

Renewable Energy Deployment Analysis

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Introduction & Motivations:

Research Question: *How do renewable electricity shares vary across countries of differing income levels, and how have these patterns shifted between 2000 and 2024, with particular attention to trends following the 2015 Paris Agreement?*

Why Study Post-Paris Renewable Energy Deployment?

- Global electricity demand is **rising**
- Renewable energy crucial for **climate mitigation**
- **Income** and **technology** influence adoption rates
- Impact of **international policy** on energy adoption

PARIS CLIMATE AGREEMENT



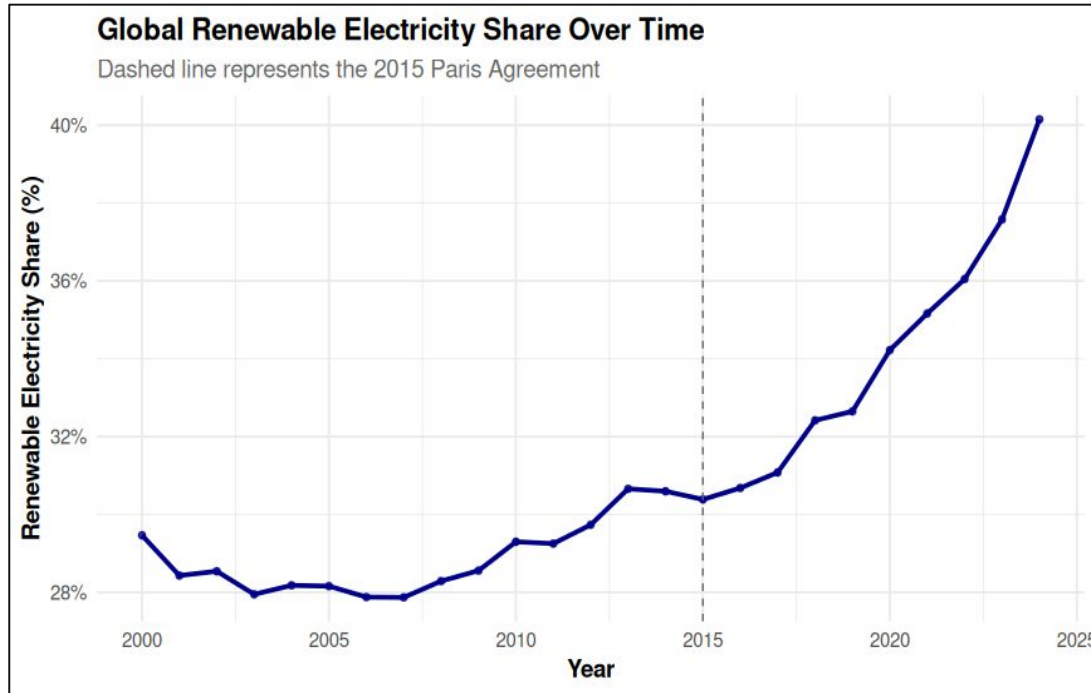
In 2015, 196 nations signed the Paris Agreement, committing to limit global warming. **But has that commitment shown up in the data?**

Our World in Data (OWID) – Energy Dataset

Source: Our World in Data (Oxford), compiled from the Energy Institute, U.S. EIA, and Ember

<u>Unit of Observation</u>	7,454 rows after filtering to 2000–2024
<u>Key Variables</u>	Renewable electricity share, consumption by source (solar, wind, hydro, biofuel, GHG emissions, GDP per capita, population
<u>Income Classification</u>	GDP per capita thresholds: Low ≤ \$1,135 · Lower-Middle ≤ \$4,495 · Upper-Middle ≤ \$13,935 · High > \$13,935
<u>Data Decisions</u>	Filtered to 2000–2024 to reduce missingness and focus on modern energy transition. No Individual-level data, entirely aggregated at the national level. *Note: lower-income nations may have less reliable energy reporting infrastructure, potentially introducing measurement bias .

EDA Analysis: Global Renewable Electricity Share Over Time



Main Takeaways:

- 1) Renewables grew from **~27%** → **~40%** (2000 - 2024)
- 2) Post-2015, we see a **sharp rise** → international climate commitments + decreasing technology costs

EDA Analysis: Renewable Electricity Adoption by Income Level (2000 - 2024)

1

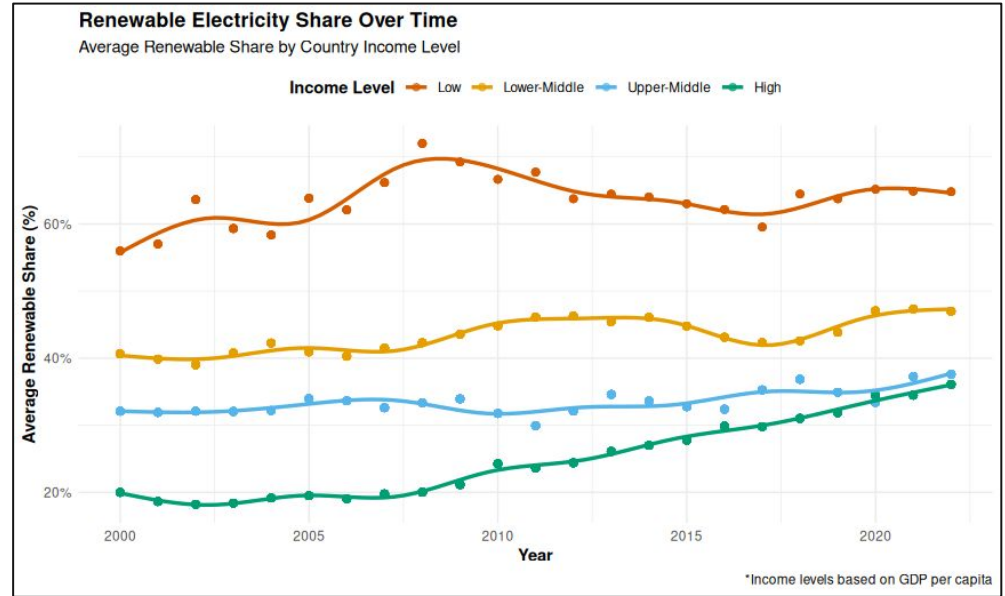
Low-income countries: **highest** overall renewables share, mainly from **traditional** sources

2

Middle-income countries: relatively stable around the **30-40%** with minimal fluctuations

3

High-income countries: start lower but show **steady growth**; ~18% in 2000 → **36%** in 2024

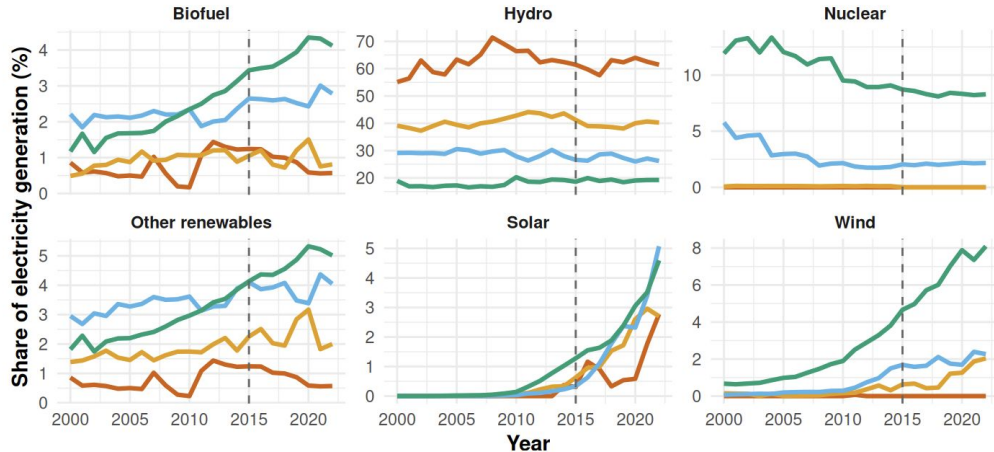


EDA Analysis: Types of Renewables Used by Income Level

Share of electricity from individual renewable sources by income level

Average across countries | Dashed line marks 2015 Paris Agreement

Income level — Low — Lower-Middle — Upper-Middle — High



Low/Lower-Middle: **hydropower** as primary source (traditional)

Upper-Middle: growth in **solar** and **wind** energies (modern)

High: Rapid increase in solar and wind (especially after **2015**)

Nuclear declines slightly in **high-income** countries

EDA Analysis: Global Energy Mix Transition in Fossil Fuels vs. Renewables

1

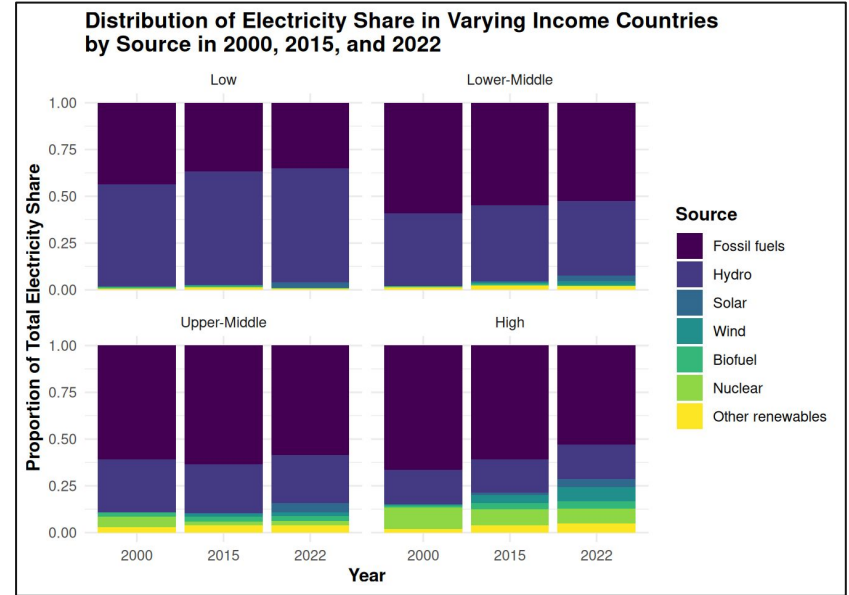
Fossil fuels **dominate** overall: especially in upper-middle and high-income countries

2

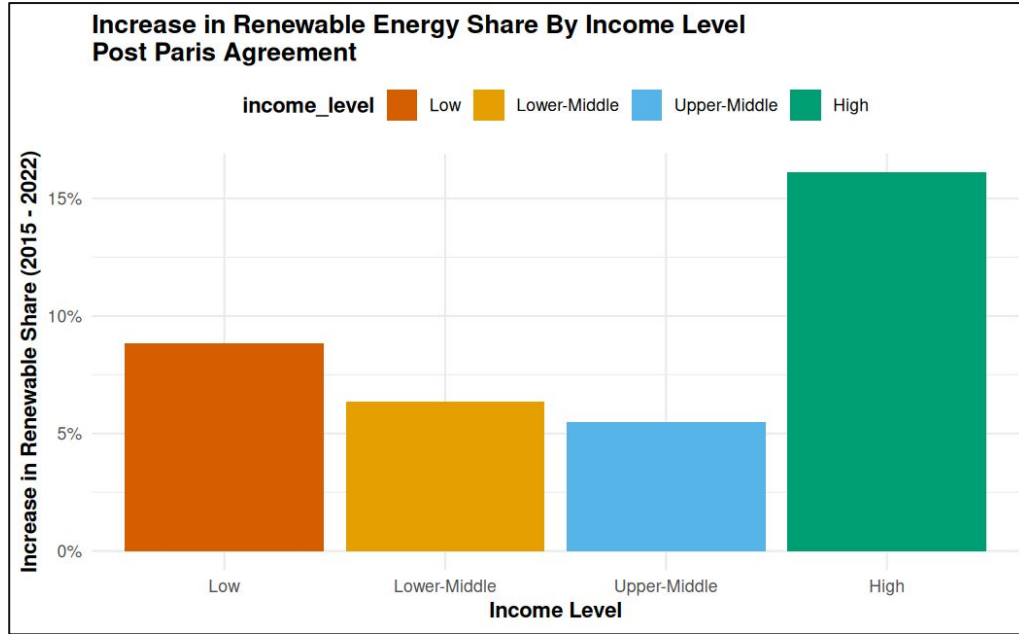
Renewables are growing unevenly: ex. **little change** beyond **hydro**; fluctuations in **nuclear**

3

High-income countries are **diversifying** and **reducing** reliance on fossil fuels



EDA Analysis: Percent Renewable Increase



Post Paris Agreement:

Largest increase: High Income
Low Income
Lower-Middle

Smallest increase: Upper-Middle

Reasoning:

Visualize the difference in increase in renewable shares by income bracket following the Paris Agreement.

Conclusions, Limitations, and Future Discussion

Conclusions:

- 1) Global renewable electricity share has steadily **increased** from 2000 to 2024
- 2) Renewable energy adoption **varies** significantly by **income level**
- 3) **Policy** and economic factors accelerate energy transitions

Limitations:

- 1) Cannot prove **causality**: Post-2015 changes may have confounding variables
- 2) **Incomplete** data: low-income countries may underreport energy use
- 3) Averages hides variability: cannot compare **country-specific** trends

Future Discussion:

- 1) Look into barriers to energy adoption: examine how **financing, infrastructure, and policymaking** affect **modern** renewable energy uptake in **lower-income countries**
- 2) Future work could investigate how prioritizing solar and wind expansion could maximize **greenhouse gas reduction** per unit of investment → identify countries where modern renewables would have largest **climate impact**

Thank You

