Abstract:

In the 21st century, energy consumption is at an all-time high, with individuals possessing multiple electronic devices as well as living in homes filled with electronics. As people run their technological devices all day year long, energy is being used at a rate higher than it has been in previous years. In order to reduce energy consumption, as citizens, we must understand in what sector we're consuming energy and how much we are using. Understanding energy usage on a micro and macro-level is essential to gaining insights on how we utilize energy and how we can potentially reduce our carbon footprint.

Objectives:

1. Analyze energy consumption for different apartments over the course of three years in order to gain insight on how a typical residence consumes energy (line chart)
2. Understand how a particular nation in the world consumes different energy-related commodities over time in order to understand how each individual nation utilizes different commodities as part of their energy sector (Small-multiple line charts)
3. Gain birds-eye-view of how each state in the United States of America consumes different energy-related commodities in order to understand the prevalence of different commodities in different states and regions (Heatmap)
4. Visualize correlation between energy consumption and economic activity in the United States in order to gain insight on how economic activity may or may not be impacted by the United States Gross Domestic Product (Scatterplot)

Dependencies:

The interface will be built through Microsoft Visual Studio Code IDE with Live Server functionality. I will be using React, D3, HTML, CSS, JavaScript to build this interface. Using the technology stack mentioned, I will be using the D3 library to create small multiple line charts, heatmaps as well as scatterplots to gain insights on how we consume energy on a micro and macro-level.

Datasets:

1. **Apartments Energy Usage (2014-2016: Apartment Energy Usage)**
    - Time (per second)
    - Energy Voltage
2. **United Nations Energy Census (all_energy_statistics.csv)**
    - country_or_area
    - commodity_transaction
    - year
    - unit
    - quantity
    - quantity_footnotes
    - category
3. **USA Energy (Energy Census and Economic_Data US 2010-2014.csv)**

    Census & Geographic Data:

    - StateCodes: The state 2-letter abbreviations. Note that I added "US" for the United States.
    - Region: The number corresponding to the region the state lies within, according to the 2010 census. (1 = Northeast, 2 = Midwest, 3 = South, 4 = West)
    - Division: The number corresponding to the division the state lies within, according to the 2010 census. (1 = New England, 2 = Middle Atlantic, 3 = East North Central, 4 = West North Central, 5 = South Atlantic, 6 = East South Central, 7 = West South Central, 8 = Mountain, 9 = Pacific)
    - Coast: Whether the state shares a border with an ocean. (1 = Yes, 0 = No)
    - Great Lakes: Whether the state shares a border with a great lake. (1 = Yes, 0 = No
    - CENSUS2010POP: 4/1/2010 resident total Census 2010 population
    - POPESTIMATE{year}: 7/1/{year} resident total population estimate
    - RBIRTH{year}: Birth rate in period 7/1/{year - 1} to 6/30/{year}
    - RDEATH{year}: Death rate in period 7/1/{year - 1} to 6/30/{year}

- RNATURALINC{year}: Natural increase rate in period 7/1/{year - 1} to 6/30/{year}
- RINTERNATIONALMIG{year}: Net international migration rate in period 7/1/{year - 1} to 6/30/{year}
- RDOMESTICMIG{year}: Net domestic migration rate in period 7/1/{year - 1} to 6/30/{year}
- RNETMIG{year}: Net migration rate in period 7/1/{year - 1} to 6/30/{year}

Energy Data:

- TotalC{year}: Total energy consumption in billion BTU in given year.
- TotalP{year}: Total energy production in billion BTU in given year.
- TotalE{year}: Total Energy expenditures in million USD in given year.
- TotalPrice{year}: Total energy average price in USD/million BTU in given year.
- TotalC{first year}–{second year}: The first year's total energy consumption divided by the second year's total energy consumption, times 100. (The percent change between years in total energy consumption.)
- TotalP{first year}–{second year}: The first year's total energy production divided by the second year's total energy production, times 100. (The percent change between years in total energy production.)
- TotalE{first year}–{second year}: The first year's total energy expenditure divided by the second year's total energy expenditure, times 100. (The percent change between years in total energy expenditure.)
- TotalPrice{first year}–{second year}: The first year's total energy average price divided by the second year's total energy average price, times 100. (The percent change between years in total energy average price.)
- BiomassC{year}: Biomass total consumption in billion BTU in given year.
- CoalC{year}: Coal total consumption in billion BTU in given year.
- CoalP{year}: Coal total production in billion BTU in given year.
- CoalE{year}: Coal total expenditures in million USD in given year.

- CoalPrice{year}: Coal average price in USD per million BTU in given year.
- ElecC{year}: Electricity total consumption in billion BTU in given year.
- ElecE{year}: Electricity total expenditures in million USD in given year.
- ElecPrice{year}: Electricity average price in USD per million BTU in given year.
- FossFuelC{year}: Fossil fuels total consumption in billion BTU in given year.
- GeoC{year}: Geothermal energy total consumption in billion BTU in given year.
- GeoP{year}: Geothermal energy net generation in the electric power sector in million kilowatt hours in given year.
- HydroC{year}: Hydropower total consumption in billion BTU in given year.
- HydroP{year}: Hydropower total net generation in million kilowatt hours in given year.
- NatGasC{year}: Natural gas total consumption (including supplemental gaseous fuels) in billion BTU in given year.
- NatGasE{year}: Natural gas total expenditures in million USD in given year.
- NatGasPrice{year}: Natural gas average price in USD per million BTU in given year.
- LPGC{year}: LPG total consumption in billion BTU in given year.
- LPGE{year}: LPG total expenditures in million USD in given year.
- LPGPrice{year}: LPG average price in USD per million BTU in given year.

Economic Data:

- GDP{year}{quarter}: The GDP in the provided quarter of the given year (in million USD).
- GDP{year}: The average GDP throughout the given year (in million USD).

Implementation:

To implement and test our hypotheses on what insights we hope to gain through data visualization of energy-related data, I will be creating a web interface built with React library for a smooth and sleek user interface and experience as well as D3 (Data-Driven Documents) to manipulate document objects to create interactive visualizations. The header on the NJITVIS navigation bar has 5 options: The first is a home landing page, where we will explain our hypotheses and why we are visualizing this data as well as what we're trying to learn from our data. The first visualization tab is going to be the visualization of "Apartment Energy" for different apartments in three different years. For this, we will generate a line chart, where we can track spikes in energy consumption over time for each individual apartment. The second visualization tab is the "UN Energy Census", where we will generate small multiple line charts for each commodity in the energy-sector used by a particular nation. The interface will feature a dropdown menu to select which country you want to look at. The third visualization tab is the "USA Energy" visualization, where I generate a heatmap encompassing all of the data from the dataset in order to show overall energy consumption for different total commodities (Natural Gas, Coal, Biomass, Hydropower, etc.). The final visualization tab on the interface is the "USA Energy vs. Economy", where I generate a scatter plot to graph the correlation between Total Energy Consumption and the GDP for each state in the United States in order to understand if energy consumption has any influence on the economy.