CO2 Emission across World Regions and its relation to Energy-Consumption and Fuel-Type

Messaging

The visualization gives a comparative view of how CarbonDioxide (CO2) has been emitted by different regions across the world, and explores its relationship with per capita energy consumption, and types of fuel used for these consumptions. It establishes a clear relationship between these factors. We can easily see how historical events like economic growth of Asian countries like China were fueled by large consumption of fossil fuels, thus leading to heavy release of CO2. Viewers can explore CO2 emissions of each world region separately, and correlate it with additional information provided by supporting charts (energy consumption and fuel types used).

Narrative Structure

The narrative visualization is “roughly” a drill down story. The viewer is presented with a big “stacked” area chart depicting the main theme (CO2 emissions over years), and is allowed to select different regions in the area chart to drill down to details about each region. For example, if the viewer selects a particular region, it gets highlighted, and other regions in the area chart get dimmed. The associated annotations remain active, whereas the unrelated associations are removed from the scene. At the same time information in supporting charts is filtered to highlight only the details related to the selected region in the main chart. This allows viewers to understand the relationship between CO2 emissions, and factors like energy consumption, fuel profile better.

For example, a viewer can observe that there was a dip in CO2 emissions in Europe around 1973-75. The reason for this can be interpreted from the support chart depicting per capita energy consumption, where it can be seen that there is a big dip (probably due to the Arab-Israel war raising the cost of oil).

Visual Structure

The visualization has a drill-down kind of setup. So, there is mainly a single page/scene showing all the details to the viewer, and engaging viewer through various visual elements to explore the details:

- As the page loads, first the “stacked” area chart is created through an animation, to give the Viewer the clue that “year” is an important parameter.
- There is a brush explicitly available in the middle of the page, (which is also shown in the animation). This encourages the user to apply brushing over the horizontal axis and focus on a certain period of time.
- Additional annotations are provided in the main chart, to help provide additional insights.
- As the viewer hovers over the main chart, the mouse pointer is changed to “hand” pointer to give clues to the user to click the areas in the charts.
- The main chart has a color coordinated tooltip to provide data related to different regions in corresponding color. Also, the chart in the supporting chart is color coordinated with the main chart.
- Each chart has well designed mouse pointer behavior to provide necessary detail on hover.

Scenes

This is a drill-down style visualization. So, it's presented in a single scene setup, with visual clues to allow the user to dig into the details. The scene consists of the main chart depicting the quantity (in million tonnes) per region over a period of 1965-2021. This is presented in a stacked area chart. Additional charts are provided: multi-line chart detecting the per-capita energy consumption and a stacked bar-chart depicting usage of different fuel types per region per year.

There is no notion of ordering in this setup. It's more like a free flow scene for users to explore.

Annotations

The visualization utilizes elbow-style annotations, provided by d3-annotations library. This template uses a label and an elbow-style connector. The template keeps the connector at 45 and 90 degree angles. This template provides a clean, yet sophisticated look to the visualization.

The annotations help in highlighting points of inflation. They give viewer visual clues on how to read and interpret the data.

During the initial animation, the annotations start appearing, as the animation progresses. Then when the viewer is interacting, annotations are impacted in two ways:

- When the viewer applies brushing, if the chart portion containing an annotation goes out of brush-extents, the corresponding annotation(s) too disappears.
- When the viewer applies filtering, by clicking on a single region in the main chart, all the annotations associated with that region remain in view and other unrelated annotations are removed. This helps viewers focus on the story more.

Parameters

There are two parameters:

- Year: The main chart and supporting charts are tied by the same horizontal domain, which is years. When the viewer applies brushing, this changes the number of years, and the charts get updated to display data within the given years range.

- Regions in stacked area-chart, each representing a world region/country: When the viewer clicks on any region, the corresponding region becomes the focus of the narrative. All the charts are filtered to highlight the details of the selected region. Other details are faded away or removed.

Triggers

- Viewers can use the brush handles provided in the middle of the visualization to trigger a change in the “year” state. This changes the limits of the “year” domain, and corresponding changes are applied in the charts, to help visualize the details more closely. This brush component is part of the on-load animation, which provides clue to the viewers to use the handles.

- Viewers can click on each stacked area in the area-chart to trigger a change in the “region” parameter. Corresponding sections in line-chart and bar-chart are also highlighted to enable use to explore the details corresponding to that region.