# Bridging the Gender Gap in the Energy Sector: A Multidimensional Visual Analytics Dashboard

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**Abstract.** This project presents an interactive visual analytics dashboard designed to explore gender disparities in the energy sector across five European countries: Austria, France, Germany, Portugal, and Spain. Using data from the OECD/IEA LinkEED dataset, we analyze four key domains: employment, senior management, innovation and patents, and entrepreneurship. The dashboard allows users to interactively explore trends, compare countries, and identify critical patterns over time. Targeted toward policymakers, researchers, journalists, and HR professionals, the tool aims to promote awareness and support data-driven decisions to address the gender gap in energy-related fields.

## 1 Introduction

Despite increasing global attention to gender equity, the energy sector continues to exhibit persistent disparities between men and women. These inequalities span multiple dimensions, including wages, representation in leadership positions, innovation contributions, and entrepreneurial participation. Addressing these gaps is not only a matter of social justice, but also crucial for improving economic performance, innovation capacity, and institutional diversity.

However, understanding and addressing gender gaps is often hindered by fragmented data, lack of transparency, and limited accessibility of analytical tools. Decision-makers need intuitive, evidence-based tools to explore trends, compare performance across countries, and uncover underlying patterns.

In response, we developed an interactive dashboard that visualizes gender disparities across five European countries—Austria, France, Germany, Portugal, and Spain—using data from the OECD/IEA LinkEED dataset. The dashboard supports dynamic exploration across four domains: employment, senior management, innovation and patents, and entrepreneurship. Users can interactively select countries, filter by years, and investigate both high-level KPIs and detailed breakdowns.

By integrating multiple views and enabling direct interaction, our tool empowers policymakers, journalists, HR professionals, and researchers to make data-driven decisions, identify gaps, and monitor progress toward gender equality in the energy sector.

# 2 Data and Requirements Analysis

## 2.1 Dataset Description

The dashboard is powered by the OECD/IEA LinkEED matched employer–employee dataset. It contains structured, longitudinal data from five European countries: Austria, France, Germany, Portugal, and Spain. The dataset covers four major areas relevant to gender equity in the energy sector:

- **Employment:** Gender wage gaps and contract types over time.
- **Senior Management:** Representation of women in leadership roles.
- **Innovation & Patents:** Share of female inventors by technology.
- **Entrepreneurship:** Gender-diverse founders by business sector.

Each record includes the year, country, topic, specific indicator, and associated values. Pre-processing involved merging multiple CSV files, standardizing indicator labels, and removing sparse or noisy entries to ensure data consistency.

## 2.2 User Groups and Use Cases

The dashboard is designed for a wide range of stakeholders:

- **Policymakers:** To evaluate gender equity policies and track national progress.
- **HR Professionals:** To benchmark company roles against industry trends.
- **Journalists and Researchers:** To discover patterns and report data-backed findings.

## 2.3 Analytical Goals

The dashboard supports the following core goals:

- Compare gender-related metrics across countries and years.
- Monitor trends in wage gaps, leadership, innovation, and entrepreneurship.
- Identify areas with high or low female representation.
- Drill down by sector, technology, or contract type to explore underlying dynamics.

# 3 Methodology

## 3.1 Data Cleaning and Preprocessing

The original data came in four separate CSV files, each representing a different dimension: employment, innovation, entrepreneurship, and senior management. These were merged into a single dataset using a common column structure. Missing values, irrelevant records, and inconsistent indicator labels were cleaned and standardized.

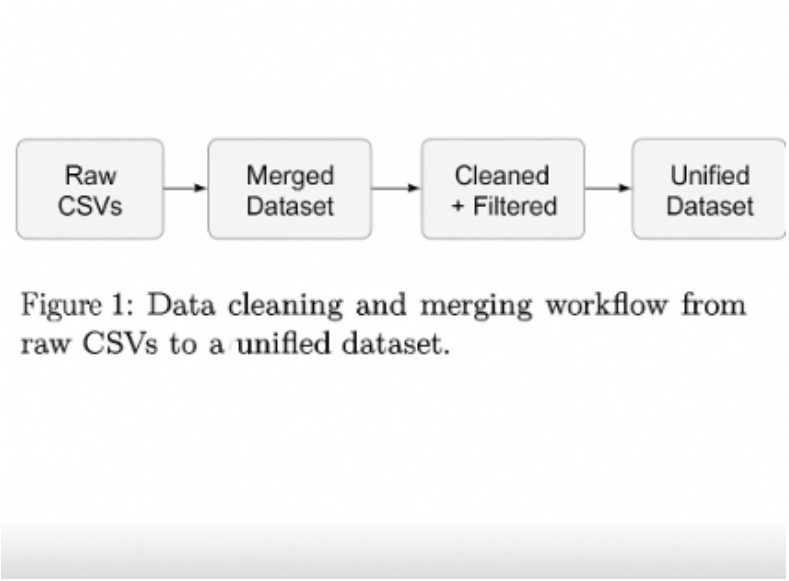


Figure 1: Data cleaning and merging workflow from raw CSVs to a unified dataset.

**Fig. 1.** Figure 1: Data cleaning and merging workflow from raw CSVs to a unified dataset.

### 3.2 Indicator Derivation and Feature Engineering

From the cleaned data, we derived key performance indicators (KPIs) used on the Overview tab:

- Average Gender Wage Gap
- Percentage of Women in Senior Roles
- Share of Female Inventors
- Percentage of Gender-Diverse Founders

### 3.3 Dashboard Layout and Interaction Design

The dashboard was implemented using the Dash framework in Python. It contains six main tabs:

- Overview
- Employment
- Senior Management
- Innovation & Patents
- Entrepreneurship
- Advanced Insights

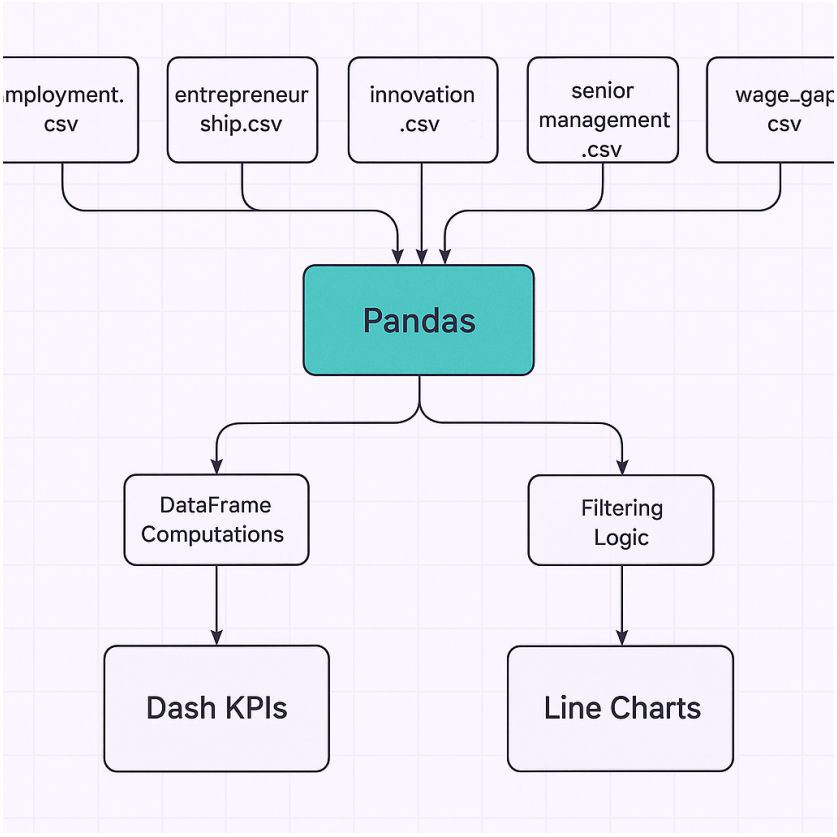


**Fig. 2.** Figure 2: Dashboard layout and tab structure showing user interaction design.

## 4 Visual Design and Interactivity

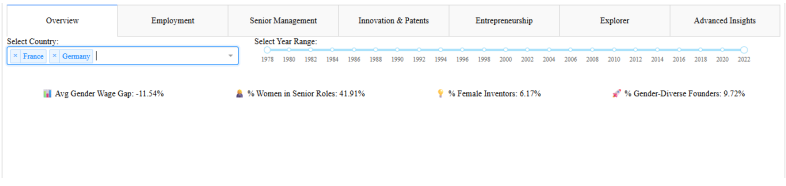


**Fig. 3.** Figure 3: Overview tab with KPI cards and country/year filter controls.

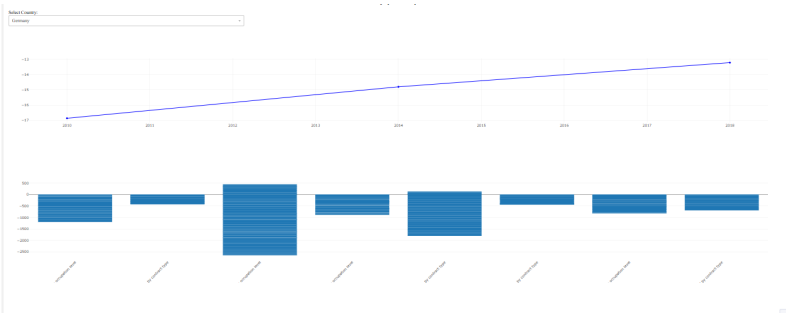

**Fig. 4.** Figure 4: Employment tab with time series (top) and employment gap breakdown (bottom).

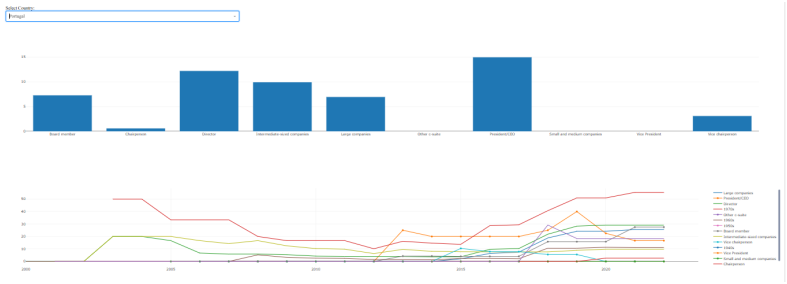

**Fig. 5.** Figure 5: Senior Management tab showing role breakdown and time evolution.

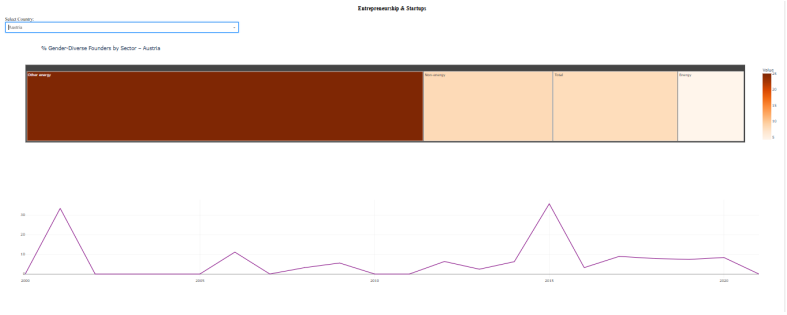


**Fig. 6.** Figure 6: Treemap showing percentage of gender-diverse founders by sector.

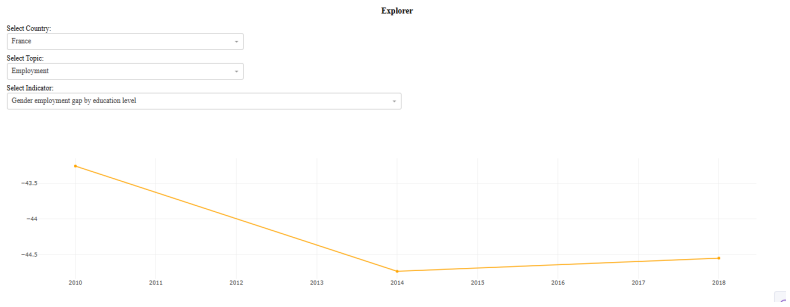


**Fig. 7.** Figure 7: Explorer tab: Fully filterable view by topic, country, and indicator.

**Fig. 8.** Figure 8: Advanced Insights tab comparing all five countries across four themes.

## 5 System Walkthrough with Screenshots

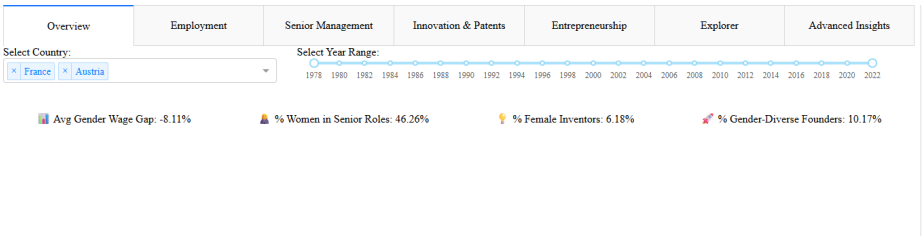


**Fig. 9.** Figure 9: The Overview tab shows KPIs for selected countries and year ranges.

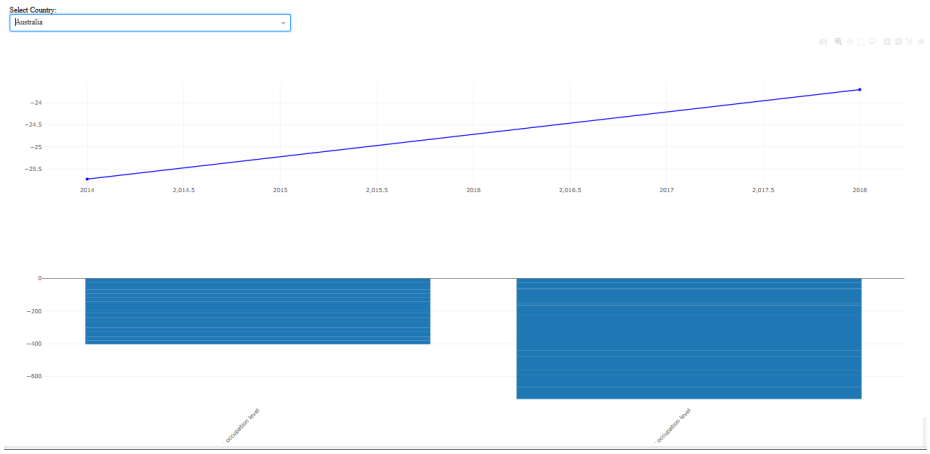


**Fig. 10.** Figure 10: The Employment tab displays wage gaps over time and by occupation type.

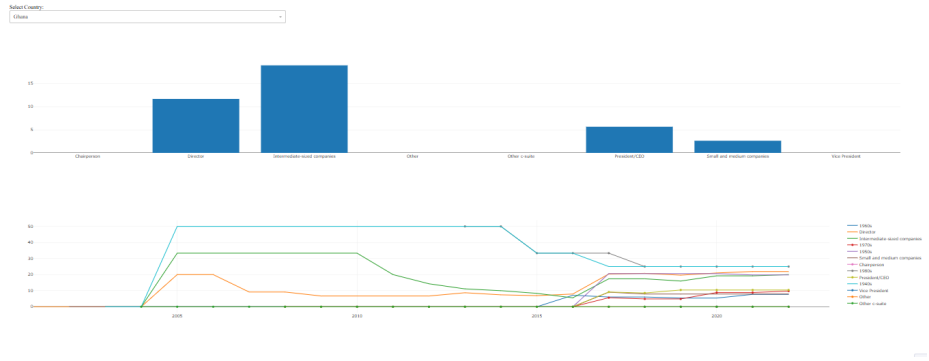


**Fig. 11.** Figure 11: The Senior Management tab shows role distribution and time evolution.

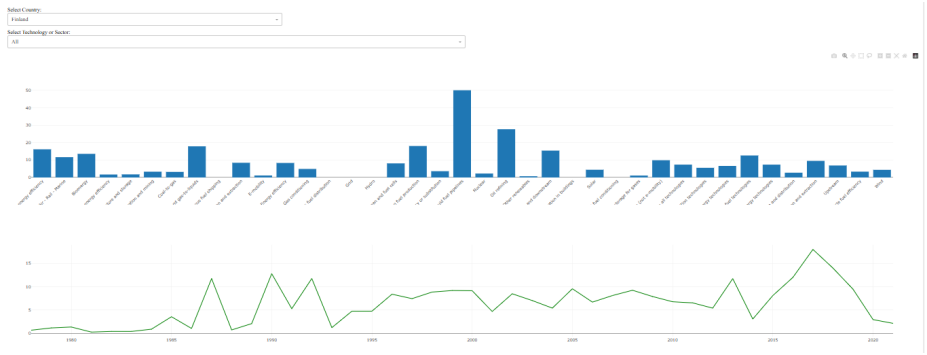

**Fig. 12.** Figure 12: The Innovation tab visualizes female inventor shares by tech sector and year.

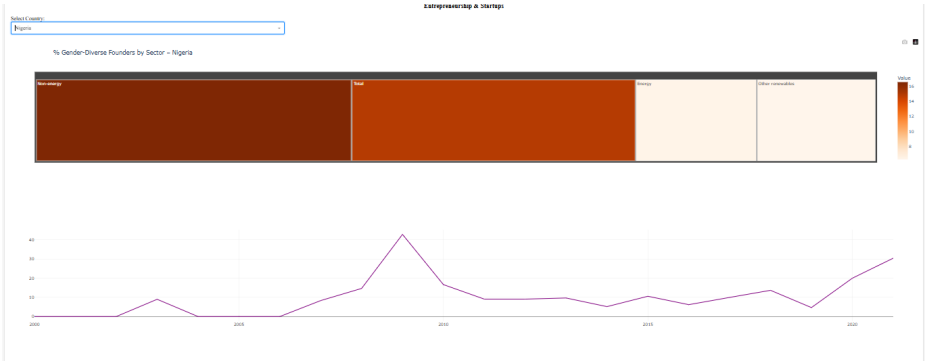

**Fig. 13.** Figure 13: The Entrepreneurship tab includes a treemap and trendline of diverse founders.

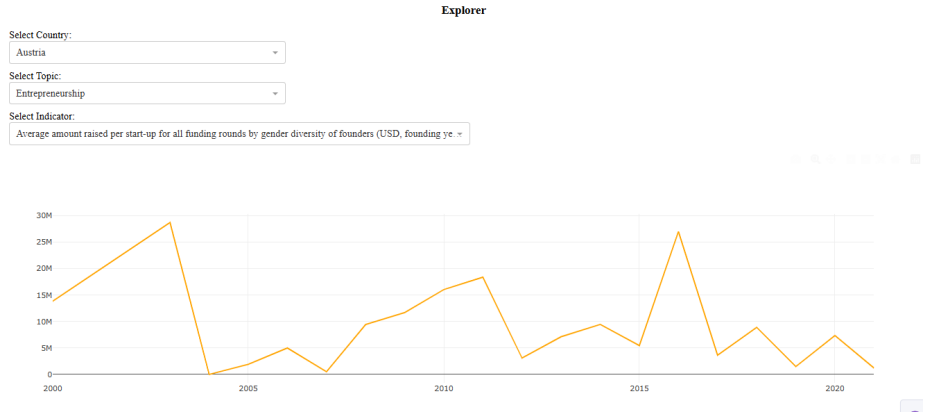


**Fig. 14.** Figure 14: The Explorer tab enables detailed indicator selection for custom trends.

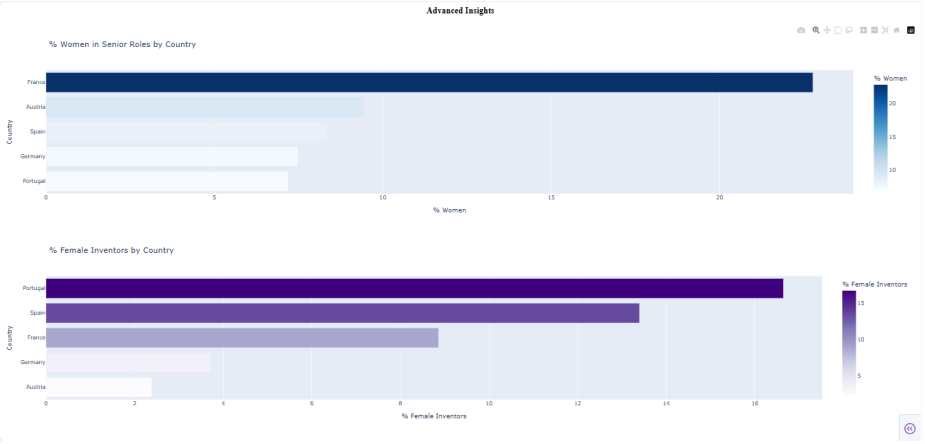


**Fig. 15.** Figure 15: The Advanced Insights tab compares countries across four major themes.

## 6 Key Findings

- **Germany has the widest gender wage gap**, with average values reaching nearly **-14.96%**.
- **Portugal leads in gender-diverse entrepreneurship**, with the highest startup diversity.
- **Female representation in innovation remains low**, around **10–15%** in all countries.

- **Senior roles remain male-dominated**, with only **20–30%** female leaders on average.
- **Progress is uneven**, with innovation and leadership showing slower change.

## 7 Discussion and Future Work

### What We Learned

- Data harmonization was essential to ensure consistency across files.
- User-centered design helped us prioritize both simplicity and insight.
- Feedback improved axis labeling and filtering for end users.

### Future Improvements

- Add comparison mode for side-by-side benchmarking.
- Enable export options for PDF and CSV.
- Integrate Sustainable Development Goal (SDG) benchmarks.
- Expand to non-European datasets for global analysis.

## 8 Conclusion

This project set out to bridge gender data with actionable insight in the energy sector. We created a dynamic dashboard covering employment, innovation, leadership, and entrepreneurship. The tool supports filtering, comparisons, and trend analysis.

By visualizing these domains in one interface, we hope to inform more inclusive policies and business strategies. Our system offers a scalable template for other social equity domains and regions.

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