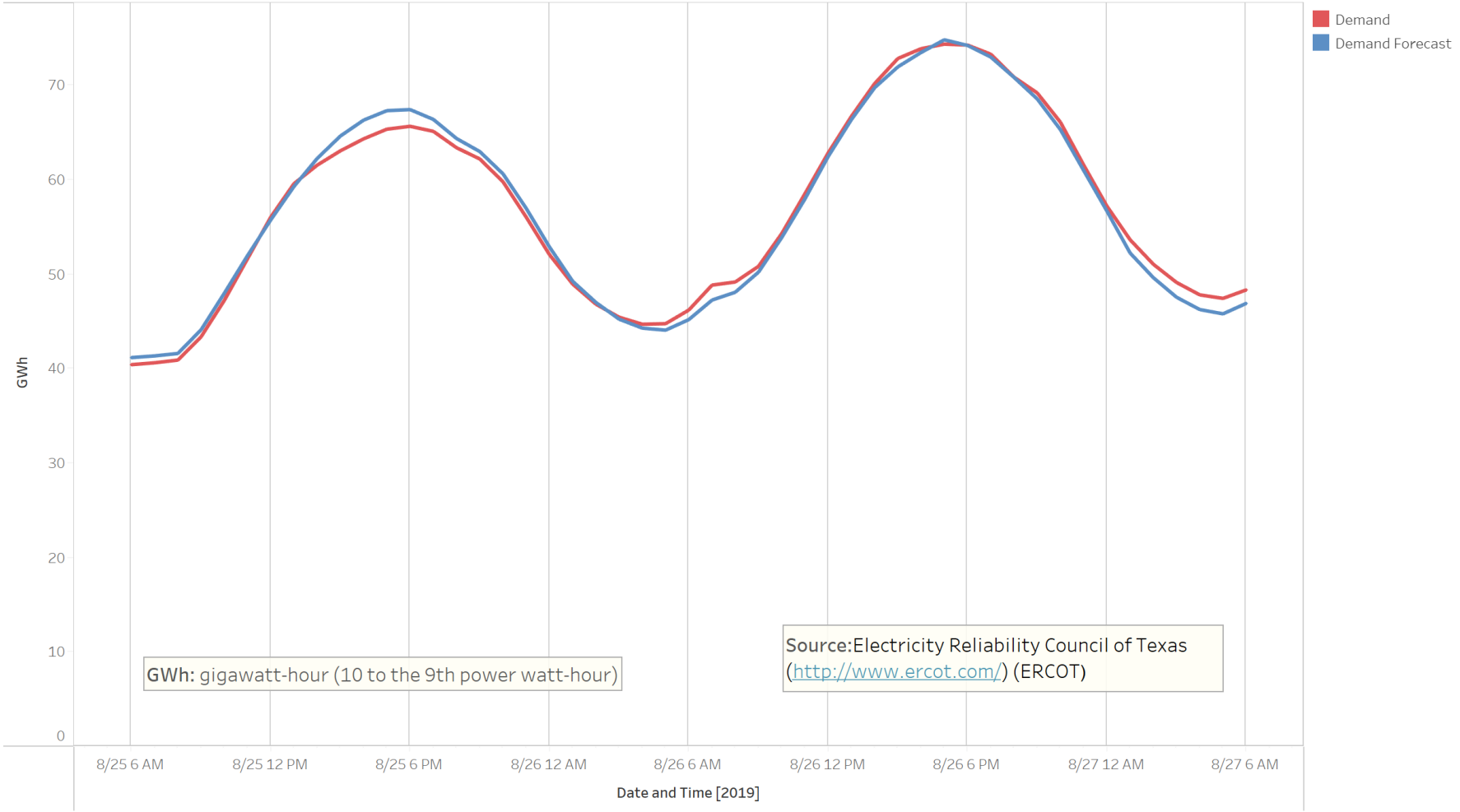
Hourly Hydro Electricity Generation in the Northwest - May 2019



Hydroelectric generation can be managed on a daily basis by allowing more water to flow when demand is greatest (during the daytime).

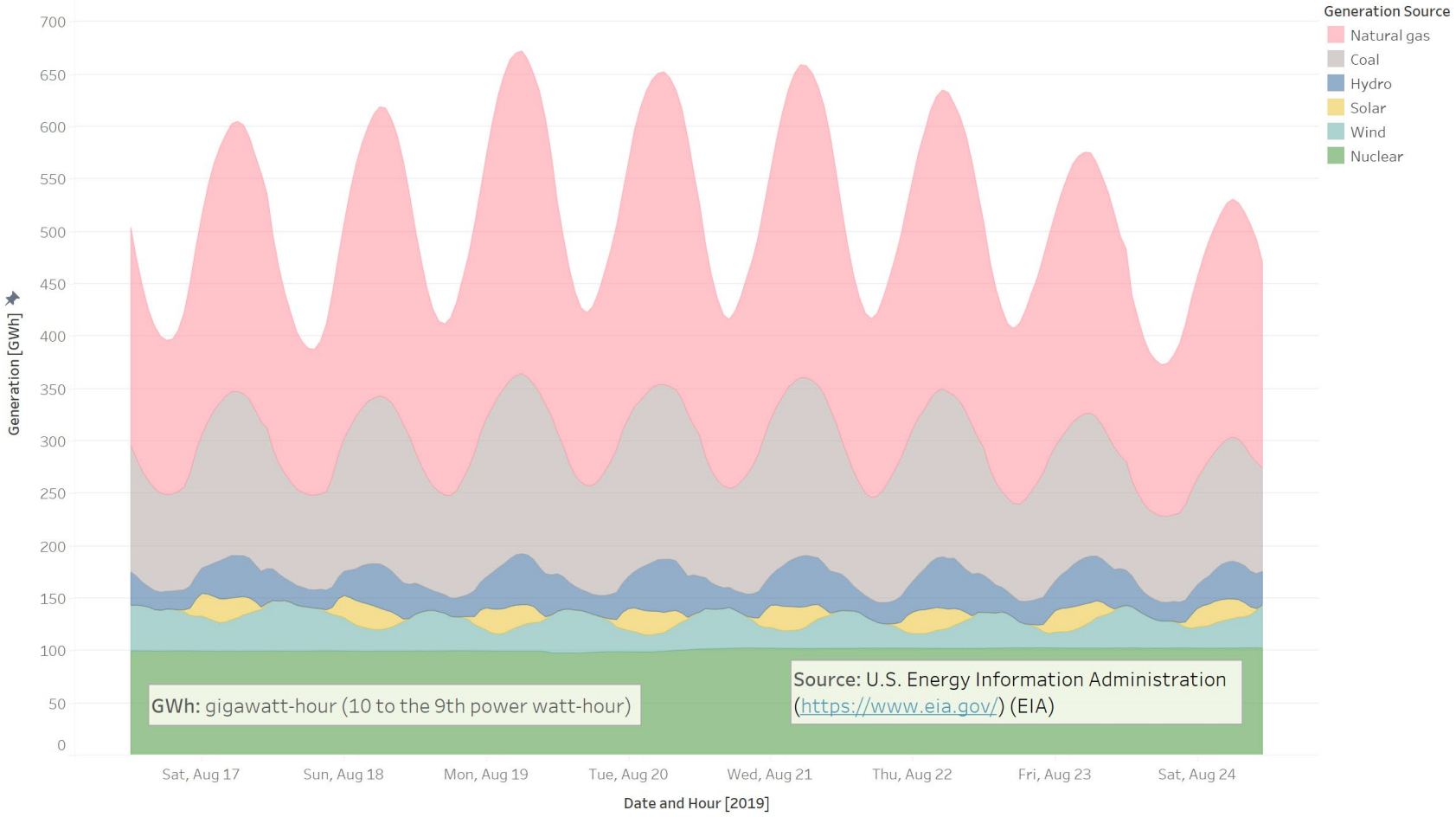
Suppliers Match Generation with Demand

Demand vs Demand Forecast in Texas - August 2019



Regional electricity suppliers forecast demand and adjust generation to match that expected demand on a daily basis.

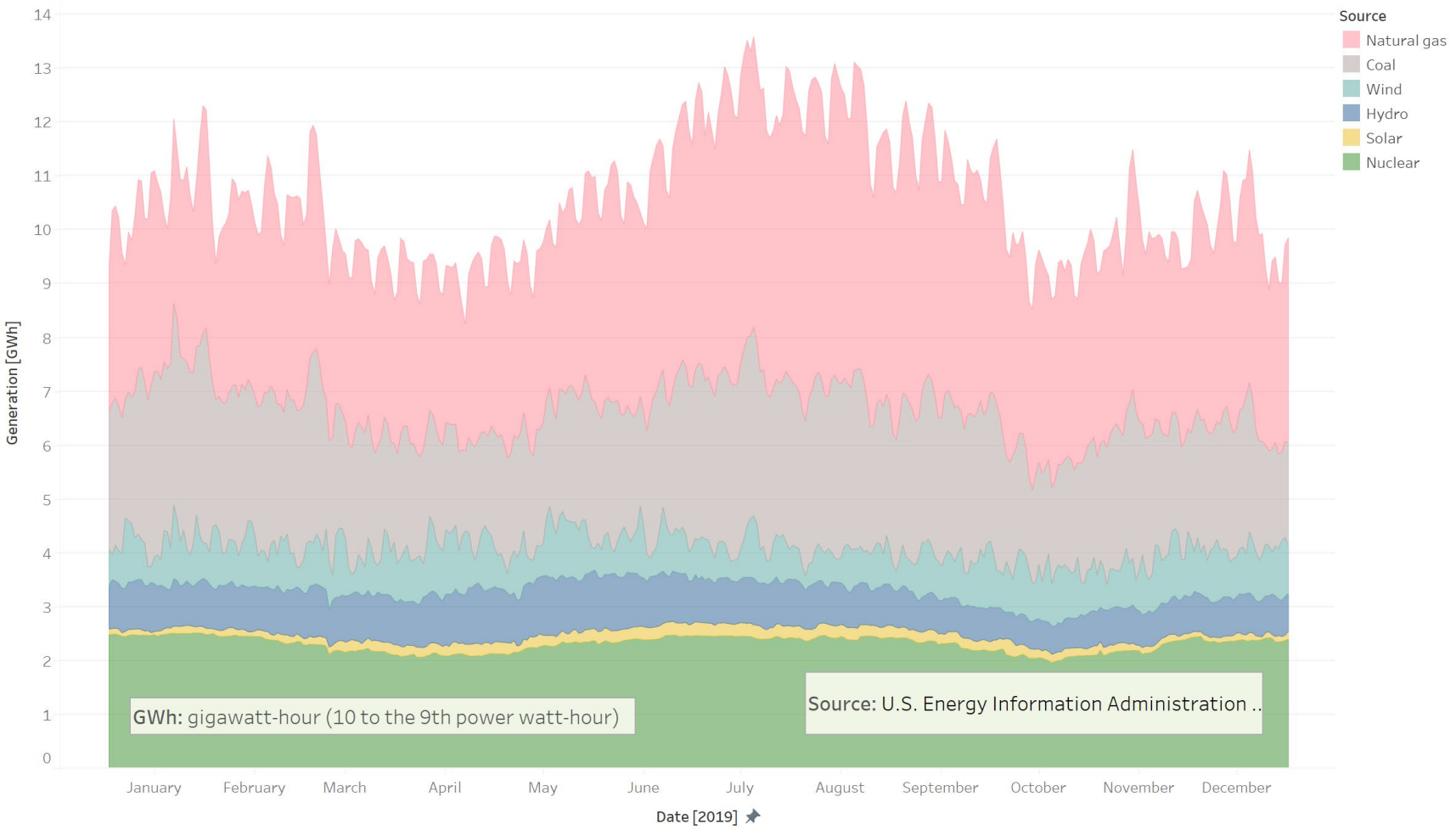
Electricity Generation Sources in Texas - August 2019



To meet demand as it varies each day, supply from flexible sources is increased during midday hours. Less supply is needed on the weekends.

Flexibility of a power system: the extent to which a power system can modify electricity production or consumption in response to expected variability

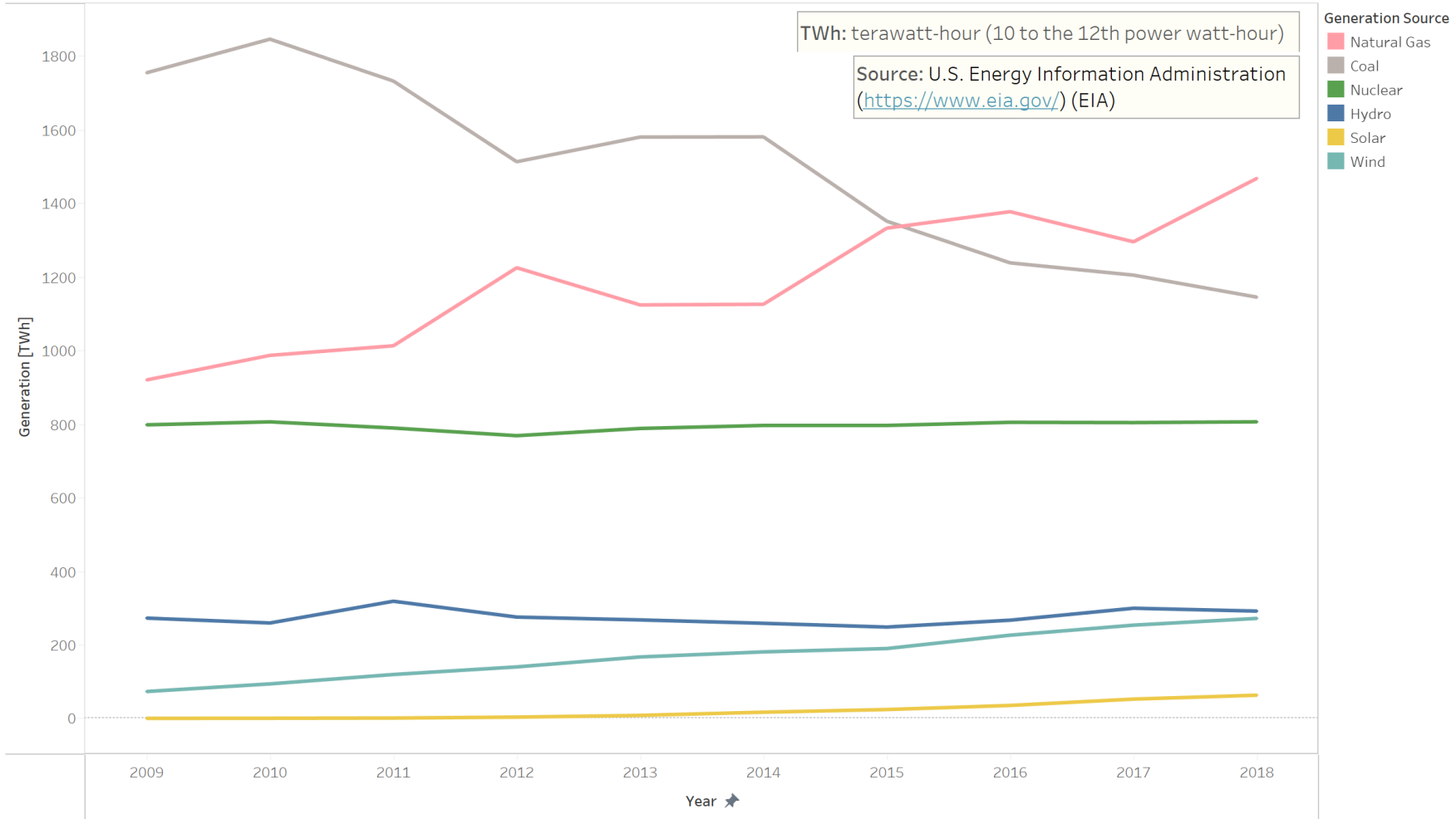
Electricity Generation Sources in the United States - 2019



Increased electricity demand in peak times of the year, like summer and winter, is largely supplied through increased use of flexible sources.

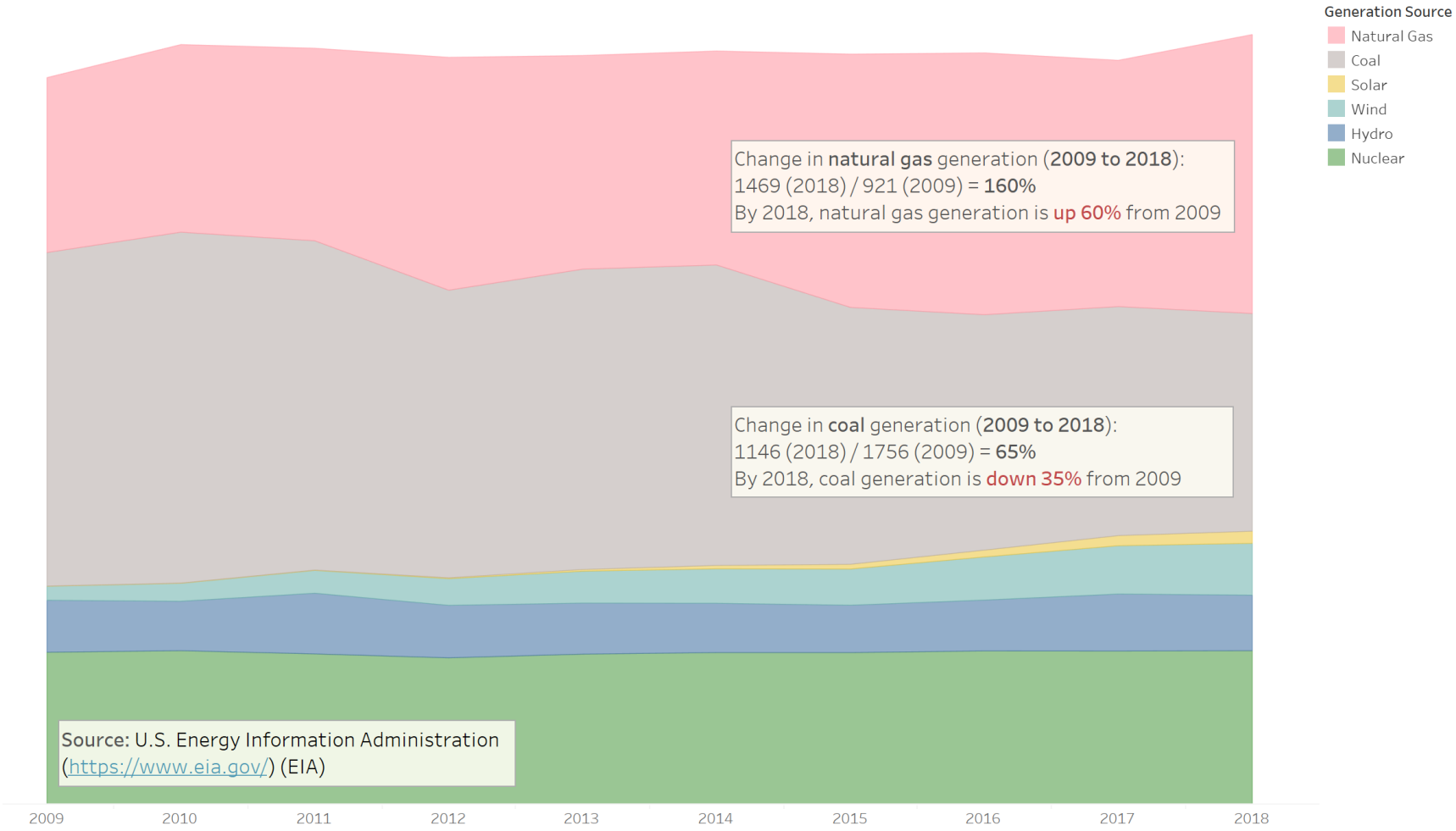
Changes in Sources of Electricity Generation

Changing Electricity Generation Sources in the United States



As renewable source generation has increased, hydro and nuclear generation have been flat and coal generation has been transitioning to Natural gas.

Changing Electricity Generation Contributions in the United States



Over the last decade, lower prices, higher flexibility, and cleaner operation have caused suppliers to switch from coal to natural gas for their flexible generation.

Electricity Generation Contributions from Coal and Natural Gas in the United States

Over the last decade (2009-2018), suppliers switched some coal generation to natural gas generation.

Conclusions

- Fluctuating demand for electricity throughout a day, week, and year as well as by regions calls for the need for flexible electricity generation.
- Over the last decade, the supply from flexible sources such as natural gas has outweighed the supply from inflexible source like nuclear power plants.
- Of flexible sources, power plants using solar, wind, and hydro sources are less controllable, and thereby those power plants using these sources cannot always be adjusted to meet the varying demand.
- The top two flexible sources, natural gas and coal, have supplied most of the electricity because of their abundance.
- In recent years, natural gas has taken some shares from coal as the electricity generation source because natural gas is more flexible, cheaper, and cleaner.
- Future studies might need to include factors beyond temperature, such as the use of electric vehicles, etc.