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Comparative Research Network:

Energy and statistics in Europe

Current status and energy policies impacts on statistics considering the roadmaps to 2050

INZEB INITIALISING ENERGY BALANCE TOWARDS ZERO

UNIVERSITÀ POLITECNICA DELLE MARCHE

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ETMI

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Content

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Introduction, brief overview of Europe's energy landscape

The different types of energy used in the EU mainly consists of five different sources:

- crude oil & petroleum products, representing 37%
- natural gas, representing 21%
- renewable energy, representing 18%
- solid fossil fuels, representing 13%
- nuclear energy, representing 11%

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Introduction, importance of energy statistics in policy-making

1. MAKE ENERGY STATISTICS AN INTEGRAL PART OF POLICY DESIGN AND EVALUATION

“[…] collecting any statistics has a cost. However, not having proper data could lead to wrong policy decisions and actions, and, as a consequence, to even higher costs.” (OECD/IEA, Energy Efficiency Indicators: Fundamentals on Statistics)

“Collecting and using relevant statistics can be highly cost-effective or generate a high benefit. This is because statistics allow existing public resources to be used more efficiently.” (Paris 21,The role of statistics in evidence-based policy-making, p.2)

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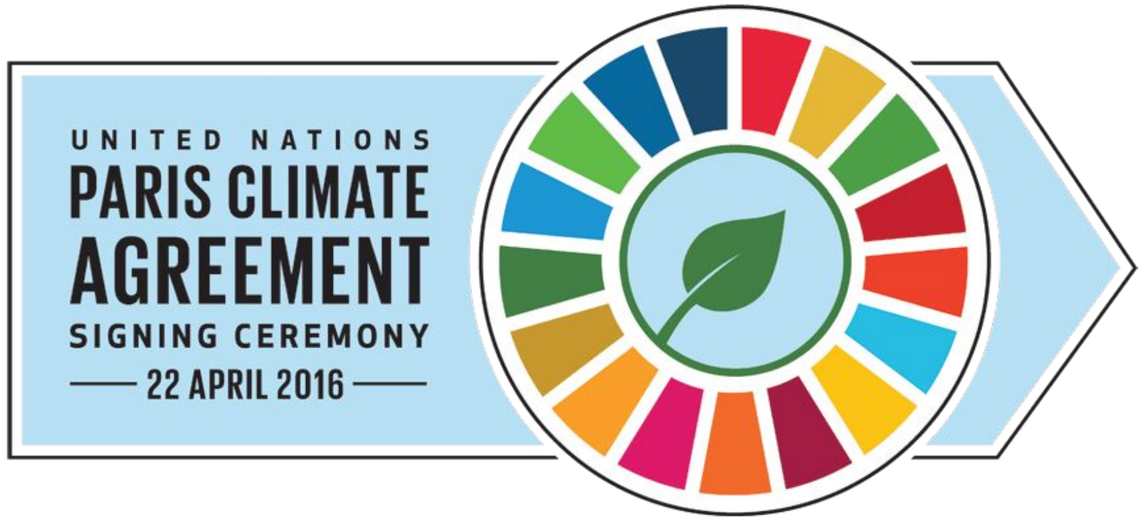
Introduction, roadmap to 2050: Aligning statistics with decarbonization goals



Following the Paris' Climate Agreement, there is an aim to strengthen the response to the climate crisis through the "Roadmap to 2050".

It is conceived on a **"systems approach"** across sectors to fight the climate crisis aspiring to decarbonize: zero gas emission by 2050.

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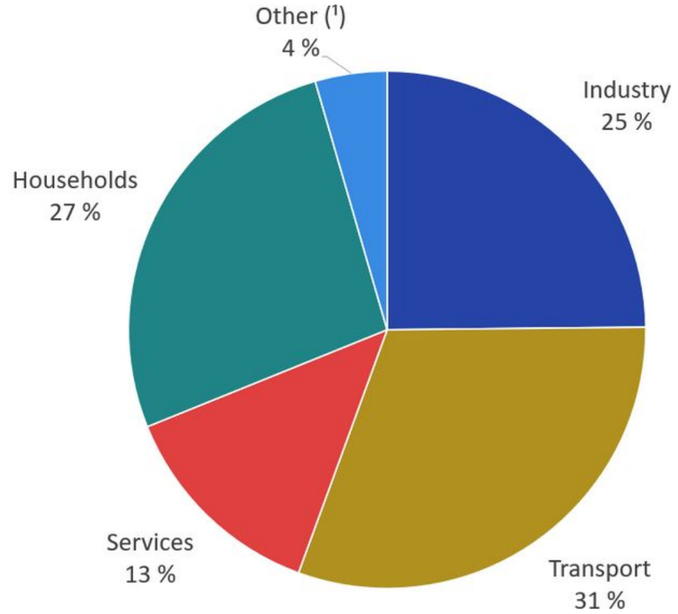
Current Energy Consumption in Europe

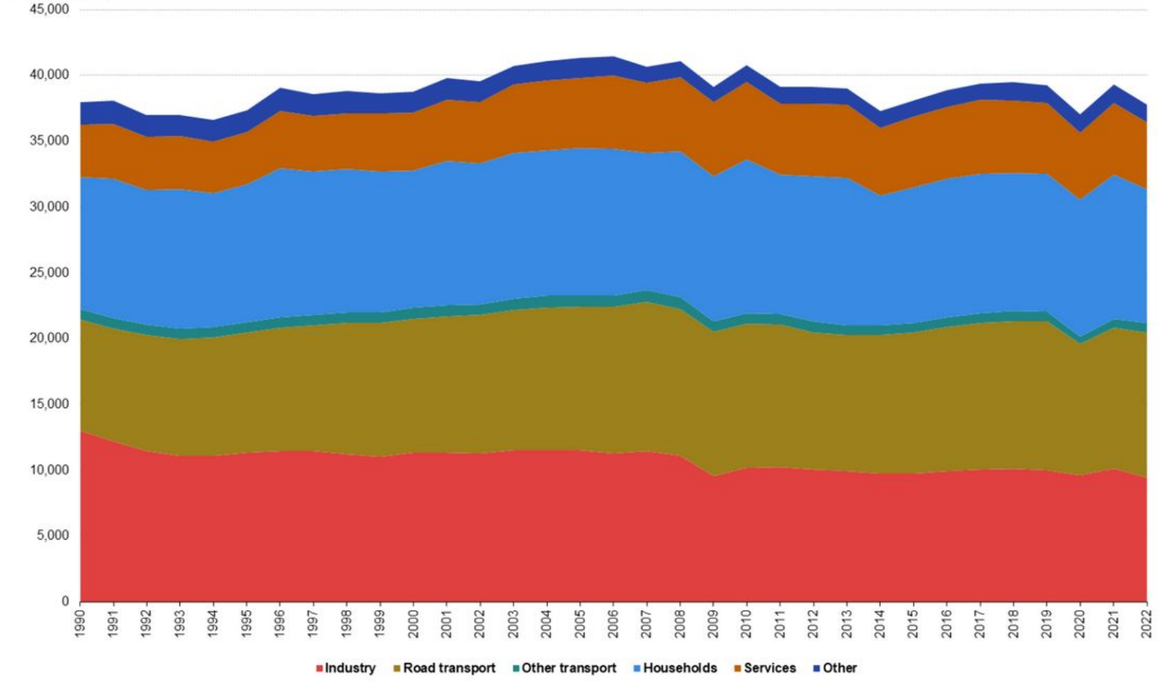
Final energy consumption by sector, EU, 2022
(% of total, based on terajoules)



(1) International aviation and maritime bunkers are excluded from category Final energy consumption for transport.
Source: Eurostat (online data code: nrg_bal_s)

eurostat

Final energy consumption by sector, EU, 1990-2022
Petajoule (PJ)



Source: Eurostat (online data code: nrg_bal_c)

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Energy Policies in Europe (European Green Deal, Fit for 55, Renewable Energy Directive (RED II)

European Green Deal

- Renewable Energy Growth
- Energy Efficiency and Savings
- Reduction of Fossil Fuel Dependency
- Climate Action Investments
- Carbon Pricing and Revenue Use

Fit for 55

- Raise EU's renewable target energy target
- Energy Efficiency Directive
- Extend the Emissions Trading System

Renewable Energy Directive (RED II, RED III)

- Transports
- Buildings
- Industry
- Acceleration of Renewable Deployment
- Bioenergy & sustainability
- Hydrogen and renewable fuels

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Energy Policies in Europe (European Green Deal, Fit for 55, Renewable Energy Directive (RED II)

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The European Green Deal, launched in **2019**, is the EU's comprehensive **strategy to achieve climate neutrality by 2050**.
It sets ambitious goals to transform **energy, transport, industry, and agriculture systems** while ensuring sustainable economic growth.

Renewable Energy Growth: The share of renewables in the EU's electricity generation has grown substantially.
Since 2019, solar energy production has more than doubled, and wind energy surpassed natural gas for the first time in 2023. Renewable energy accounted for **24.8% of total heating and cooling energy use in 2022, up from 11.7% in 2004**, reflecting broad adoption in households, industries, and services.

Energy Efficiency and Savings: Initiatives under the Green Deal and the REPowerEU Plan have led to **savings of 34 million megawatt-hours of energy consumption** and supported energy-efficient renovations in sectors like housing.

Reduction of Fossil Fuel Dependency: Efforts to reduce reliance on Russian fossil fuels have accelerated.
Measures include **expedited permitting for renewable projects** and **diversification of energy suppliers**, such as increasing imports from Norway and the U.S.

Climate Action Investments: Significant funds, including **€118 billion from the Cohesion Policy**, are directed toward green infrastructure, renewable energy, and sustainable mobility.
State aid policies have unlocked private investment in clean technologies.

Carbon Pricing and Revenue Use: The EU's Emissions Trading System expanded, **generating over €200 billion** in revenue for climate and social initiatives since its inception. This mechanism drives the shift toward low-carbon energy sources.

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Energy Policies in Europe (European Green Deal, Fit for 55, Renewable Energy Directive (RED II)

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The **"Fit for 55"** package is part of the European Green Deal, it aims to **achieve reducing net greenhouse gas** (GHG) emissions by **at least 55% by 2030 (compared to 1990 levels)**.

The revised **Renewable Energy Directive** raises the EU's renewable energy target to **42.5% of overall energy consumption by 2030**. Additional contributions aim to **achieve a total target of 45% of overall energy consumption by 2030**. The Energy Efficiency Directive mandates a **13% reduction in final and primary energy consumption by 2030**. This involves stricter energy-saving obligations for member states, which will require substantial investments in energy efficiency across industries and buildings.

The package extends the **Emissions Trading System (ETS)** to **include new sectors**, such as road transport and buildings, while also tightening the overall emissions cap. This should incentivize cleaner energy use and increase the cost of fossil fuel-based energy production.

The mechanism called **Carbon Border Adjustment Mechanism (CBAM)** ensures that **imports into the EU comply** with the **same emissions reduction standards**, encouraging global adoption of lower-carbon technologies. Additionally, significant support is allocated for the development of hydrogen and other low-carbon fuels, alongside the expansion of renewable energy infrastructure like wind and solar farms.

Implications:
For Households: The **inclusion of road transport and heating** in the ETS may lead to higher costs for fossil fuel use in homes and personal transport, encouraging a shift to cleaner alternatives like electric vehicles and heat pumps.
For Industries: Companies face **increased pressure to decarbonize** through investment in cleaner technologies and energy efficiency improvements.
Economic and Social Impact: Measures such as the Social Climate Fund aim to address the economic burden of these changes on vulnerable households.

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Energy Policies in Europe
(Renewable Energy Directive (RED III))

The Renewable Energy Directive (RED II) and its subsequent revision RED III is a framework that supports innovation and investment in renewable energy technologies, including wind, solar, and hydrogen, creating opportunities for businesses across sectors.

- RED II initially set a target of **32% for the share of renewable energy in the EU by 2030**.
- This was revised under RED III in 2023, **increasing the binding target to 42.5%** with an **additional aspirational target of 45%**.

This reflects the EU's ambition to reduce greenhouse gas emissions by **at least 55% by 2030 and achieve climate neutrality by 2050.**

- ***Transport***: Requires either **29% of energy from renewables by 2030** or a **14.5% reduction in greenhouse gas intensity**.
- ***Buildings***: Aims for at least **49% renewable energy in building energy consumption by 2030**.
- ***Industry***: Introduces annual increases in renewable energy use for industrial processes, **targeting 42% renewable hydrogen use by 2030 and 60% by 2035.**
- ***Bioenergy and Sustainability***: Strengthened sustainability criteria for biomass, including limitations on sourcing from ecologically sensitive areas and guidelines to ensure sustainable harvesting practices
- ***Hydrogen and Renewable Fuels***: Emphasis on renewable fuels of non-biological origin, such as hydrogen, with specific sub-targets for integrating these into the energy system.

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Energy Policies in Europe (Policies phasing out coal & promoting energy efficiency)

The EU's Just Transition Mechanism provides financial and technical support to coal-dependent regions to develop new industries and infrastructure, ensuring a fair shift for workers and communities.

Energy Efficiency Directive (EED): The EED sets binding targets for reducing energy consumption. The latest update aims to cut primary energy consumption by 11.7% by 2030 compared to 2020 projections.

Building Renovation Initiatives:
The EU promotes retrofitting and energy-efficient buildings through programs like the Renovation Wave, which seeks to double the annual energy renovation rate by 2030.

Industrial Energy Efficiency: Policies encourage businesses to adopt energy-saving technologies and practices, with incentives and financial support to reduce energy demand.

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Data Challenges in Tracking the Energy Transition

***Need for Standardized Energy Reporting Across Europe**:*

- Europe **lacks a harmonized framework for energy data reporting**.

Different countries use **varying methodologies, metrics, and timelines**, creating inconsistencies in understanding progress towards energy transition goals.Without standardized data, comparing progress, allocating resources, and ensuring compliance with EU-wide targets becomes challenging.

*i.e: Potential **solutions** are the EU enforcement of a unified reporting system aligned with international standards, such as those proposed by the International Energy Agency (IEA) as well as the development of a central EU database that integrates real-time reporting from member states to enhance transparency and data accuracy.*

***Measuring the Growth of Decentralized Energy Systems**:*

- The rise of **prosumers** (individuals who both produce and consume energy) and **Renewable Energy Communities** (RECs) introduces complexity in measuring distributed energy flows.

Current systems often **fail to capture small-scale energy contributions**, such as rooftop solar installations or community-led wind projects. It matters because **decentralized energy systems play a vital role** in achieving energy independence and sustainability. Therefore, understanding their growth ensures proper integration into national grids and policy planning. This is why experts encourage **digital solutions** like smart meters and blockchain-based energy tracking to provide granular data on decentralized systems and mandate utilities to report data on prosumers and RECs as part of their regulatory obligations.

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Data Challenges in Tracking the Energy Transition

Addressing the Gap in Tracking Emerging Technologies:

Hydrogen production and usage data remain fragmented.

There is **insufficient tracking of hydrogen supply chains**, including the **origins of hydrogen** (green, blue, or gray), **production costs**, and integration with existing energy systems.

Experts have suggested **solutions** like the **introduction of specific reporting requirements** for hydrogen projects under EU directives and a collaboration with industry stakeholders to create a hydrogen registry that tracks production methods, capacities, and carbon footprints.

i.e: A supporting tool could be the scope extension of existing platforms such as the EU Observatory for Energy Statistics to include emerging technologies.

Conclusion

Tackling these data challenges is critical for the EU to monitor and accelerate the energy transition effectively. Standardized reporting, advanced tracking for decentralized systems, and robust monitoring of emerging technologies like hydrogen will enhance decision-making and help achieve climate goals more efficiently.

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The Roadmap to 2050: Long term energy goals & statistics

Importance of tracking new metrics, including energy poverty and energy justice.

The **Energy Roadmap to 2050 with**

- **Net-zero by 2050**: The roadmap outlines that by 2050, Europe's energy production must be nearly carbon-free, reducing emissions by over 80% compared to 1990 levels. To reach this, substantial investments in renewable energy, energy efficiency, and low-carbon technologies are required.
- **Intermediate Milestones**: By 2030, the EU aims to reduce greenhouse gas emissions by **at least 55%** and ensure that renewables account for **at least 42.5%** of total energy consumption.
- **Electricity's Growing Role**: Electrification is a key component, with renewable energy becoming the dominant source of electricity across sectors such as transportation and industry.

Accurate data collection and analysis, through statistics, are crucial for tracking the progress toward these goals. This includes monitoring renewable energy adoption, energy efficiency improvements, and emission reductions. Additionally, the EU plans to modernize its energy infrastructure with "smart" grids and cross-border connections to support the energy transition.

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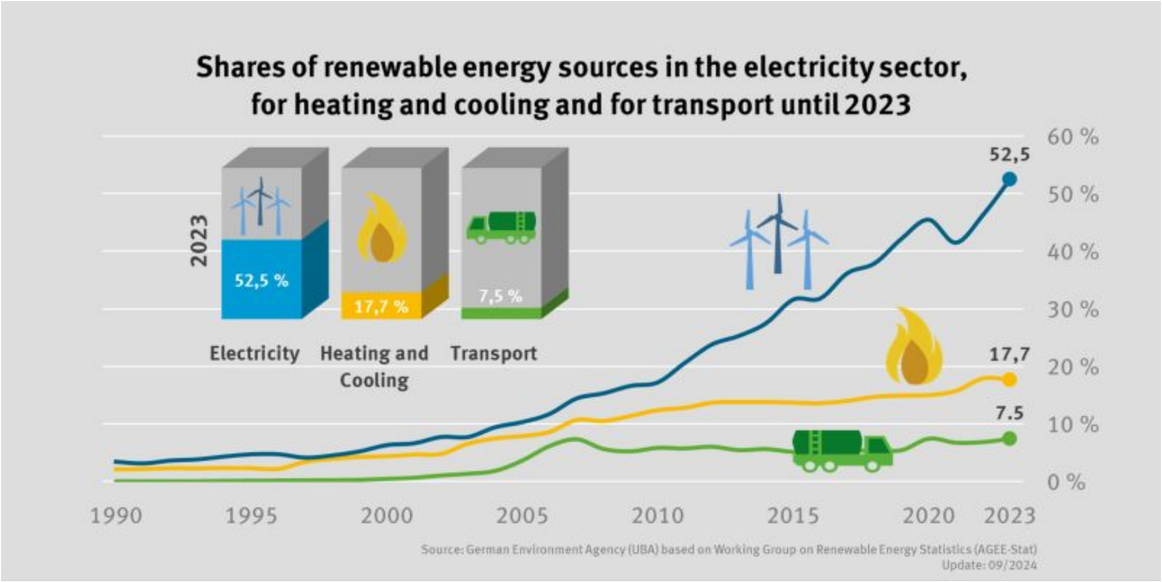
Case Studies: Germany & Energiewende

Germany's Energiewende (energy transition) is an **ambitious policy initiative** aimed at **transitioning to a sustainable, low-carbon energy system**. It highlights Germany as a leader in renewable energy adoption, emphasizing long-term environmental and economic goals.
Germany's approach is notable for its focus on **public participation and decentralized energy systems**. **Citizens, farmers, and cooperatives** play a vital role, demonstrating that energy transitions can be inclusive while driving innovation and sustainability.

Renewable energy account for 52.5% of Germany's electricity consumption in 2023, a significant leap from just 6.3% in 2000.

Economic and Social Impact: The renewables sector has created thousands of jobs, with nearly half of the installations owned by individuals or cooperatives, encouraging grassroots participation. **However**, the costs of transitioning (e.g., feed-in tariffs) have led to **higher electricity bills for consumers**



Despite the progress, challenges remain, especially in transport (7.5% renewables in 2023) and integrating emerging technologies like battery storage and smart grids.

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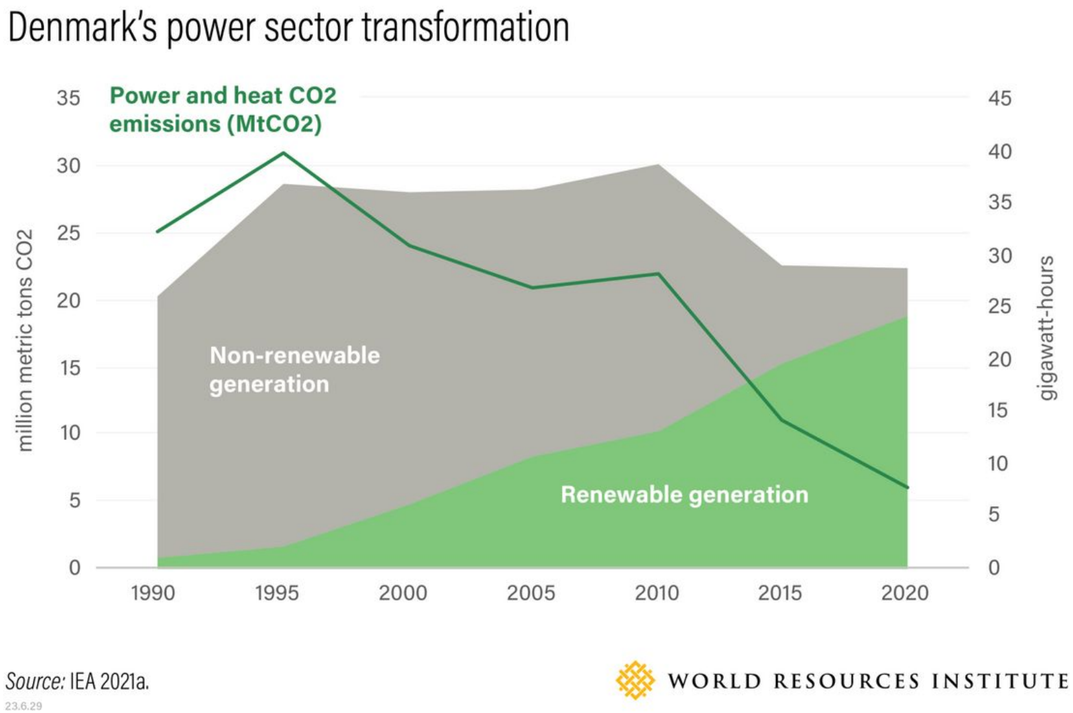
Case Studies: Denmark & wind energy

Denmark generates **more than 50% of its electricity from wind**, the **highest share globally**. This achievement stems from strategic investments, community involvement, and strong policy support. Denmark's Renewable Energy Act mandates that **local citizens be offered at least a 20% share in new wind projects**, fostering local support and investment.
i.e: Community-owned wind farms are common, allowing residents to benefit directly from wind energy revenue.
Denmark has been a pioneer in developing and deploying offshore wind farms, capitalizing on its high-wind coastal regions. Offshore projects, like those in the North Sea, significantly boost capacity and efficiency.

Investments in wind energy have reduced Denmark's dependence on fossil fuels, **lowering carbon emissions from the power and heat sectors by 76% between 1990 and 2020.**

Local ownership models and strong social policies ensure equitable benefits from the transition. This model has made Denmark a benchmark for countries aiming to scale up renewable energy initiatives.

Denmark has expanded 24-fold since 1990, and the country aims for 100% renewable electricity by 2030. Current targets also emphasize innovations like wind-to-hydrogen technology and repowering aging wind farms with modern turbines.



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Case Studies: Spain & solar power

Spain has made significant progress in integrating solar power into its energy mix, **achieving a record 56% of electricity generation from renewables in 2024**, with solar photovoltaic (PV) playing a substantial role. Indeed, they have developed utility-scale solar: As of May 2024, **Spain had 29.5 GW of utility-scale solar PV installed, with an additional 7.8 GW under construction**. This positions the country at **60% of its 2030 target of 57 GW for utility-scale solar PV**. Moreover, **nearly 90% of Spain's solar installations utilize bifacial modules**, enhancing efficiency by capturing sunlight on both sides. Additionally, **approximately 84% of installations employ tracker structures** to optimize energy capture.

Balancing challenges:

- Supply-Demand Imbalance
- Grid Saturation
- Energy Storage Needs

Strategic responses:

- Hybrid Renewable Assets
- Regulatory Frameworks

In the future, Spain aims to produce 80% of its electricity from renewables by 2030, with solar energy playing a pivotal role. Achieving this goal will require continued investment in grid infrastructure, energy storage, and regulatory support to manage the increasing share of variable renewable energy sources.

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Key Challenges and Future Directions

Barriers to Accurate Energy Statistics

- Data Inconsistency
- Tracking Decentralized Energy
- Evolving Metrics
- Strengthening Europe’s Statistical Framework
- Real-Time Monitoring
- Collaborative Databases
- AI & IoT Applications

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Conclusions

The EU's energy transition is a **complex interplay** between ambitious policies and the critical need for precise statistical insights.
Initiatives like the European Green Deal, Fit for 55 package, and Renewable Energy Directive demonstrate the Union's commitment to decarbonizing its energy systems. Meanwhile, case studies from countries like Germany, Denmark, and Spain highlight the successes and challenges of integrating renewables and balancing grids.

These examples underline the **importance of accurate, comprehensive energy data to guide decision-making, monitor progress, and address emerging challenges such as decentralized energy systems and evolving metrics like energy justice.**
Robust energy statistics are **necessary and required** for achieving the EU’s 2050 vision of net-zero emissions.

They enable **effective policy implementation**, **foster international collaboration**, and **drive technological innovation**. Without reliable data, tracking progress, identifying gaps, and adapting strategies would be significantly hindered.
To ensure a sustainable and equitable energy transition, it is imperative to strengthen statistical capacities across the EU. This includes harmonizing data collection, investing in real-time monitoring technologies, and embracing AI-driven analytics to predict trends and optimize energy use. A unified effort to enhance energy statistics will empower the EU to meet its climate goals while ensuring energy justice for all citizens.

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Thank you

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