



Collaborative and Reproducible Practices

Global Renewable Energy Leaders

Arisara Therdthianwong, Quanyu Qian, Dhruv
Kaushal Gal

June 2025

Table of contents

0.1 Executive summary 1

0.2 Introduction 2

1 Methodology 3

1.1 Top 10 Countries by Renewable Energy Share in 2023 3

1.2 Norway: Global Leader in 2023 3

1.3 Global Hydropower Generation by Country (2023) 4

2 Results 5

3 Discussion and Conclusion 6

Recommendations 7

3.1 References 7

3.2 Citations 7

0.1 Executive summary

This report investigates the top 10 countries with the highest renewable energy share in 2023 and global trends in energy transitions. It further analyzes the sources of renewable energy in the leading country. The analysis is conducted using reliable data from Our World in Data. Among these countries, Norway stands out as a global leader with 72.09% of its primary energy coming from renewable sources. The findings offer valuable insight to effectively implement national approaches that could transform sustainable energy transitions worldwide.

0.2 Introduction

The global energy landscape has transformed rapidly in the last few decades. Many countries are undergoing a major shift toward adopting renewable sources such as hydropower, wind, and solar in response to the challenges of climate change and resource sustainability. Renewable energy now plays an important role as an alternative source that helps to reduce reliance on fossil fuels and mitigate greenhouse gas emissions.

Throughout the report, global renewable energy trends are identified, with a focus on the top 10 countries with highest proportion of renewable energy in total energy consumption in 2023. Norway leads the way, with roughly 72% of primary energy sourced from renewable. Sweden and Brazil are also undergoing significant transitions, with 53.9% and 50.3% renewable shares, respectively.

A deeper analysis on Norway has been conducted to better understand how a developed country manages its energy infrastructure achieving a high level of renewable integration. Understanding these factors behind Norway's performance can be beneficial for planning and improving renewable energy policies and strategies that could be adapted to different regional and national contexts. This analysis aims to provide a useful insight that can guide future energy transitions globally.

1 Methodology

Building on the global patterns identified above, we used 2023 data from Our World in Data to examine national-level energy composition. Aggregated regions were excluded to identify the top 10 countries by renewable energy share.

We focused on Norway—the global leader—to explore the drivers behind its performance. This included analyzing Norway’s internal energy mix, comparing it with other major economies, and evaluating absolute hydropower output across countries.

This multi-layered analysis provides both a proportional and quantitative basis for assessing Norway’s global leadership in renewable energy.

1.1 Top 10 Countries by Renewable Energy Share in 2023

Table 1: Top 10 Countries by Renewable Energy Share (%) in 2023

Country	Code	Year	Renewables (%)
Norway	NOR	2023	72.09110
Sweden	SWE	2023	53.89018
Brazil	BRA	2023	50.33141
Denmark	DNK	2023	42.73486
New Zealand	NZL	2023	42.26695
Austria	AUT	2023	40.08019
Switzerland	CHE	2023	38.32534
Portugal	PRT	2023	36.04341
Finland	FIN	2023	35.93626
South and Central America (EI)	NA	2023	35.39018

Table 1 and Figure 1 show the top 10 countries with the highest renewable energy shares. Norway leads with over 70%, far ahead of others.

Its standout performance led us to investigate its domestic energy sources.

1.2 Norway: Global Leader in 2023

To understand Norway’s lead, we examined its 2023 electricity mix (Table 2).

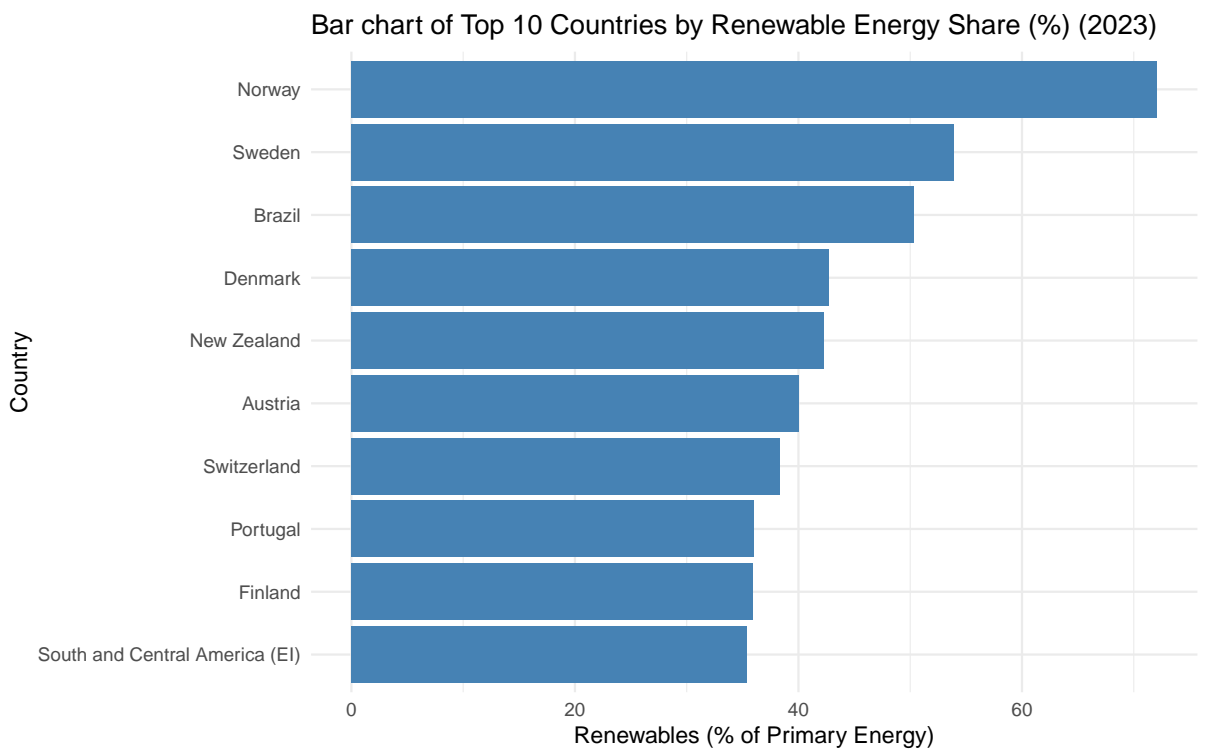
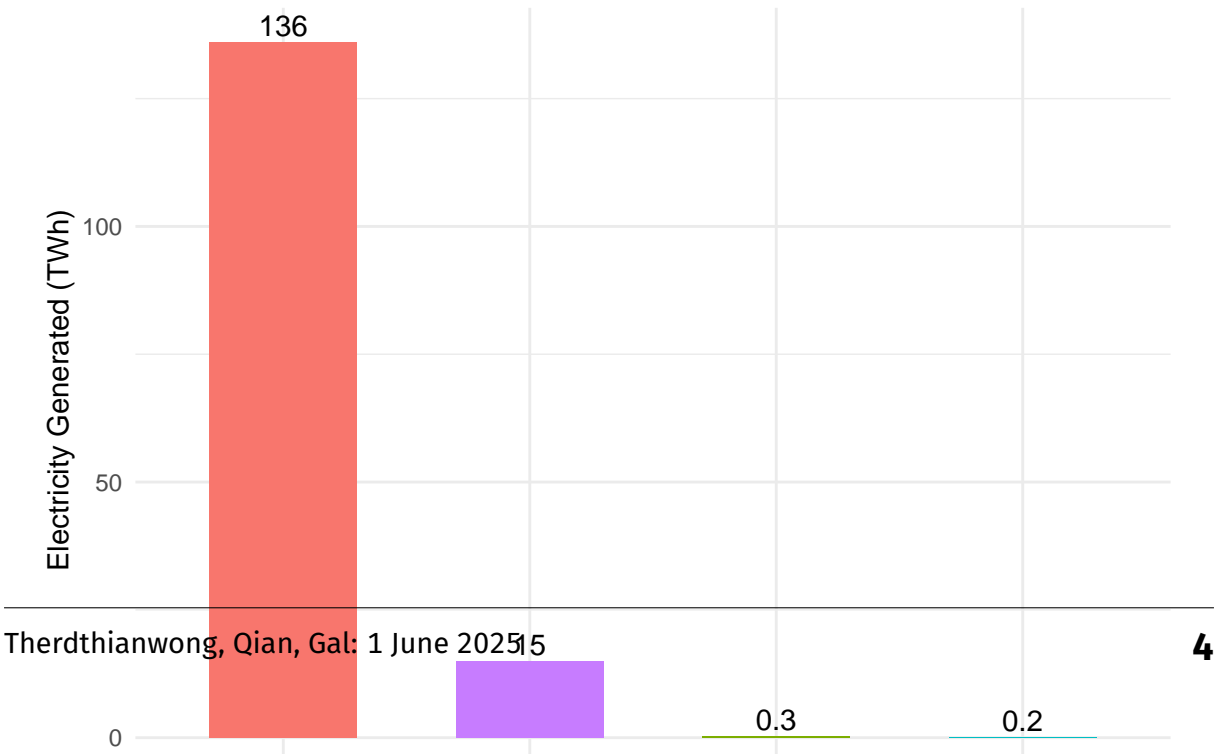


Figure 1: Bar chart of Top 10 Countries by Renewable Energy Share (%) (2023)

Table 2: Norway’s Renewable Electricity Generation by Source in 2023 (TWh)

Source	TWh
wind	14.96
hydro	135.96
solar	0.17
Other renewables including bioenergy	0.26



To determine whether its leadership is substantive, we further compared Norway’s absolute hydropower output with that of other major economies.

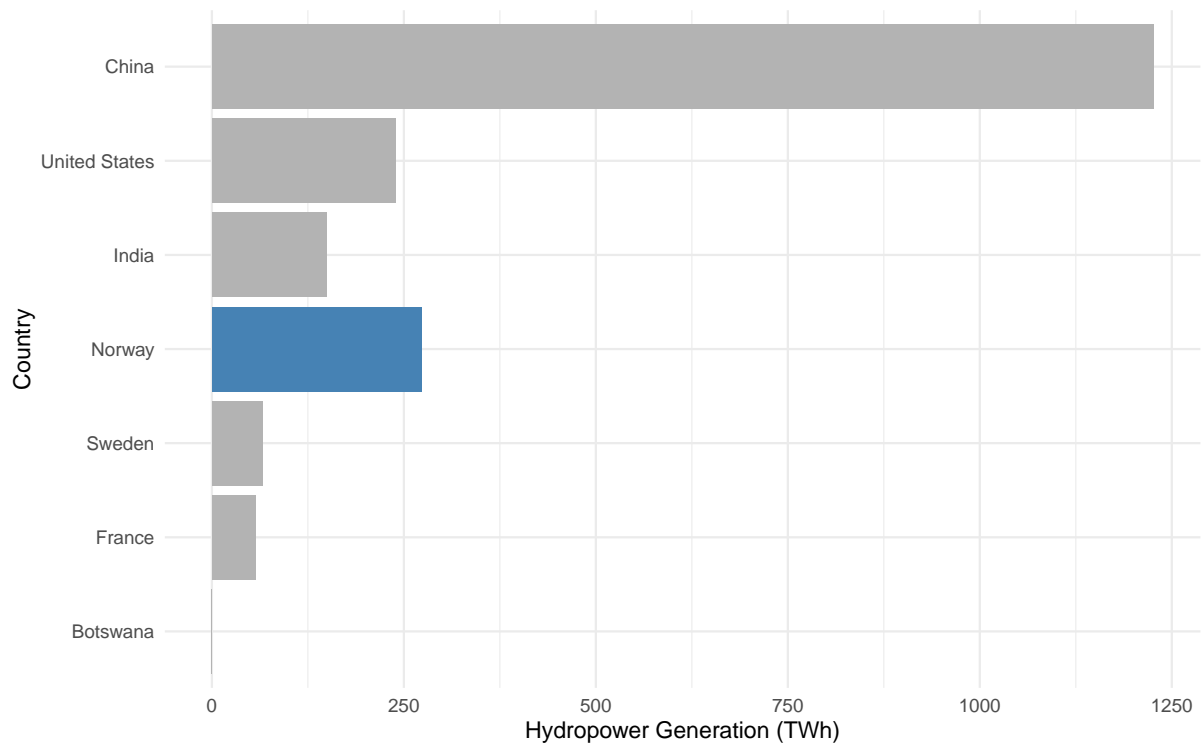


Figure 3: *Global Hydropower Generation (TWh) in 2023 by Country*

Figure 3 shows that in 2023, Norway generated 270 TWh—exceeding the U.S. (239 TWh) and India (149 TWh), despite its significantly smaller population and land area.

This demonstrates that Norway’s leadership in renewable energy is not just based on proportional share, but is firmly supported by substantial infrastructure and high absolute output in clean energy production.

2 Results

The analysis revealed that in 2023, Norway led globally in renewable energy adoption, with 72.09% of its primary energy coming from renewable sources, as shown in Table 1. Sweden (53.9%) and Brazil (50.3%) followed closely, highlighting strong national commitments to clean energy transitions.

Figure 1 visualizes these rankings, with Norway’s share standing distinctly above the rest of the top 10. This outperformance reflects long-term national investments and natural hydroelectric potential.

To understand this further, Table 2 and Figure 2 show that Norway’s 2023 electricity mix was over 90% hydropower, supported by modest wind output and minimal solar and bioenergy contributions.

Crucially, Figure 4 illustrates that Norway's leadership is not new—it has maintained a renewable share above 60% for over two decades. This trend reinforces the country's sustained commitment to renewable development through stable policy, investment, and infrastructure planning.

Overall, these results demonstrate that top-performing countries combine favorable geography with long-term national strategies. Norway exemplifies how consistent planning and natural resource optimization can produce a globally leading clean energy profile.

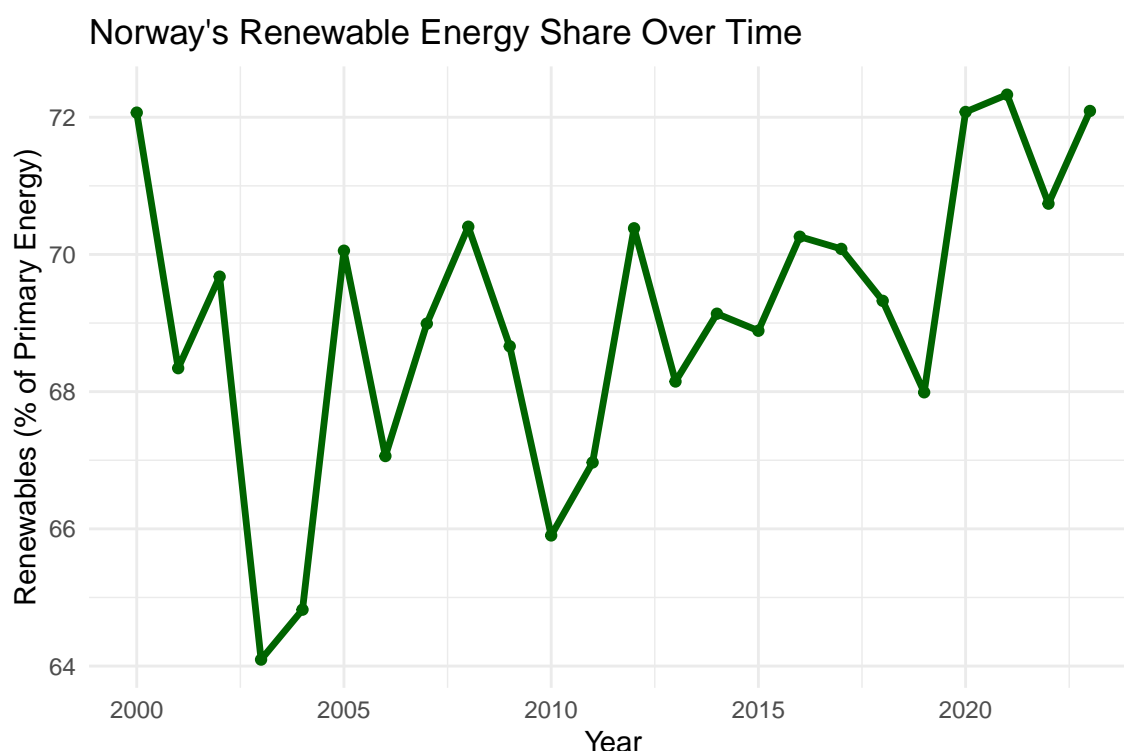


Figure 4: *Norway's Renewable Energy Share (2000–2023)*

3 Discussion and Conclusion

Norway's top ranking in renewable energy share is not incidental—it reflects decades of strategic investment in hydroelectric infrastructure, supported by favorable geography and a stable policy environment. The country's energy profile, dominated by hydropower, illustrates how natural endowments can be effectively leveraged to transition away from fossil fuels.

However, this reliance on a single dominant source introduces potential vulnerabilities. Climate variability, such as droughts or shifting precipitation patterns, could significantly impact hydroelectric generation. Furthermore, despite its leadership, Norway's use of wind, solar, and bioenergy remains minimal, indicating untapped potential for diversification.

The global comparison in hydropower generation reinforces Norway's substantial absolute output relative to its size. This combination of high renewable share and high volume is rare among countries and highlights the effectiveness of long-term, resource-aligned energy planning.

In conclusion, Norway's case exemplifies how geographic advantages, when matched with consistent national policy and infrastructure investment, can result in world-leading performance in renewable energy integration.

Recommendations

- *Diversify energy sources:* Invest in wind and solar to reduce overreliance on hydropower.
- *Modernize energy infrastructure:* Improve grid flexibility to integrate more variable renewables.
- *Export expertise:* Share Norway's policy, regulatory, and engineering frameworks with other nations.
- *Support adaptive policy:* Prepare for climate risks by developing redundancy and storage solutions.

3.1 References

Our World in Data. (2024). Renewable energy data explorer. Retrieved from <https://ourworldindata.org/renewable-energy>

Our World in Data. (2024). Hydropower generation by country. Retrieved from <https://ourworldindata.org/grapher/hydropower-consumption>

3.2 Citations

Library readr - Wickham H, Hester J, Bryan J (2024). *readr: Read Rectangular Text Data*. R package version 2.1.5, <https://github.com/tidyverse/readr>, <https://readr.tidyverse.org>.

Library Tidyverse - Wickham H, Averick M, Bryan J, Chang W, McGowan LD, François R, Golemund G, Hayes A, Henry L, Hester J, Kuhn M, Pedersen TL, Miller E, Bache SM, Müller K, Ooms J, Robinson D, Seidel DP, Spinu V, Takahashi K, Vaughan D, Wilke C, Woo K, Yutani H (2019). "Welcome to the tidyverse." *Journal of Open Source Software*, 4(43), 1686. doi:10.21105/joss.01686 <https://doi.org/10.21105/joss.01686>.

Library Knitr - Xie Y (2025). *knitr: A General-Purpose Package for Dynamic Report Generation in R*. R package version 1.50, <https://yihui.org/knitr/>.