

# Process Book

## European Country Energy Statistics Analysis

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## 1. Introduction

Energy statistics are in the spotlight due to their strategic importance to the drive towards competitive and sustainable economic growth. To meet approach producers' developing requirements for energy information, EuroStat has fostered a cognizant and orchestrated arrangement of energy insights. Eurostat statistics for European member states from 1990 onwards, and provide an easy visualization view of the data. The existing data visualization view is only for a certain type of data simple visualization of one single table, interactivity is relatively poor and limited. The motivation of our project is to use the existing data with data analysis and statistics to provide an interactive multimodal view of data and help people understand the statistical trends hidden behind the data more visually and vividly.

## 2. Problem Statement

The energy crisis is the concern that the world's demand for the limited natural resources utilized to power modern society is outpacing their availability. The availability of these natural resources is confined. While they do arise naturally, rejuvenation can take hundreds of thousands of years.

In countries' view, the energy crisis has become a more complex problem. For example, how can we strike a balance between the use of traditional fossil fuels and alternative energy sources such as renewables while still ensuring there is sufficient energy? How to balance the ratio of domestic and industrial electricity consumption through electricity tariffs? Can the country's future energy security be guaranteed if the overall energy source is mostly dependent on imports?

With our data visualization, we would like to address the following aspects: 1) Overall energy statistics; 2) Renewable Energy; 3) Energy Security.

## 3. Dataset

The Dataset [European energy dataset](#) from [EuroStat](#) contains 120 .tsv files. We mainly use information from the following perspectives :

- Final Energy Consumption
- Energy Imports and exports by energy type
- Shares of renewable

The whole dataset contains about 38 countries in European energy statistics since 1990. Part categories of statistics have been available since 2008. The

main tables section presents data in a predefined format for the most frequent requests. The database tables allow a much larger customized selection of countries, periods, products, flows, and units of the full energy balance and related indicators.

Our data is well structured and clean but separated into multiple files. We wrote scripts to fetch data by website directory. Partial data is organized with professional abbreviations and relies on other files. Our data process's main challenge is to deal with redundant data, and process missing values and dependencies.

## 4. External Libraries

We followed the common practice of web development and used several external libraries to achieve beautiful UIs and smooth interactions. Specifically, these libraries are:

- Bootstrap: A popular frontend toolkit to develop fast and responsive websites. It has good compatibility with a variety of plugins. For example, we use Bootstrap-select plugin to create dropdown menus with multi-select support. It is also easier to use Bootstrap's predefined widgets and classes to style the whole website.
- D3.js: D3.js is an Open Source JavaScript library for producing dynamic, interactive data visualizations in web browsers. D3's integrating sophisticated visualization components with a data-driven approach to DOM manipulation.
- Highcharts: Highcharts is a software library for charting written in pure JavaScript, first released in 2009. It is based on SVG, with fallbacks to VML and canvas for old browsers.
- JQuery: A fast library for easier yet powerful manipulation of the website.
- Popper: A lightweight toolkit for positioning tooltips and popovers.

## 5. Project Structure

Our website can be viewed through this [link](#).

The whole website is organized as below:

```
. 
└── bootstrap/
    ├── assets/          #contains all processed data and
    │   └── data/         images resources/
    └── img/
```

```

├── css/           #cascading style sheet (CSS) file used
│   └── style.css  to format the contents of a webpage
├── js/            #javascript files to draw charts and do
│   └── main.js    interactions
├── index.html    #Home Page
├── renewable.html #subpage about renewable energy
├── security.html  #subpage about energy security
└── statistics.html #subpage about overall energy statistics

```

## 6. Visualizations

All our web pages have been optimized for different resolutions. Thanks to the powerful CSS styles of Bootstrap and jQuery, we are able to show our webpage and images in proper sizes. This guarantees the same viewing experience for user's whether they are using mobile devices, computers, or tablets.



Figure 1 Homepage

On the home page (Figure 1), there is a navigation bar for our four pages: Introduction, Energy Statistics, Environmental-Friendly Energy, and Energy Security. The icons provide access to our Github repository, EuroStats datasets, the process book, our milestone 1 and 2, and the D3.js website. An animated clickable arrow will lead you to the visualization below.

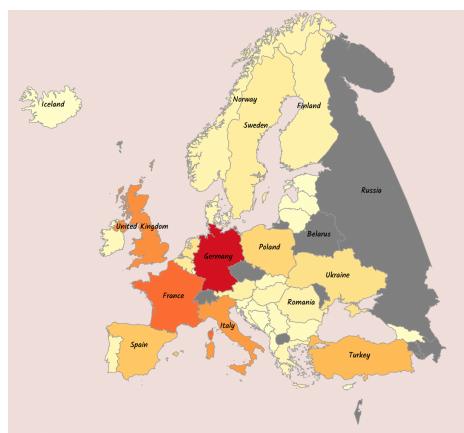


Figure 2 Map View of Overall Energy Information in Europe

The visualization on the page offers a map view of European countries (Figure 2). Hover the mouse over the country to view a summary of energy information of that country, including the final energy consumption by sector and renewable energy share. Use the slider above to select the year, and the countries on the map will be colored based on their total final energy consumption.

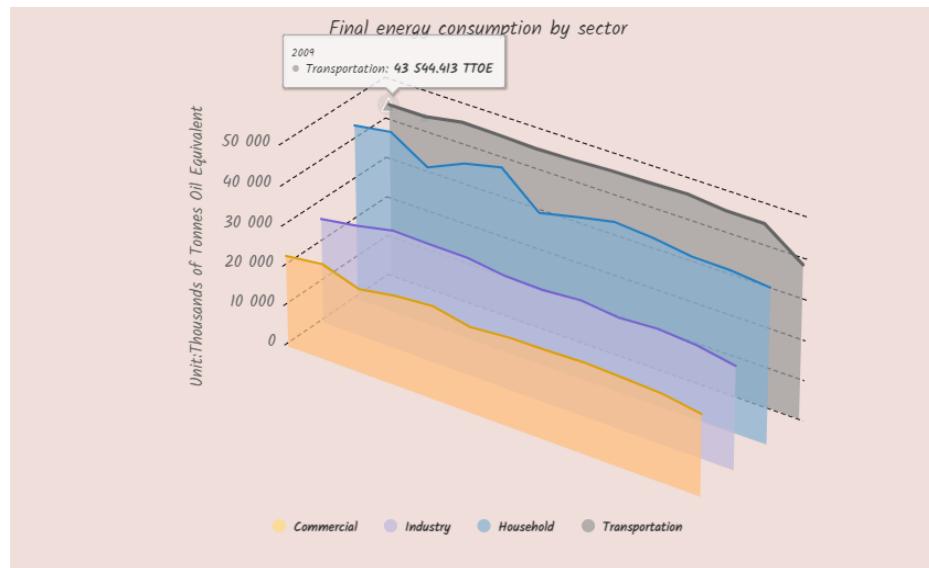
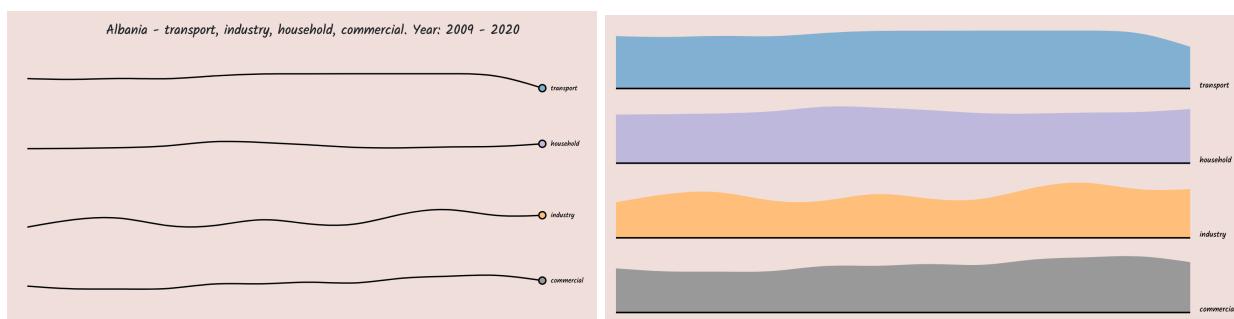


Figure 3 3d Area Graph

Figure 3 is a 3d area graph to show each country's final energy consumption graph by sector. Final energy consumption is the total energy consumed by end-users, such as households, industry, and agriculture. It is the energy that reaches the final consumer's door and excludes that which is used by the energy sector itself. It is measured in TTOE which means thousands of tons of oil equivalent.



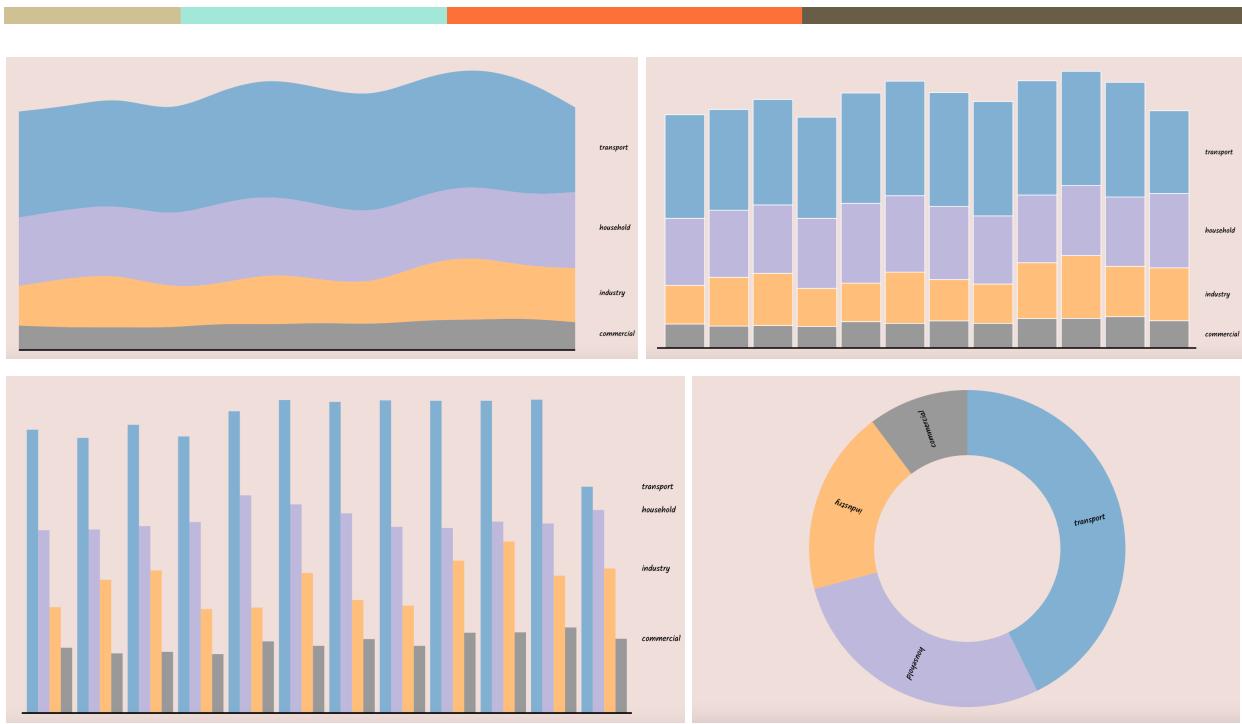


Figure 4 A set of animated diagrams

On the energy statistics page, we also provide a set of animated graphs (Figure 4) to show the final energy consumption for each sector. These graphs are displayed in a loop. Use the dropdown menu to select multiple countries and multiple sectors. Use the slider to select the year range. Then for each selected country, we will generate a separate animated graph.

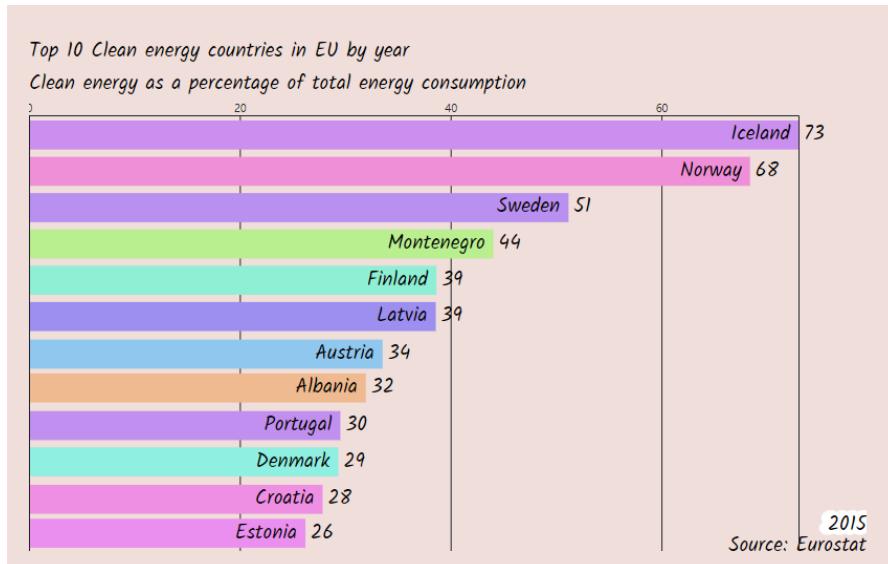


Figure 5 Race bar Graph

The race bar chart (Figure 5) is a more interactive bar chart. It shows the top 10 clean energy countries in Europe by year. The position of the bar changes with the year and ranking. The ranking is based on the share of clean energy

consumption to final energy consumption. We can see the Scandinavian countries are ahead of Europe in using clean energy.

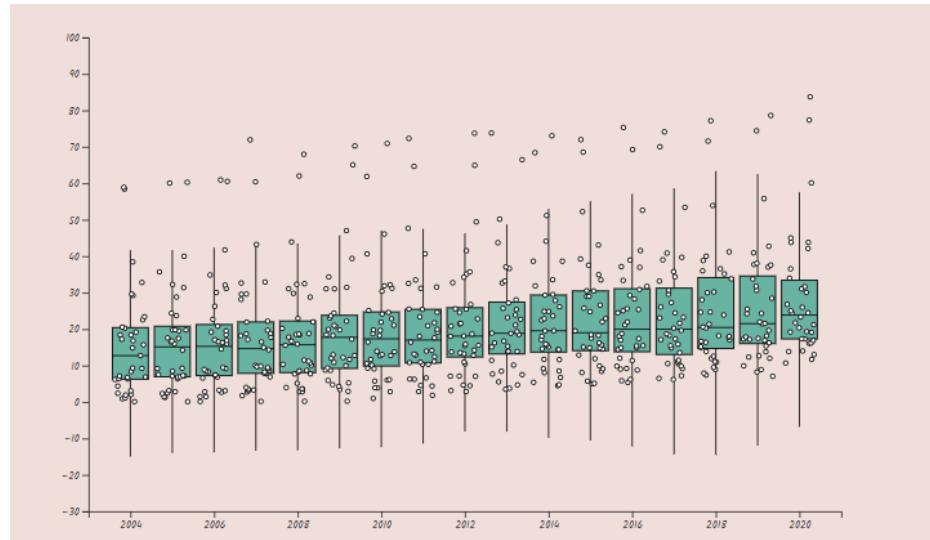


Figure 6 Box plot Graph

Boxplot is a method for graphically demonstrating the locality, spread, and skewness groups of numerical data through their quartiles. Our boxplot is shown in Figure 6. In addition to the box on a box plot, there can be lines (which are called whiskers) extending from the box indicating variability outside the upper and lower quartiles. The above graph shows the year-by-year clean energy share of the box plot. Try moving the mouse over the data point to see the country.

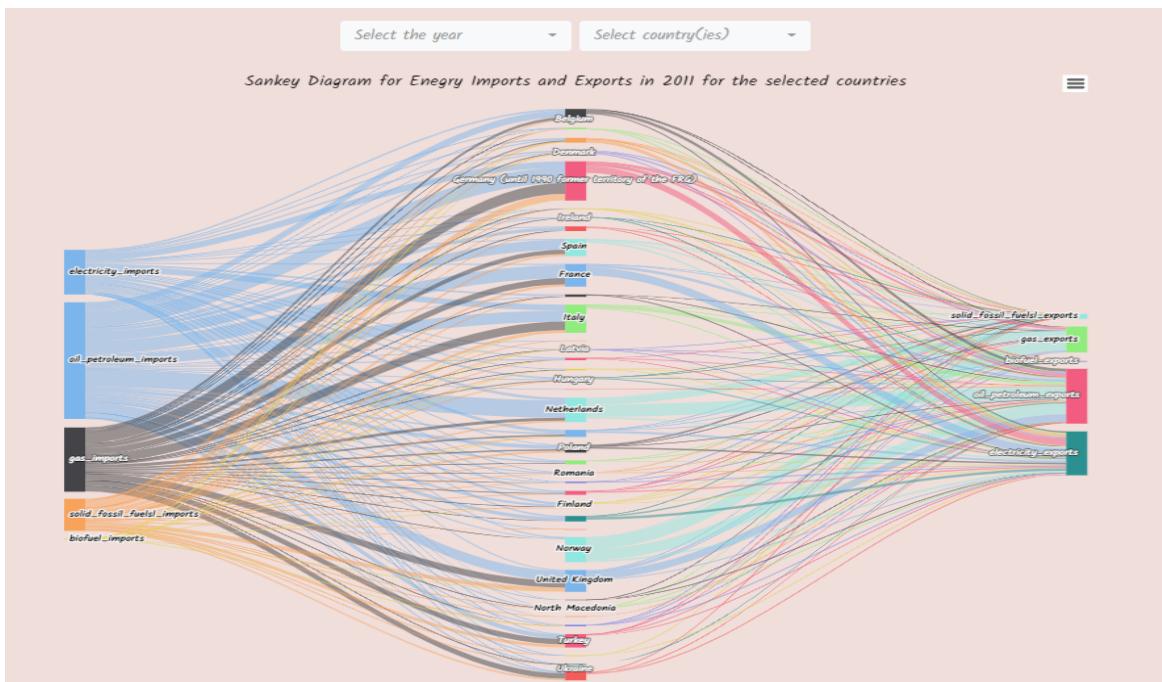


Figure 7 Sankey Graph

The Sankey chart (Figure 7) is used to visualize data flow and volume between nodes. The wider lines indicate larger volumes. This graph illustrates the import-export relationship for chosen nations during the given year. You can also choose a specific country to see the detailed import and export volume. If the energy import of a country is much larger than the export, we think there is instability in the energy security of this country.

## 7. Challenges and Design Decisions

Throughout the whole project, we have met several difficulties. The first difficulty we have is tackling the CSS styles for figures and texts. To have proper CSS files, we decided to use Bootstrap template as a starting point. It provides several CSS styles and highly customizable configurations of fonts, headers, and other settings. We reuse the same set of CSS files across all the pages to make the style consistent.

Another difficulty is preparing the data for visualization. Since the data from EuroStat is a bit messy and complicated, we first merge several files into one, then we convert them into another csv file that only contains data that we are interested in. Since we have two or more dimensions for the data, such as country and year, we decompose them into 1d tuples that each line contains all the dimension variables and the value.

## 8. Peer Assessment

Ziqi Zhao	Yixin Cheng	Boran Xu
<ul style="list-style-type: none"> <li>• Website design</li> <li>• Web app setup, Web global structure</li> <li>• Show_reel graph,</li> <li>• Sankey graph</li> <li>• Finish the process book</li> </ul>	<ul style="list-style-type: none"> <li>• Website design</li> <li>• Data Processing</li> <li>• Racing bar graph</li> <li>• 3D area graph</li> <li>• Finish the process book</li> </ul>	<ul style="list-style-type: none"> <li>• Website design</li> <li>• Map Graph</li> <li>• Boxplot Graph</li> <li>• Finish the process book</li> </ul>