

RENEWABLE ENERGY DYNAMICS IN NORTH AMERICA (1965-2024)

A DATA-DRIVEN ANALYSIS OF RENEWABLE PRODUCTION, CONSUMPTION, AND INSTALLED CAPACITY USING THE ENERGY INSTITUTE'S STATISTICAL REVIEW OF WORLD ENERGY 2024

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Data Source: Energy Institute – Statistical Review of World Energy 2025



INTRODUCTION

The global energy landscape has undergone a profound transformation over the past six decades. The increasing urgency to reduce greenhouse gas emissions has driven a significant shift toward renewable energy sources such as solar, wind, hydro, and bioenergy.

This project focuses on understanding how this transformation has evolved across North America (the United States, Canada, and Mexico) between 1965 and 2024, highlighting patterns in generation, consumption, and installed capacity.

The goal is to provide a clear and data-driven perspective of the energy transition in one of the world's most economically and technologically developed regions.





METHODOLOGY

The analysis is based on data extracted from the Energy Institute's Statistical Review of World Energy (2025), using the "ALL data" workbook that consolidates historical information for over 100 countries.

The data preparation involved the following steps:

- Filtering: Selecting only the sheets related to renewable sources — solar, wind, hydro, biomass, biofuels, and geothermal — under the categories of generation, consumption, and installed capacity.
- Regional focus: Retaining only data from North American countries (United States, Canada, and Mexico).
- Standardization: Converting units and ensuring consistency across the datasets:
 - Generation measured in TWh and PJ
 - Consumption in EJ and PJ
 - Installed capacity in MW
- Data cleaning: Removing duplicates, harmonizing country names, and transposing tables where necessary.
- Visualization: Developing interactive dashboards in Power BI, allowing year-based filtering and comparative analysis between countries and energy sources.



GLOBAL RENEWABLE OVERVIEW (1965-2024)

Objective:

To provide a macro perspective of renewable energy generation trends across the world from 1960 to 2024.

Description:

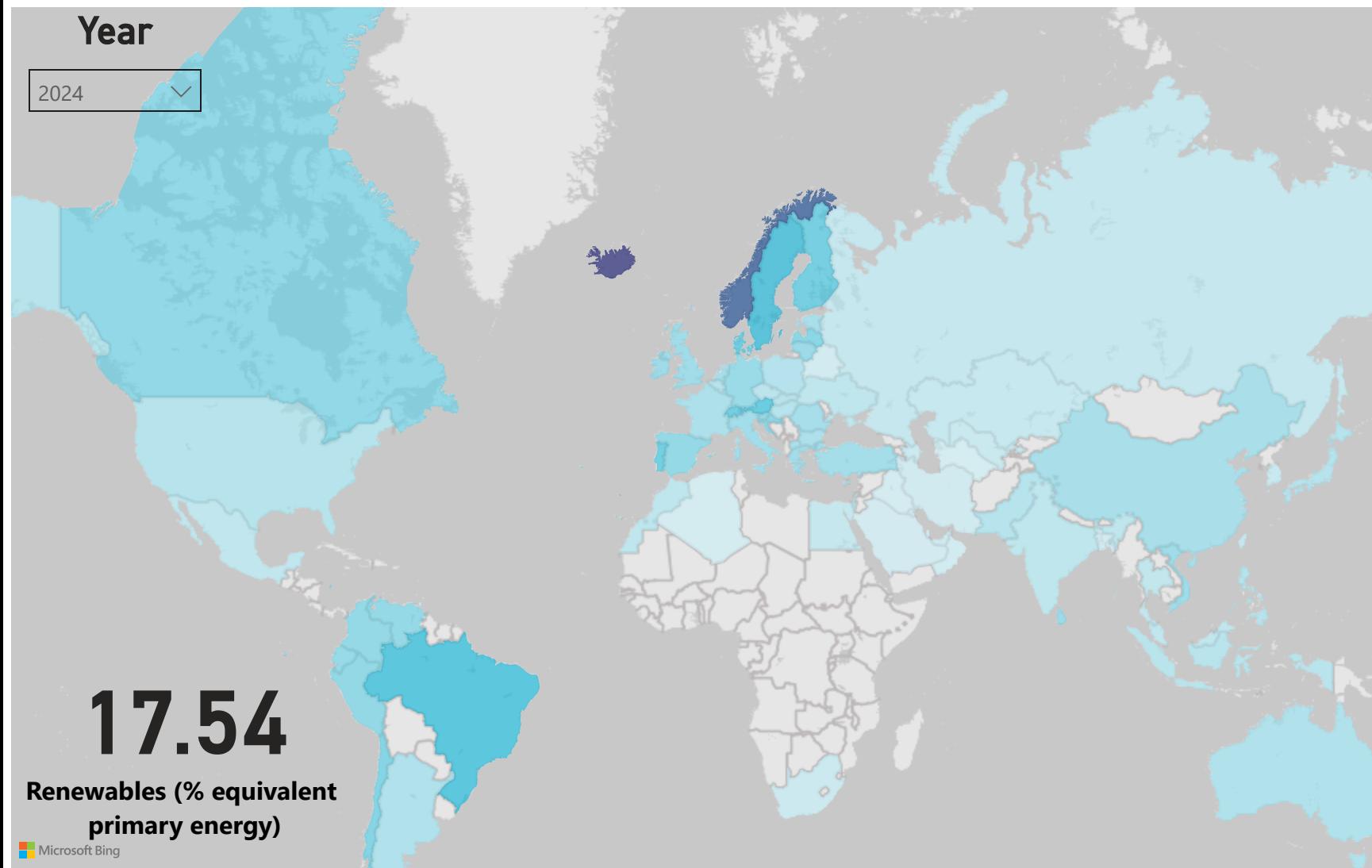
The dashboard contains a choropleth map displaying the geographical distribution of total renewable generation per year and a treemap showing the proportional contribution of each source.

Key Insights:

- Global renewable generation has grown exponentially since 2000.
- North America, Europe, and Asia are the main contributors to global clean energy output.
- The visualization allows users to select specific years to observe regional changes and global energy shifts.

Global Renewable Energy Consumption (1965–2024)

Measured as a percentage of primary energy. Renewables include hydropower, solar, wind, geothermal, bioenergy, wave, and tidal, but not traditional biofuels.



Renewables by country (% equivalent primary energy)

Iceland	Norway	Sweden	Brazil	Other...	Aust...			
New Z...	Denm...	Switz...	Portu...	Other...	Finland	Sout...		
South a...	Peru	Col...	Sp...	Ve...	Ec...	Slo...	Ot...	Ge...
Chile	Lithuania	Italy	Tu...	Ot...	Ro...	O...	N...	Es...
Eastern ...	Sri Lanka	Europe	O...	W...	Ar...	A...	A...	L...
Middle ...	Europe...	China	Non-...					
Latvia	Europe...	Uppe...	High...					
Croatia	Ireland	OEC...	Nort...					
Central ...	Vietnam	France	Nort...	Af...				
Canada	United ...	Bulg...	Poland	Af...				
	Greece	Nort...	Asia	In...				
			Philippines	M...				



RENEWABLE ENERGY PRODUCTION IN NORTH AMERICA (1965–2024)

Objective:

To analyze the total renewable energy production of the United States, Canada, and Mexico by source.

Description:

This section focuses on generation in TWh, segmented by solar, wind, hydro, biomass, and biofuels.

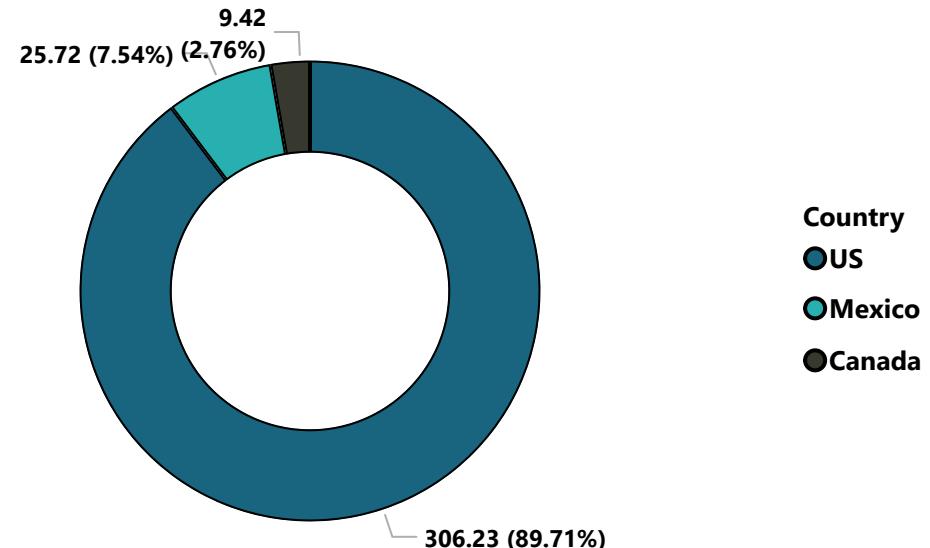
Each page includes a time series graph showing long-term trends and a ring chart illustrating each country's share in 2024.

Key Insights:

- The United States leads regional production, contributing more than 80% of total renewable generation.
- Hydroelectric power dominated until the early 2000s, after which wind and solar began to grow rapidly.
- Canada maintains strong hydroelectric generation, while Mexico shows recent growth in solar and bioenergy sectors.

SOLAR AND WIND POWER GENERATION IN NORTH AMERICA 1965-2024

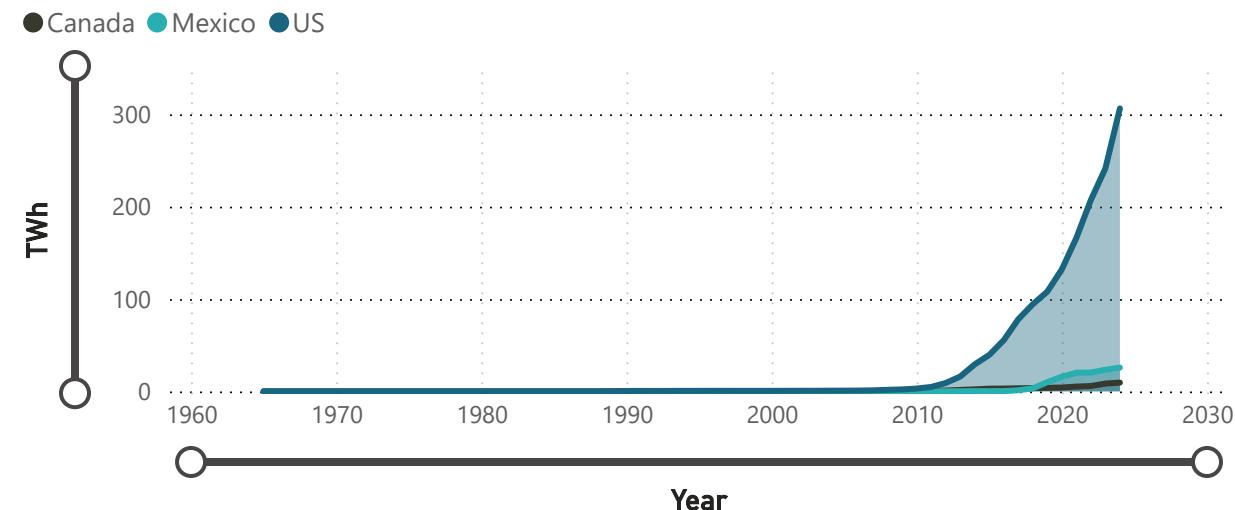
Total energy production by source TWh - North America 2024



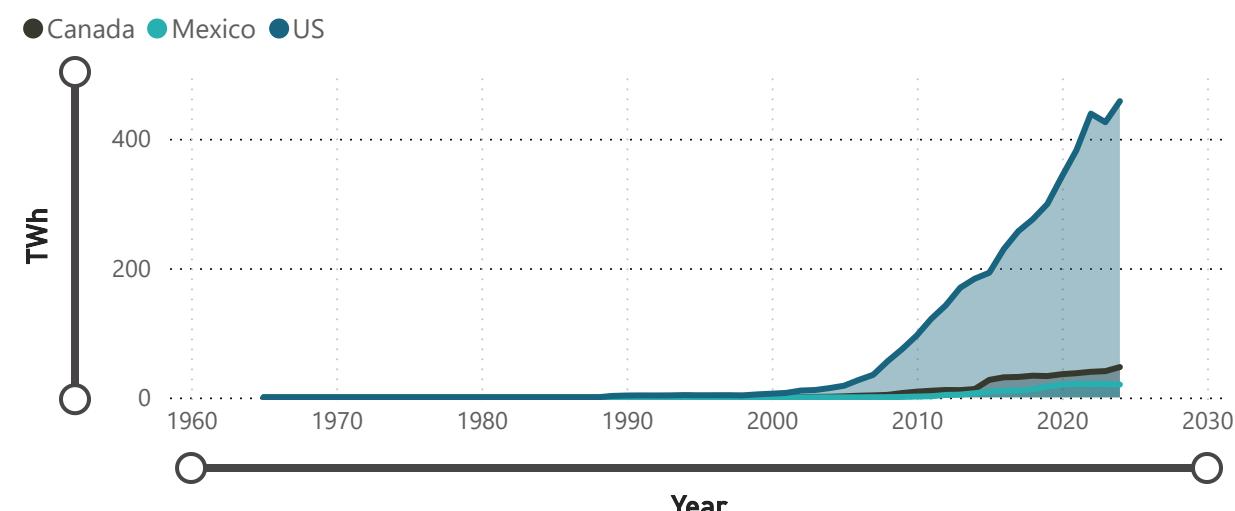
Solar2024

Wind2024

Solar power generation TWh - North America (1965-2024)

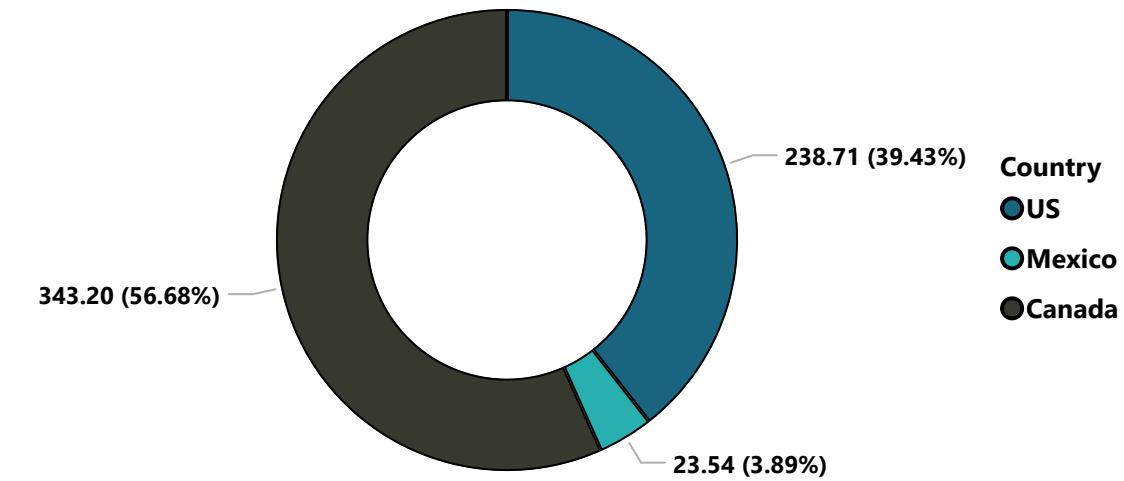


Wind power generation TWh - North America (1965-2024)



HYDROELECTRIC, GEOTHERMAL, BIOMASS AND OTHER ENERGY PRODUCTION IN NORTH AMERICA 1965-2024

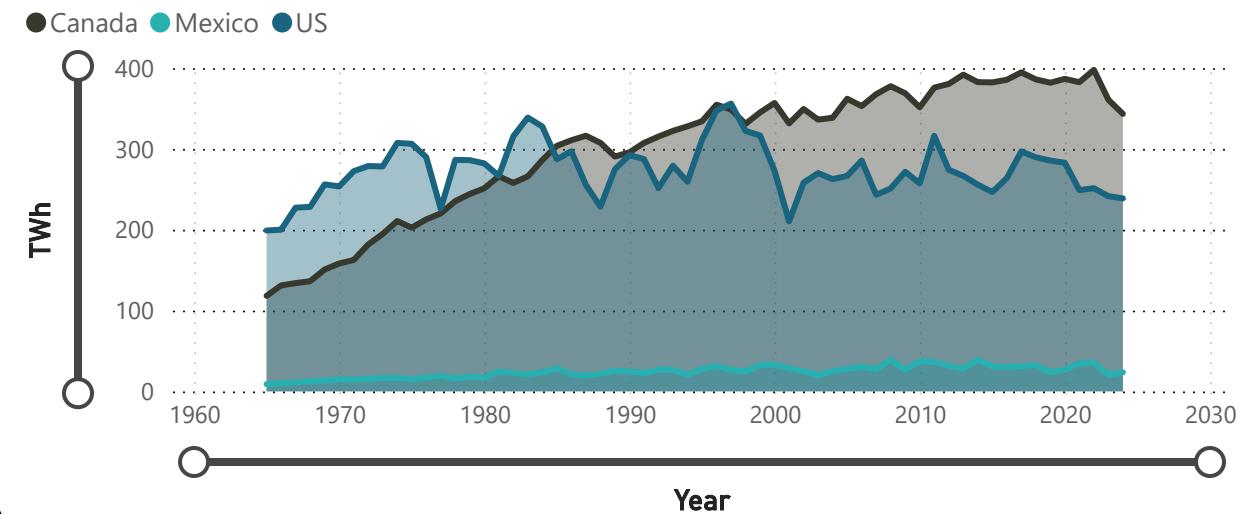
Total energy production by source TWh - North America 2024



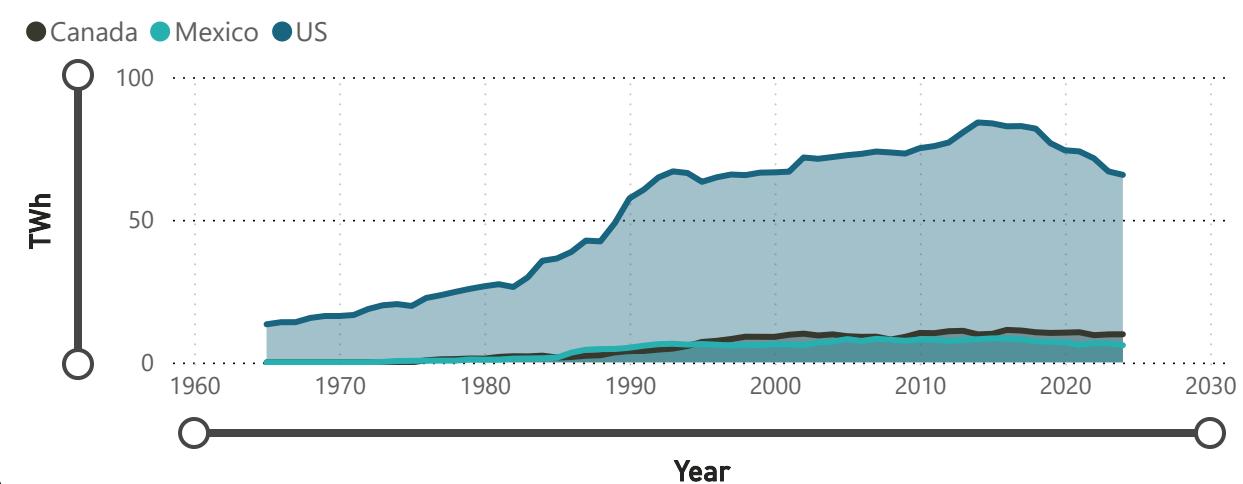
Hydro2024

Other renewables2024

Hydro power generation TWh - North America (1965-2024)

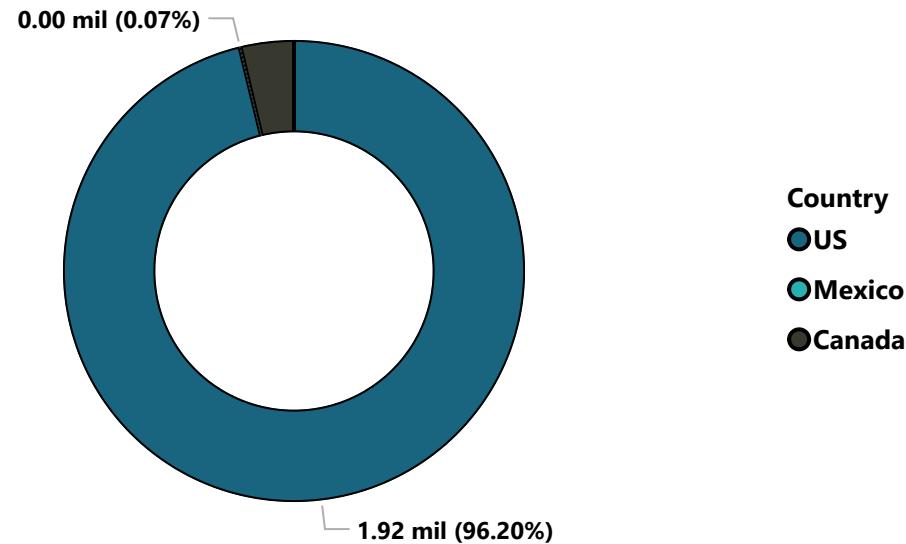


Geothermal, biomass and other power generation TWh - North America (1965-2024)

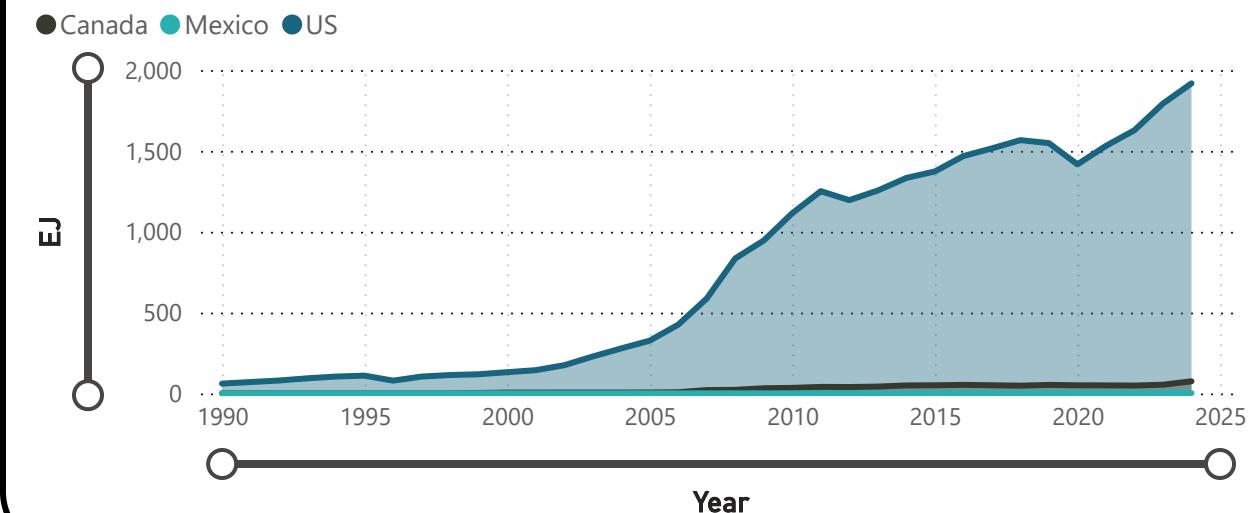


BIOFUELS POWER GENERATION IN NORTH AMERICA 1990-2024

Total energy production by source PJ - North America 2024



Biofuels power production PJ - North America (1990-2024)





RENEWABLE ENERGY CONSUMPTION IN NORTH AMERICA (1965-2024)

Objective:

To evaluate renewable energy consumption across North America and its evolution over time.

Description:

Consumption data is measured in Exajoules (EJ), providing an aggregated view of renewable energy use by country and source.

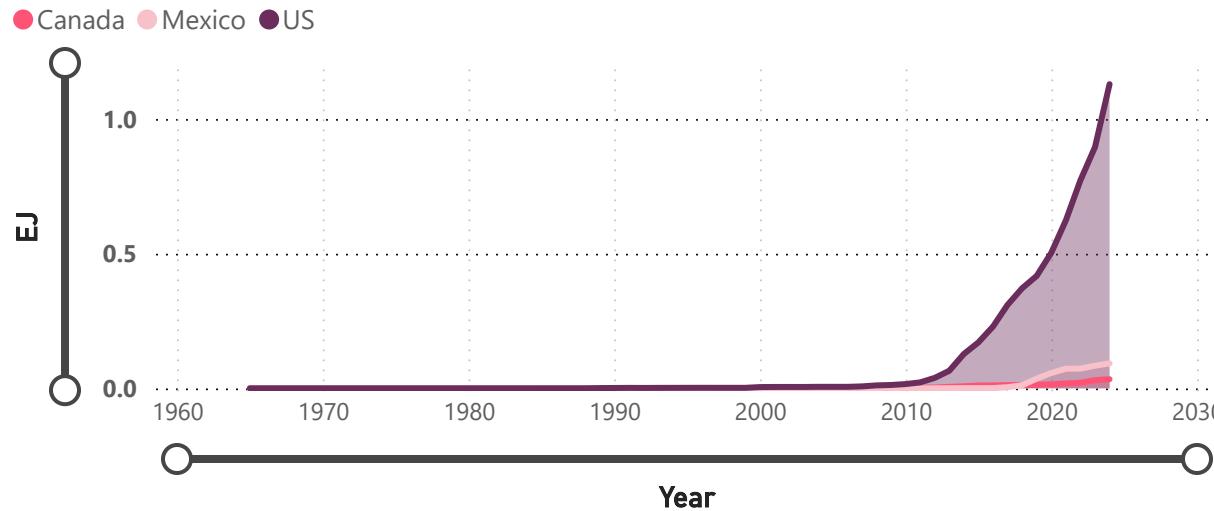
Visualizations include time series by country and share rings for 2024.

Key Insights:

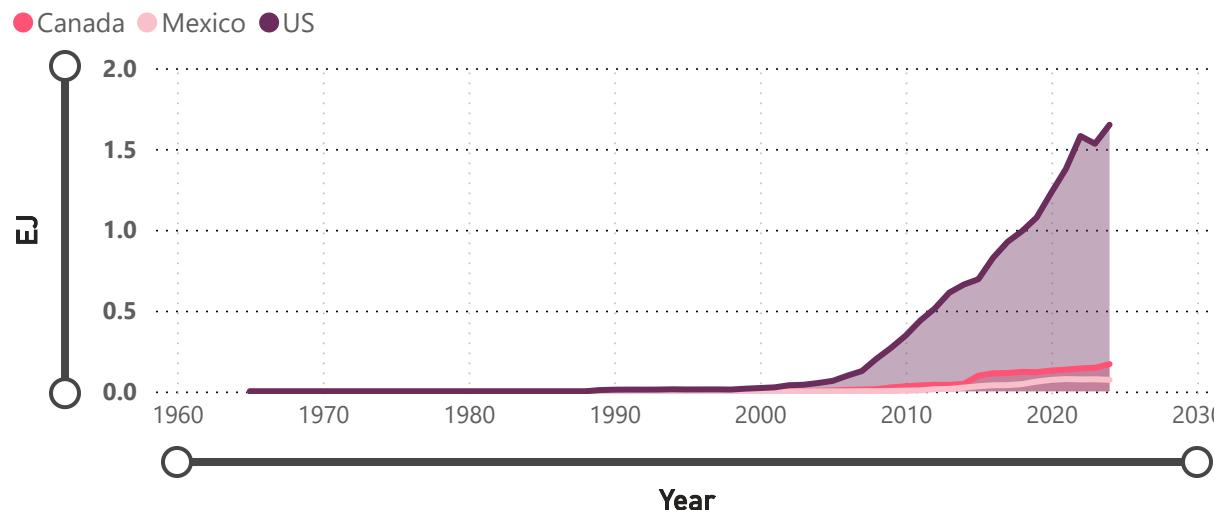
- The United States displays the largest renewable energy consumption, reflecting its large-scale integration of renewables into the grid.
- Canada's consumption is stable, sustained by hydropower as the primary renewable source.
- Mexico has shown steady growth, primarily through the expansion of solar and biofuel consumption, in the last decade.
- Consumption patterns correlate strongly with policy incentives and national energy targets.

SOLAR AND WIND POWER CONSUMPTION IN NORTH AMERICA 1965-2024

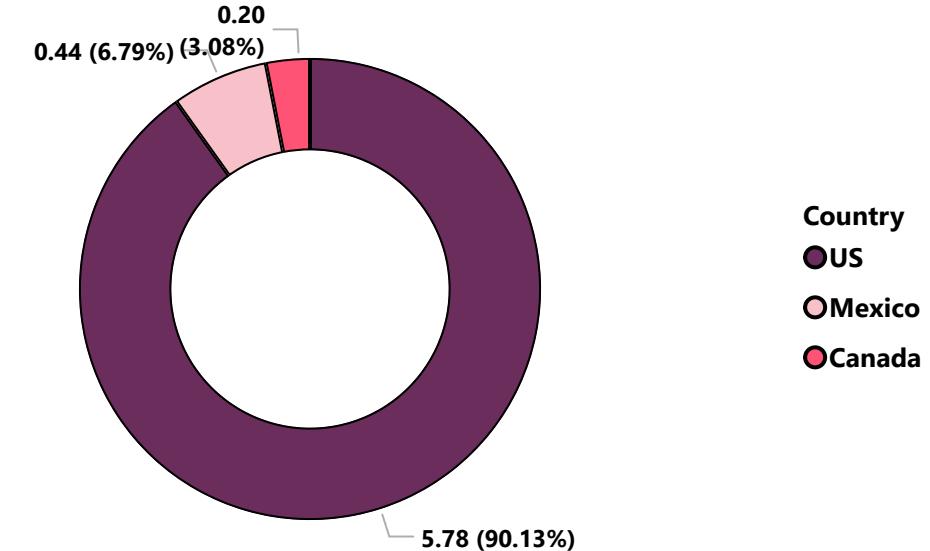
Solar power consumption EJ - North America (1965-2024)



Wind power consumption EJ - North America (1965-2024)



Total energy consumption by source EJ - North America 2024

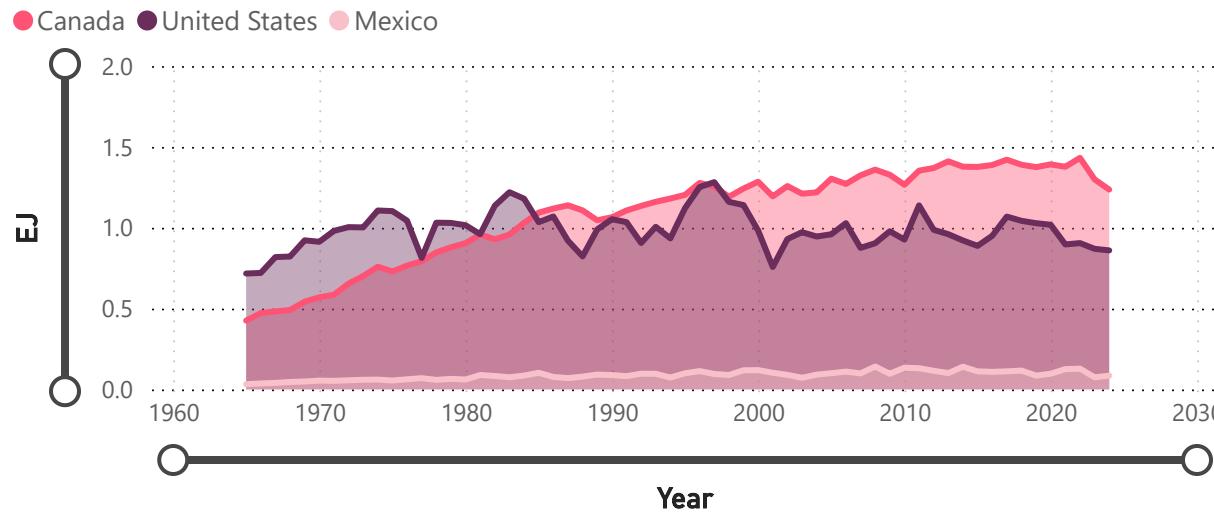


Solar

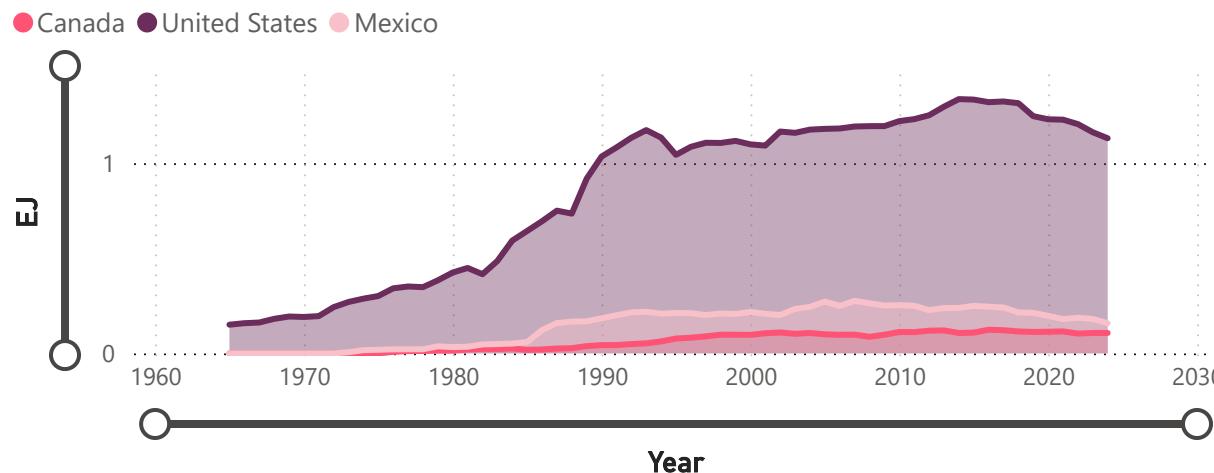
Wind

HYDROELECTRIC, GEOTHERMAL, BIOMASS AND OTHER ENERGY CONSUMPTION IN NORTH AMERICA 1965-2024

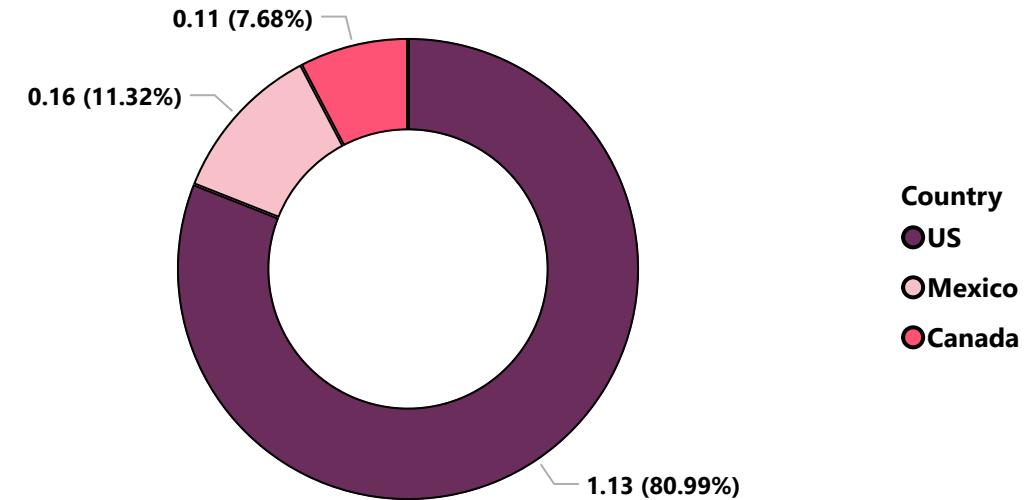
Hydro power consumption EJ - North America (1965-2024)



Geothermal, biomass and other power consumption EJ - North America (1965-2024)



Total energy consumption by source EJ - North America 2024

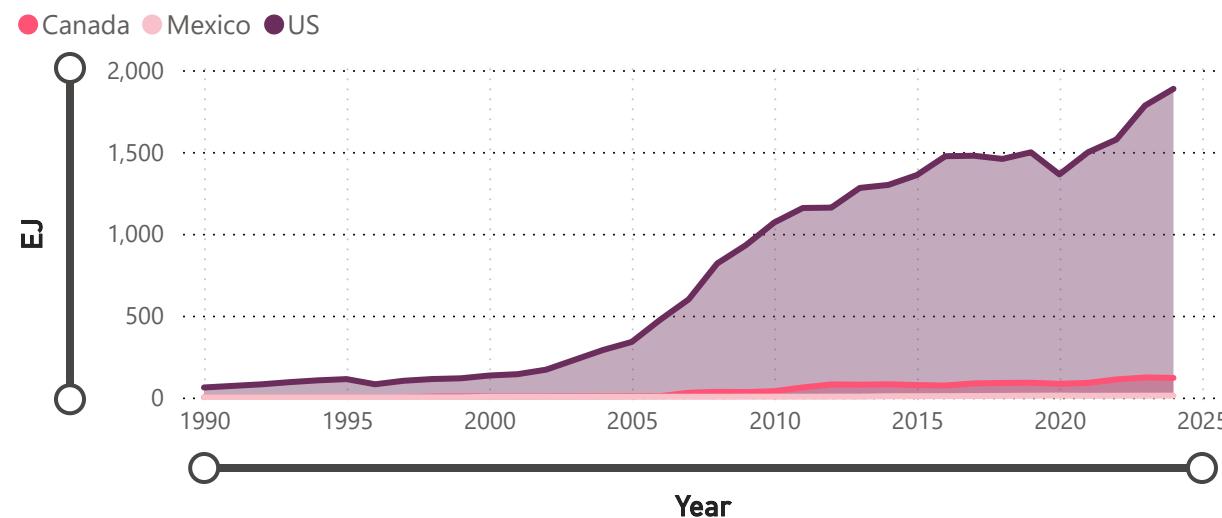


Geo Biomass Other

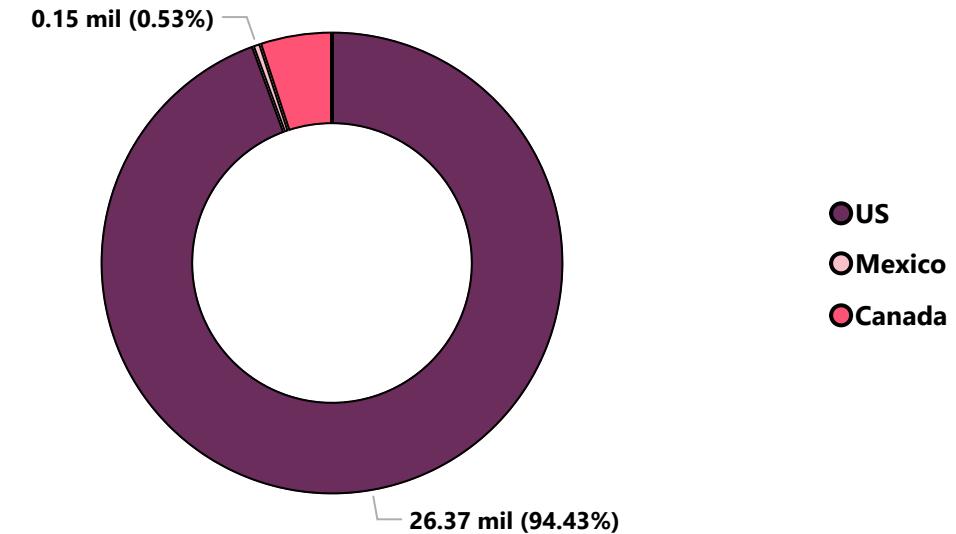
Hydro

BIOFUELS POWER CONSUMPTION IN NORTH AMERICA 1990-2024

Biofuels power consumption PJ - North America (1990-2024)



Total energy consumption by source PJ - North America 2024





INSTALLED CAPACITY IN NORTH AMERICA (SOLAR & WIND, 2000-2024)

Objective:

To measure infrastructure growth in renewable energy generation across the region.

Description:

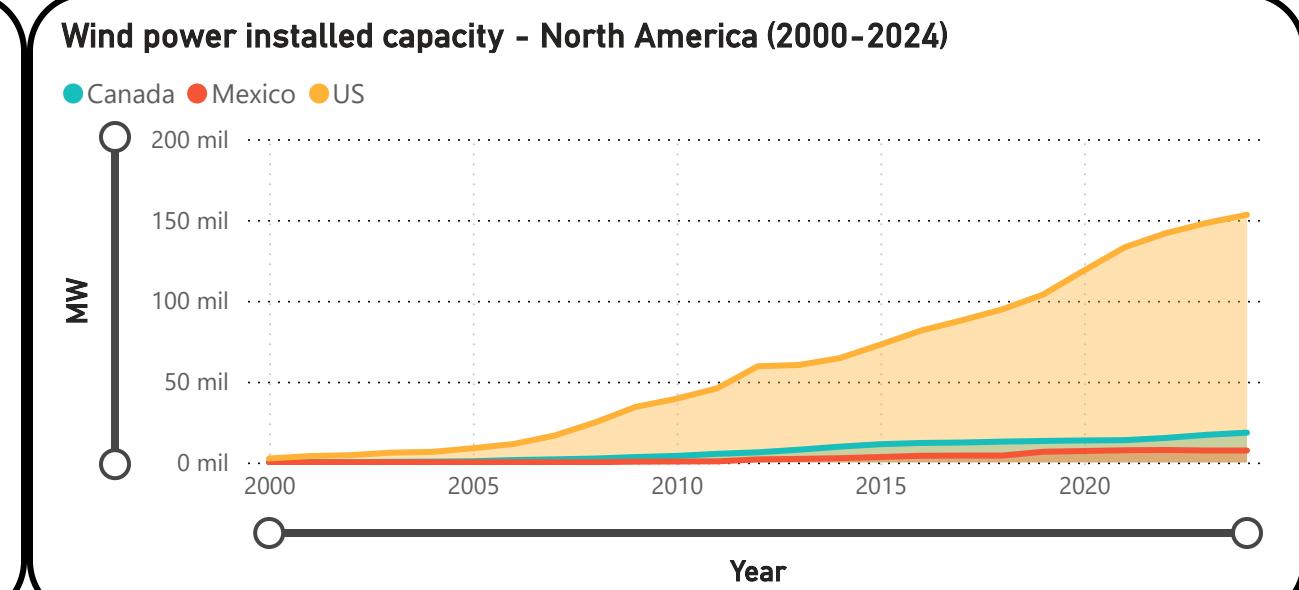
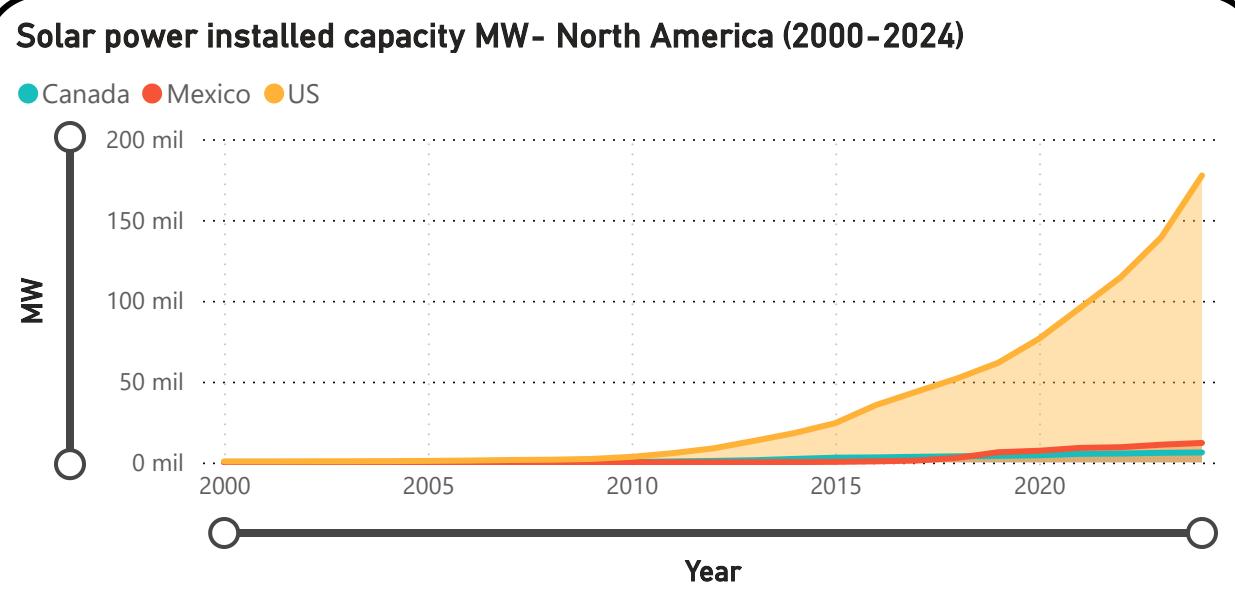
This section presents installed capacity data in megawatts (MW), focusing on solar and wind energy, the two sources with the fastest expansion.

Visualizations include long-term time series and comparative charts among countries.

Key Insights:

- Installed capacity has experienced exponential growth since 2010, particularly in solar energy.
- The United States accounts for the majority of total installed capacity, followed by Canada.
- Mexico's capacity growth is accelerating, indicating increasing investment in renewable infrastructure.
- Installed capacity growth outpaces consumption in several cases, suggesting a buildup of generation potential.

SOLAR AND WIND POWER INSTALLED CAPACITY IN NORTH AMERICA 2000-2024



INSIGHTS AND DISCUSSION

THIS ANALYSIS HIGHLIGHTS THE STRUCTURAL TRANSFORMATION OF NORTH AMERICA'S ENERGY SYSTEM.
THE FOLLOWING INSIGHTS SUMMARIZE THE KEY FINDINGS:

Shift in Dominant Sources

Hydroelectric power, once the uncontested leader, has been gradually overtaken by wind and solar since the early 2010s.

UNEVEN NATIONAL CONTRIBUTIONS

The United States remains the dominant producer and consumer, while Canada's contribution is concentrated in hydropower, and Mexico's growth is recent but promising.

Infrastructure Expansion

Installed capacity—especially solar—has seen exponential growth, reflecting both private investment and policy support.

Decoupling of Capacity and Consumption

In several countries, capacity growth has outpaced actual consumption, signaling potential challenges in grid integration and energy storage.

CONCLUSIONS

The renewable energy transition in North America shows clear momentum toward sustainable generation.

While the region remains heavily dependent on fossil fuels, renewables are expanding rapidly, particularly solar and wind.

Key conclusions include:

- Renewable energy now represents a significant and growing share of total energy supply.
- Technological innovation and public policy have been crucial to accelerating capacity growth.
- Further progress will depend on the ability to balance generation with consumption and enhance cross-border energy cooperation.



REFERENCES

Energy Institute. (2025). Statistical Review of World Energy (2025) – with major processing by Our World in Data. “Share of primary energy consumption that comes from renewables – Using the substitution method” [Dataset]. Energy Institute. Retrieved from <https://www.energyinst.org/statistical-review/>

