

ELECTRIFICATION IN A RENEWABLES-BASED ECONOMY

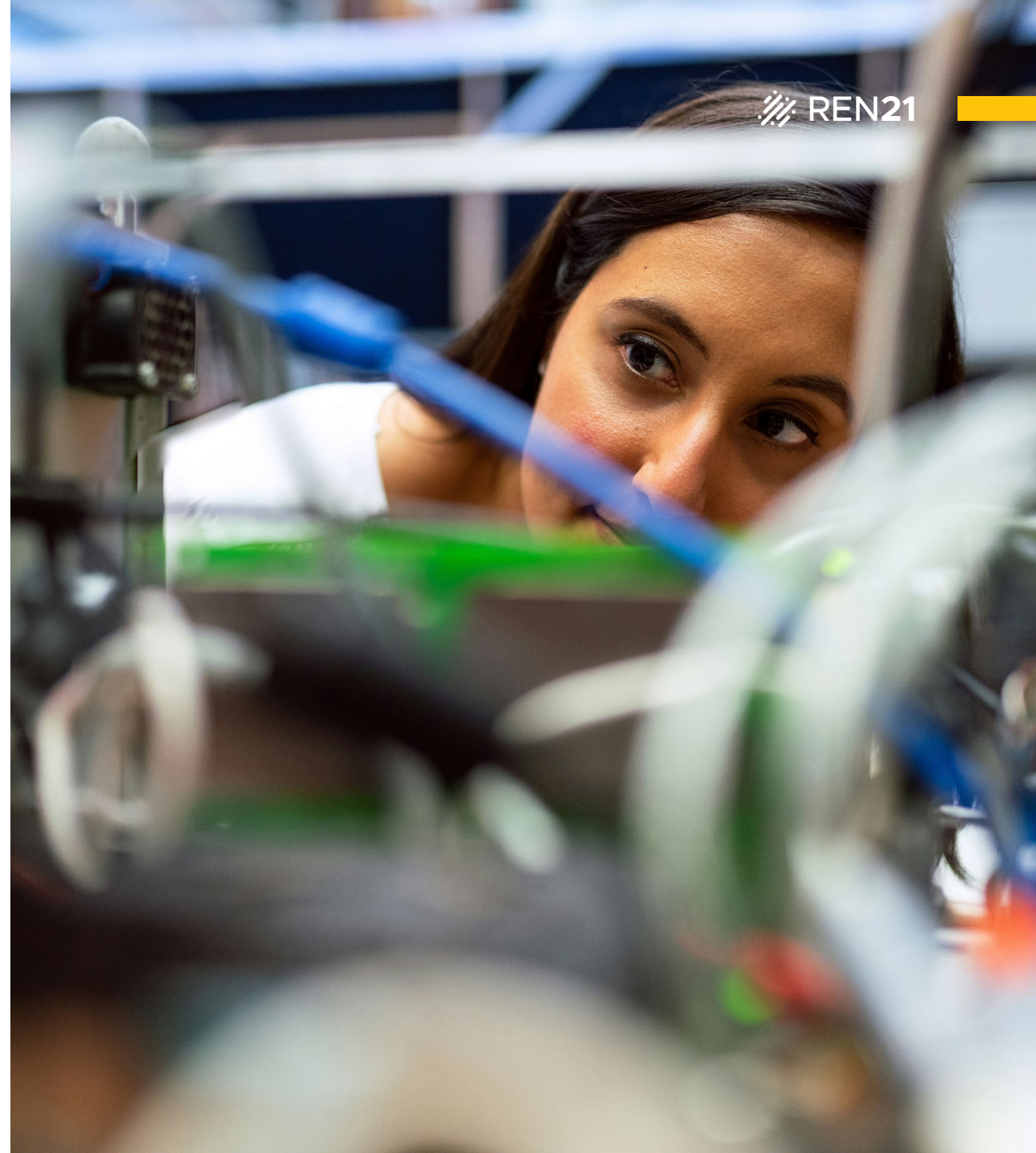
ALIGNING DEMAND GROWTH, RENEWABLE POWER
AND DEVELOPMENT OBJECTIVES



WHY ELECTRIFICATION MATTERS NOW

ELECTRICITY IS BECOMING THE BACKBONE OF MODERN ECONOMIES

- ➔ **Electricity demand is growing faster than overall energy demand**
 - Driven by economic development, industrialisation, cooling demand and digitalisation
- ➔ **Renewables are increasingly meeting new electricity demand**
 - Creating an opportunity to link electrification with energy security, competitiveness, resilience and decarbonisation
- ➔ **Infrastructure and investment are not keeping pace**
- ➔ **Planning and policies remain siloed, focusing on supply**
- ➔ **Cross-sectoral, demand-led planning is needed to decarbonise energy systems and drive economic development through renewables-based electrification**



WHAT ELECTRIFICATION MEANS TODAY



DIVERSE ENTRY POINTS, DIFFERENT REALITIES

Electrification can be understood differently depending on a country's development context, energy system and economic priorities.

For many developing countries, electrification is still first and foremost about **development**. It relates to building up infrastructure to provide **access** to electricity services, improve reliability, reduce load shedding and enable **industrialisation** and economic activity.

A second entry point is the **electrification of existing energy uses**. This means replacing fuel-based services with electricity, such as electric vehicles replacing internal combustion engines or heat pumps replacing fossil-fuel boilers. Electrification becomes a way to reduce fossil fuel dependence and improve efficiency, when electricity demand is met with renewable energy.

Another entry point is the emergence of **new electricity needs**. Rising temperatures are increasing electricity demand for cooling, while digitalisation and artificial intelligence are increasing demand for data centres. These new sources of demand are reshaping electricity systems and creating new planning challenges.

These diverse perspectives show why electrification must be understood through regional and economic perspectives, not only technical.

WHY RENEWABLES MATTER IN AN ELECTRIFIED WORLD



ELECTRIFICATION DELIVERS ITS GREATEST BENEFITS WHEN POWERED BY RENEWABLES

As of 2025, 92 countries are net energy importers while 36 countries are exporters.¹ This dependency is largely driven by fossil fuels. Renewable electricity can be generated in all regions, making it a strategic resource for countries seeking to **reduce dependence on imported fossil fuels**.

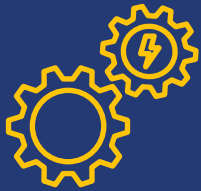
Solar and wind are now among the most **cost-competitive** sources of new electricity in many regions, and 91% of renewable projects in 2024 produced electricity at a lower cost than the cheapest fossil-fuel alternative.² Renewable electricity can shield countries from **fossil-fuel price volatility** and support electricity-intensive sectors, including manufacturing, digital services and renewable energy and enabling technologies supply chains.

Efficiency is also key: electric vehicles, heat pumps and other electric technologies often require less primary energy than their fossil-fuel alternatives, reducing overall energy consumption.

Renewables make electrification cleaner, more secure and more affordable.

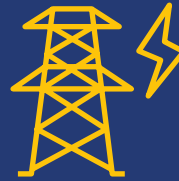


KEY FIGURES AT A GLANCE



ELECTRICITY IN THE ENERGY SYSTEM

- ➔ **23%** of total final energy consumption (TFEC) in 2025
- ➔ **2.8%** global electricity demand growth **vs.** **1.3%** energy demand growth in 2025
- ➔ Electrification of end-use varies by sector, from **1.5%** in transport to **36.2%** in buildings (2023)



RENEWABLES IN THE ELECTRICITY SYSTEM

- ➔ Renewables account for **33%** of total electricity demand
- ➔ **98%** of electricity demand growth was met by solar and wind in 2025



DEMAND-SIDE

- ➔ **1 in 4** cars sold in 2025 is electric
- ➔ Cooling: a key driver of the **4.3%** electricity demand increase in 2024
- ➔ Data centres are a new driver of demand growth

Source: see endnote 3.³



ELECTRICITY DEMAND GROWTH & RENEWABLES



INCREASE OF ELECTRICITY AND NON ELECTRICITY CONSUMPTION, 2013-2023

Electricity demand is growing more than twice as fast as total energy demand. Renewables are the fastest growing technologies.

- Increase in total energy consumption
- Increase in renewable electricity consumption
- Increase in total electricity consumption

1.3%

growth in energy
consumption in 2025

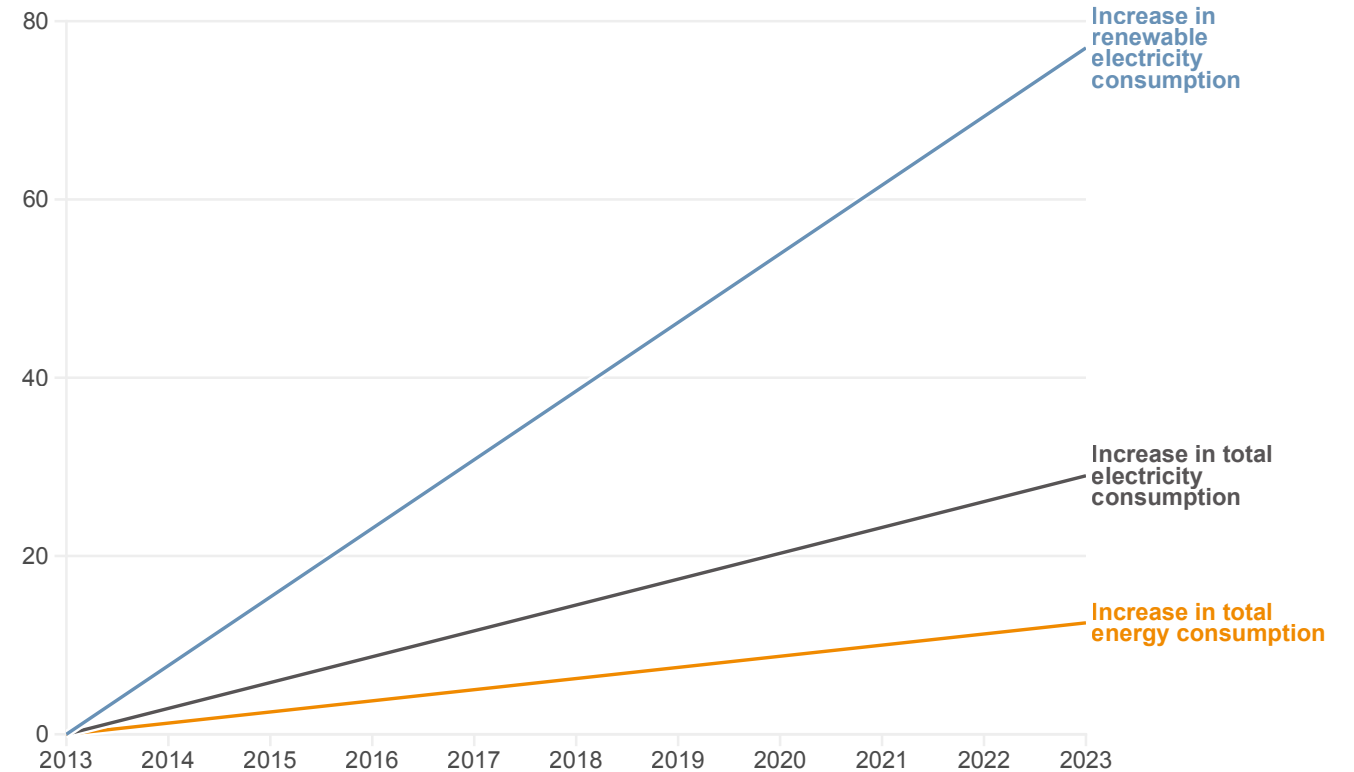
2.8%

growth in electricity
consumption in 2025

2%

growth in renewable
electricity generation in 2025

Unit: %



Source: IEA, See endnote 4. ⁴

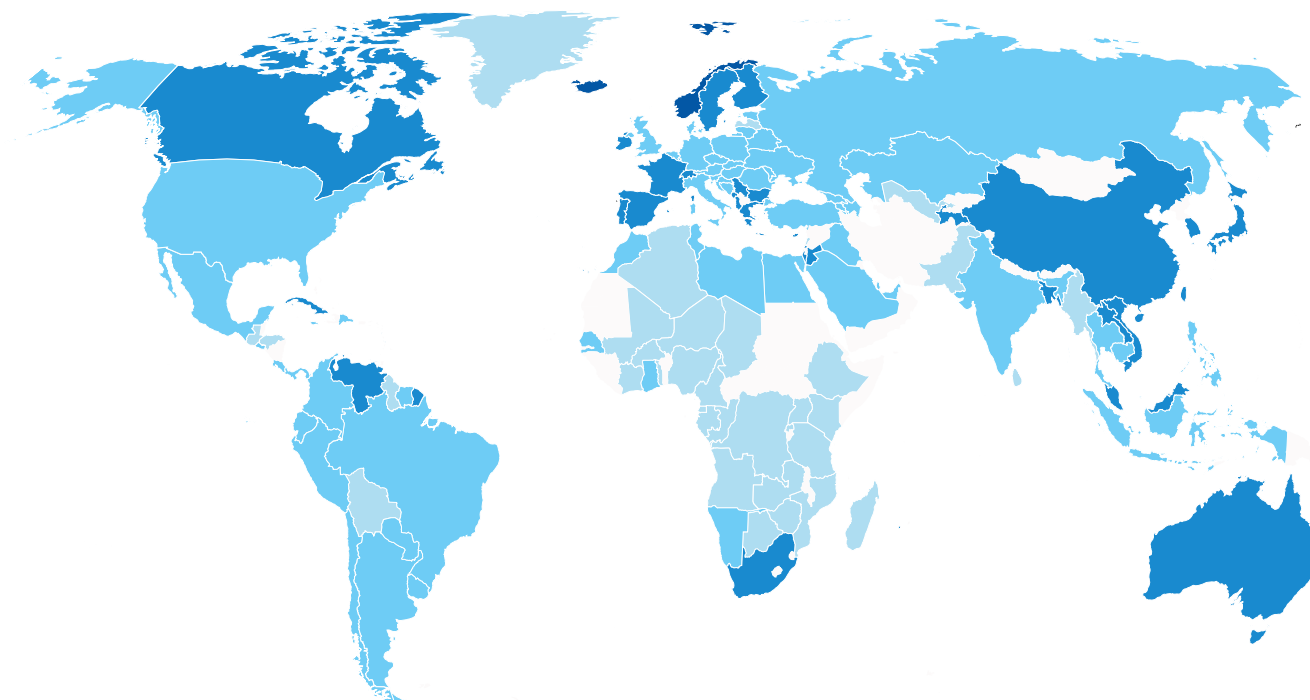


ELECTRIFICATION ACROSS REGIONS



ELECTRICITY SHARE IN TOTAL FINAL ENERGY CONSUMPTION, BY COUNTRY, 2023

Electrification is progressing across most regions, but remains below levels needed to drive deep energy system transformation and support a renewables-based economy.



Source: Ember. See endnote 5.⁵

Very few countries show more than 30% of electricity in their energy mix.



ELECTRIFICATION ACROSS REGIONS

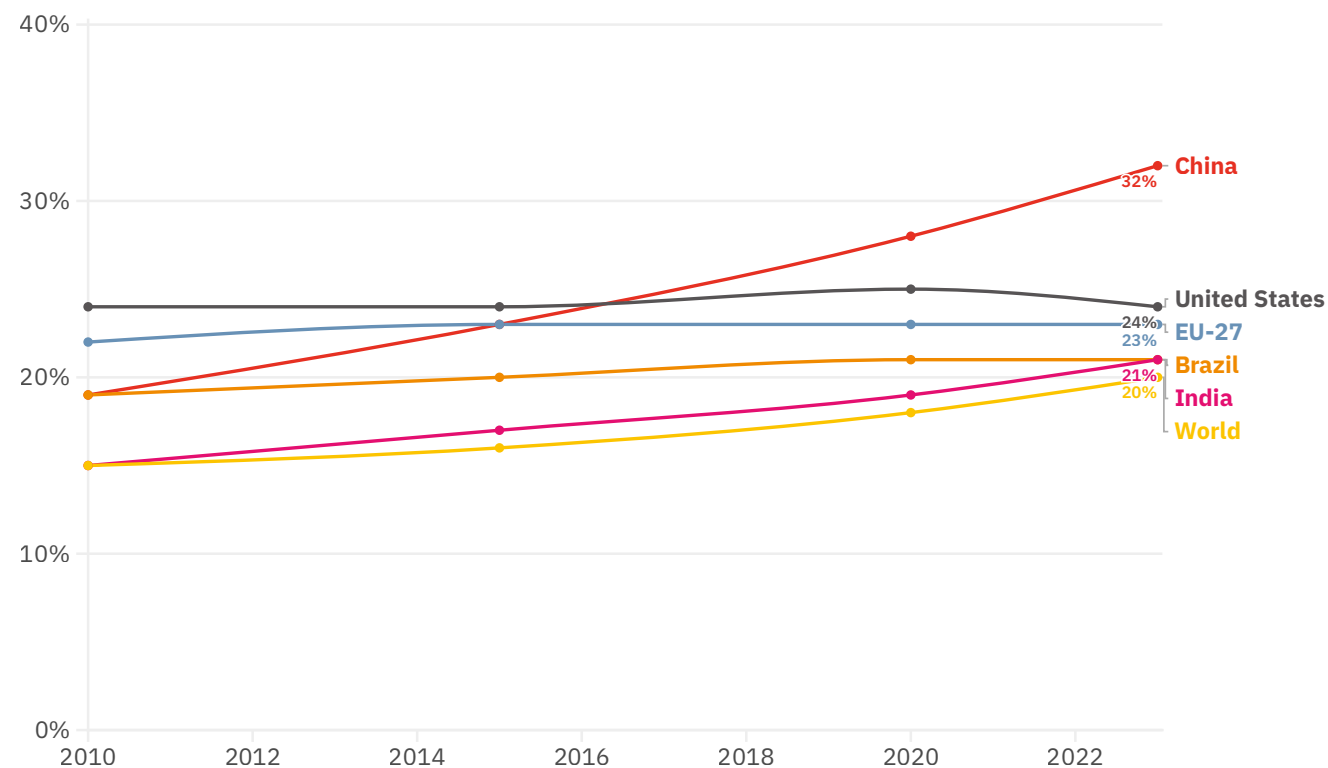


ELECTRICITY SHARE OF TOTAL FINAL ENERGY CONSUMPTION, 2010-2023

- China
- United States
- EU-27
- Brazil
- India
- World

China and India show continuous progress towards electrification.

Share of TFEC (%)



Sources: IEA, REN21, Eurostat. See endnote 6.⁶



MOST OF THE ENERGY DEMAND IS NOT COVERED BY ELECTRICITY



SHARE OF ELECTRICITY DEMAND IN TFEC, BY SECTOR, 2023

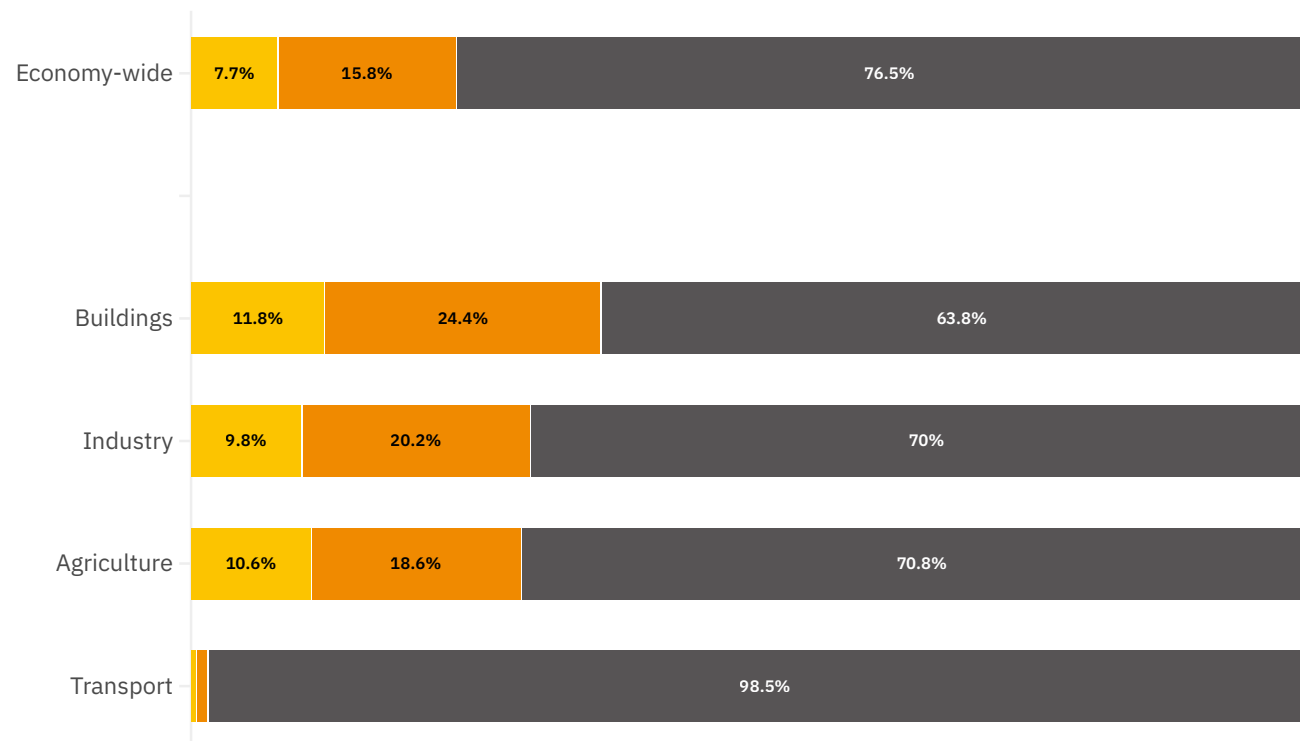
Even where electricity is growing, renewable electricity still represents only a small share of total final energy consumption.

- Renewable Electricity
- Non-Renewable Electricity
- Non-electricity

23%

Despite rapid growth, electricity still accounts for less than one-quarter of final energy use, highlighting both the progress made and the scale of the electrification challenge.

% of TFEC



Source: See endnote 7.7

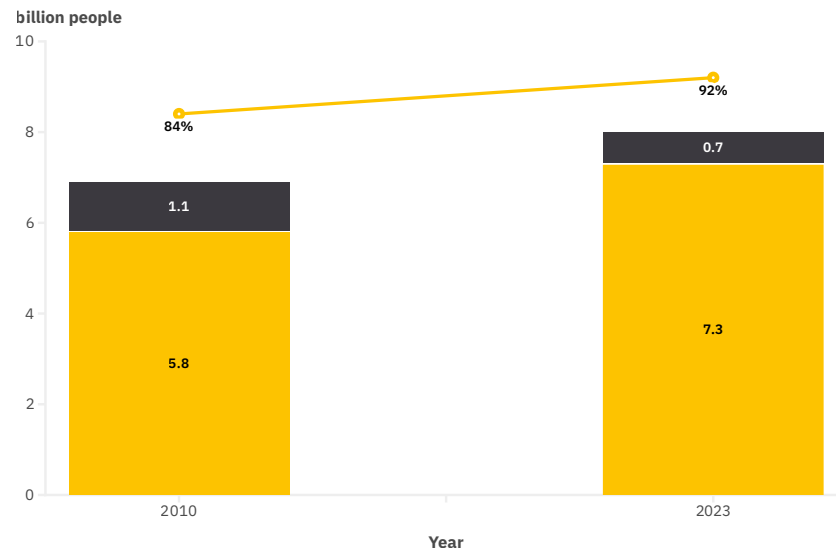


ELECTRIFICATION IN DEVELOPING COUNTRIES: ACCESS TO ELECTRICITY REMAINS A CHALLENGE



THE WORLD HAS MADE MAJOR GAINS IN ELECTRICITY ACCESS, BUT PROGRESS IS STAGNATING

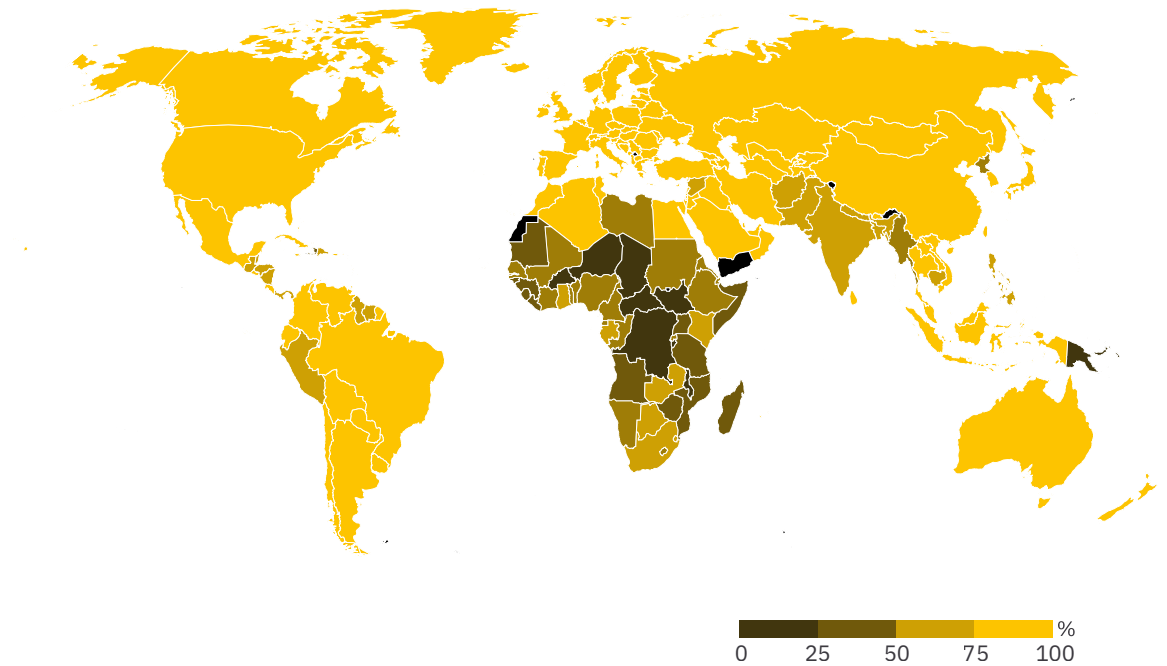
Still, over 790 million people live without electricity, and hundreds of millions have unreliable and unaffordable electricity.



Source: ESMAP, World Bank Group. See endnote 8.⁸

ELECTRICITY ACCESS RATES, BY COUNTRY, 2023

581 million people in Sub-Saharan Africa still lacked access to electricity in 2023.



Source: World Bank



NEW ELECTRICITY DEMAND AND ELECTRIFICATION OF END-USES ARE RESHAPING ELECTRICITY DEMAND ACROSS ECONOMIES



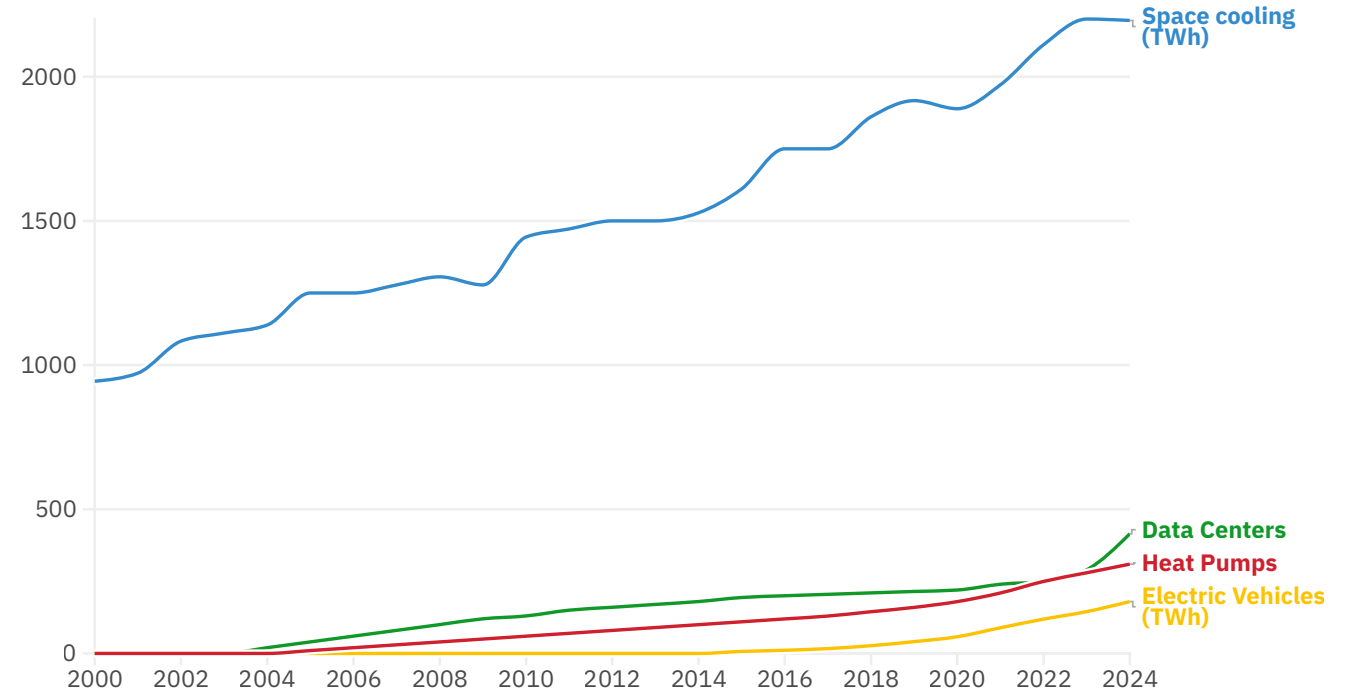
ELECTRICITY DEMAND FROM COOLING, DATA CENTRES, HEAT PUMPS AND ELECTRIC VEHICLES, 2000-2024

Cooling remains the largest electricity end use among emerging electrification drivers, while data centres, heat pumps and EVs are growing rapidly.

2,200 TWh

Global electricity demand for space cooling in 2024.

More than twice the electricity consumed by heat pumps, EVs and data centers combined.



Sources IEA, REN21 analysis. See endnote 9.9 • Note: Space cooling and electric vehicle values are based on reported electricity consumption. Data centre values are based on IEA estimates of global electricity demand. Heat pump values are indicative estimates derived from global heat pump stock and typical operating performance. Values are rounded.



ELECTRICITY DEMAND IS ACCELERATING

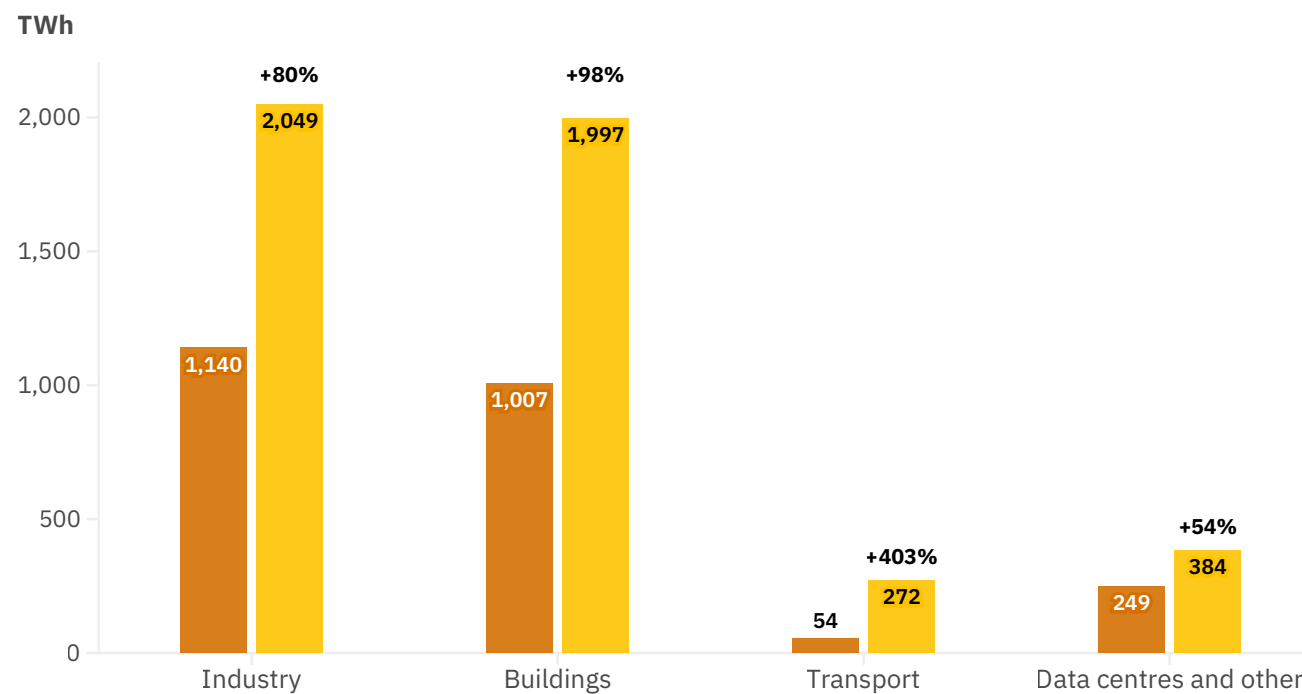


GROWTH OF ELECTRICITY DEMAND, BY SECTOR, 2015-2020 AND 2020-2025

- 2015-2020
- 2020-2025

86%

Of the growth in electricity between 2020-2025 was driven by industry and buildings.



Source: IEA, see endnote 10.¹⁰ • Note: Buildings includes heat pump and cooling.



HEAT PUMP MARKETS CONTINUE TO EXPAND



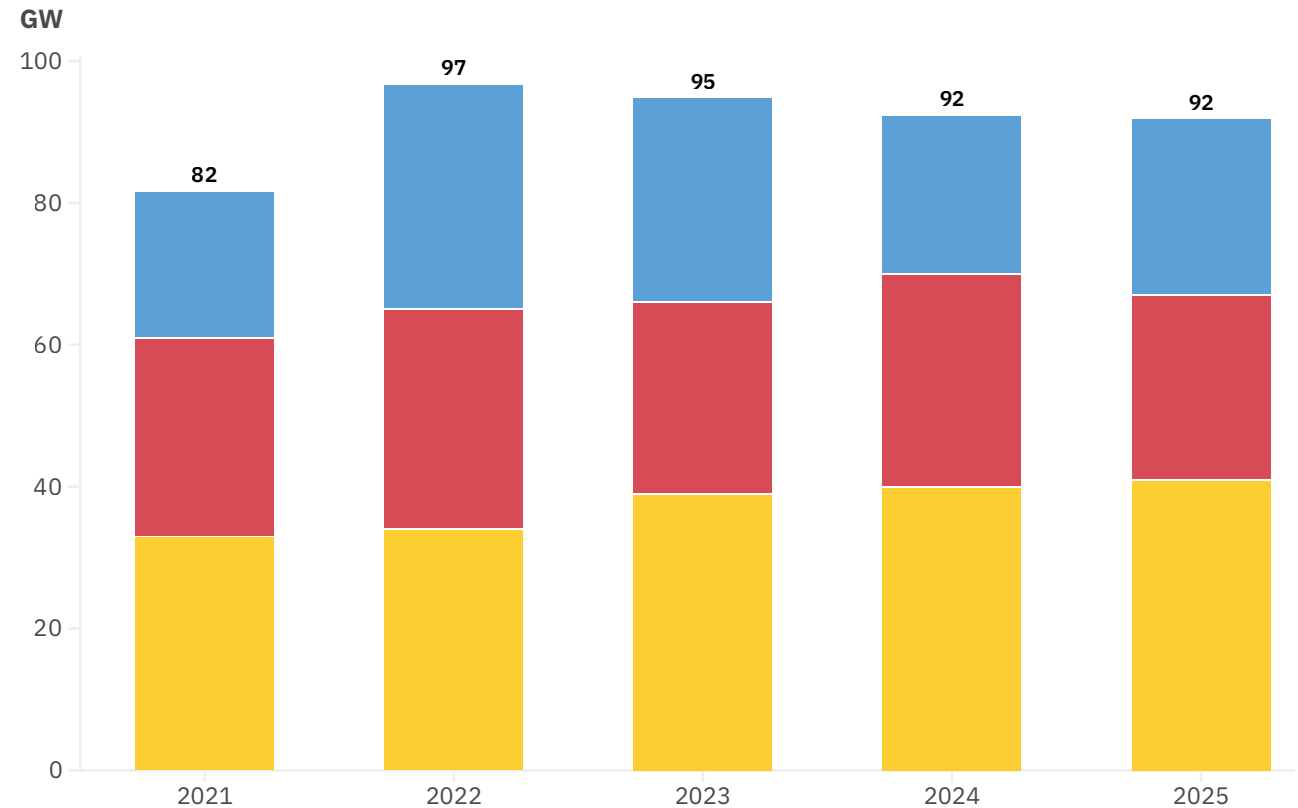
HEAT PUMP SALES FROM SELECTED MARKETS 2021-2025

Despite weaker European demand following the energy crisis, annual sales remain above 2021 levels, highlighting the growing role of heat pumps in building electrification.

- China
- United States
- Europe

92 GW

Heat pump sales across China, Europe and the United States in 2025.



Source: IEA, European Heat Pump Association. See endnote 11ⁱⁱ



TRANSPORT ELECTRIFICATION IS ACCELERATING

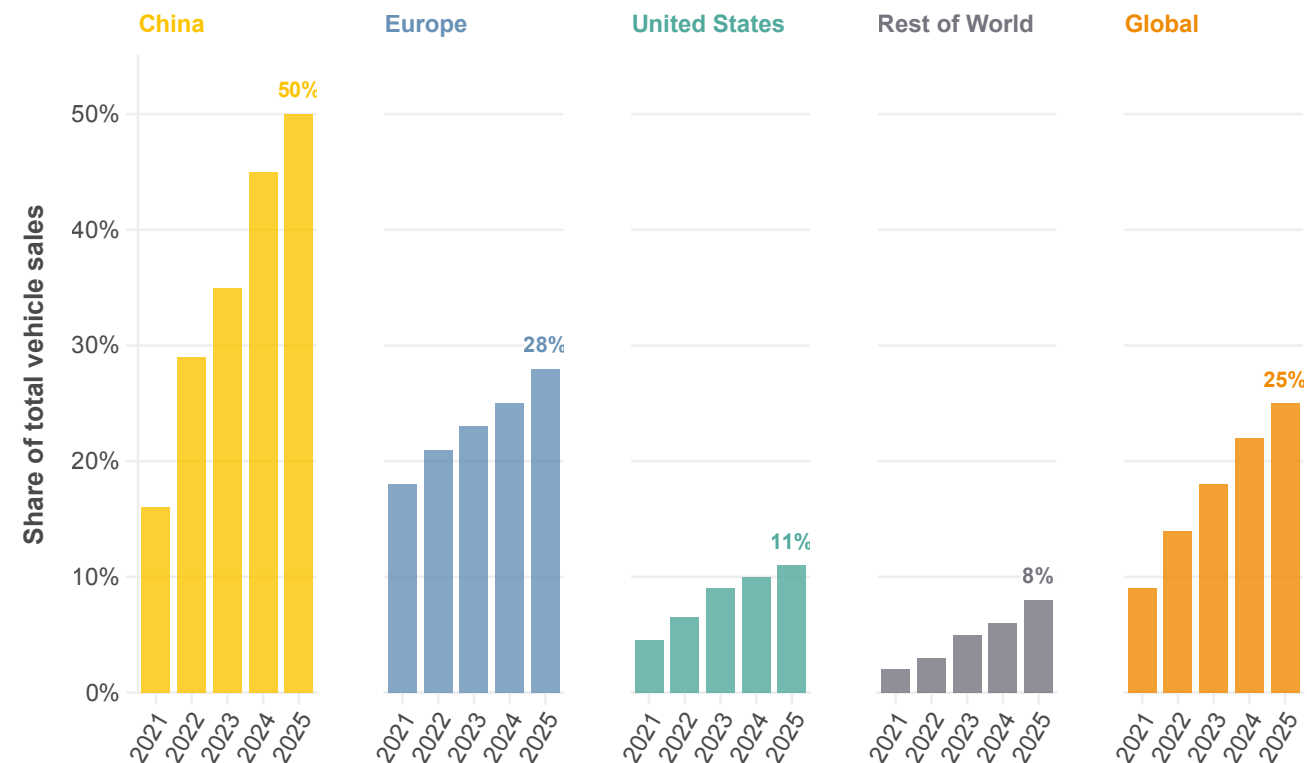


EV SHARE OF TOTAL VEHICLE SALES, 2021-2025

1 in 4 vehicles bought in 2025 was electric. This helped displace 1.2 million barrels of oil per day in 2025.

25%

of transport remains lightly electrified despite a quarter of global new car sales being electric in 2025.



Source: IEA, See endnote 12.¹²



DATA CENTRES: A NEW SOURCE OF ELECTRICITY DEMAND



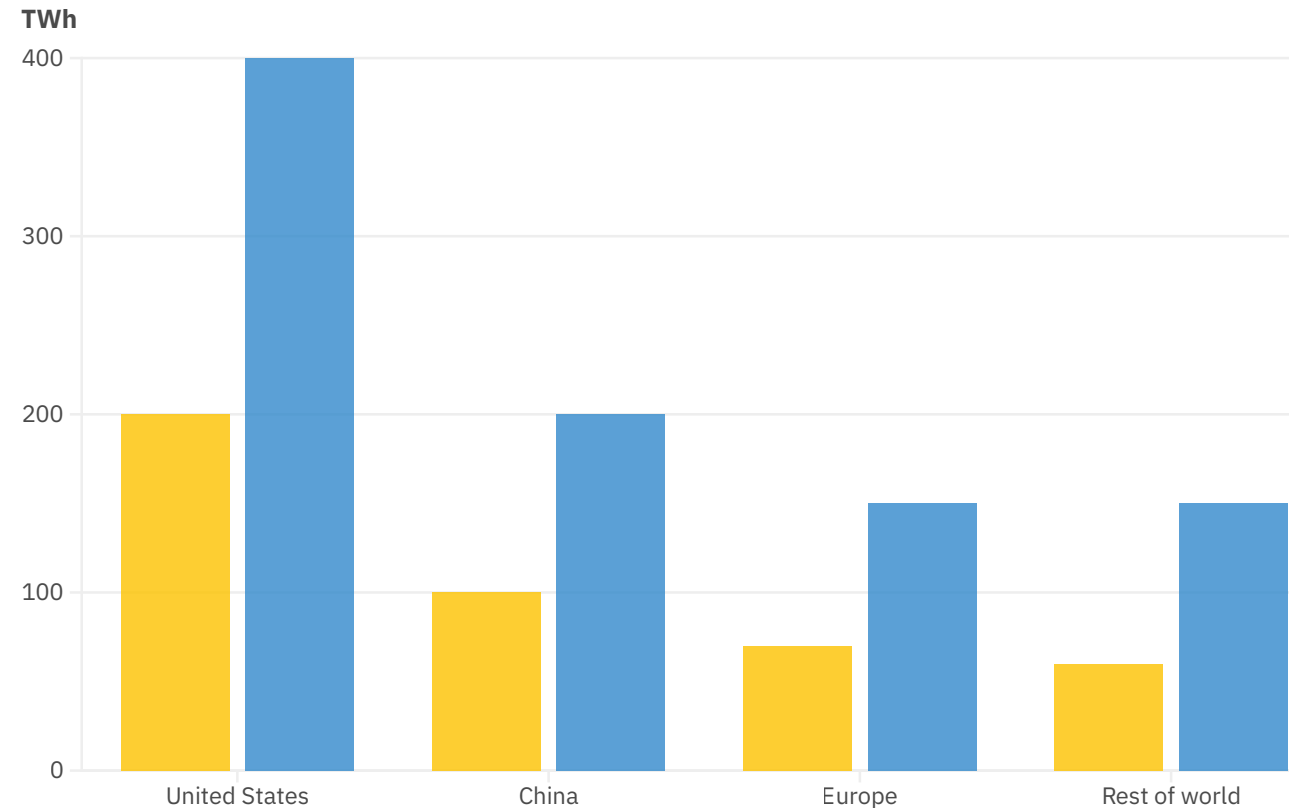
PROJECTED DATA CENTRE ELECTRICITY DEMAND, BY REGION, 2024 AND 2030

Data centre electricity demand could more than double by 2030, with the largest increases expected in the United States and China as AI and cloud computing accelerate digital infrastructure deployment.

■ 2024
■ 2030

46%

of global data centre electricity consumption in 2024 came from data centres in the United States.



Source: IEA, See endnote 13.¹³ • Note: Values are approximate and based on the IEA's central-case projection.



DATA CENTRES RAISE CONCERNS

→ Regional imbalance

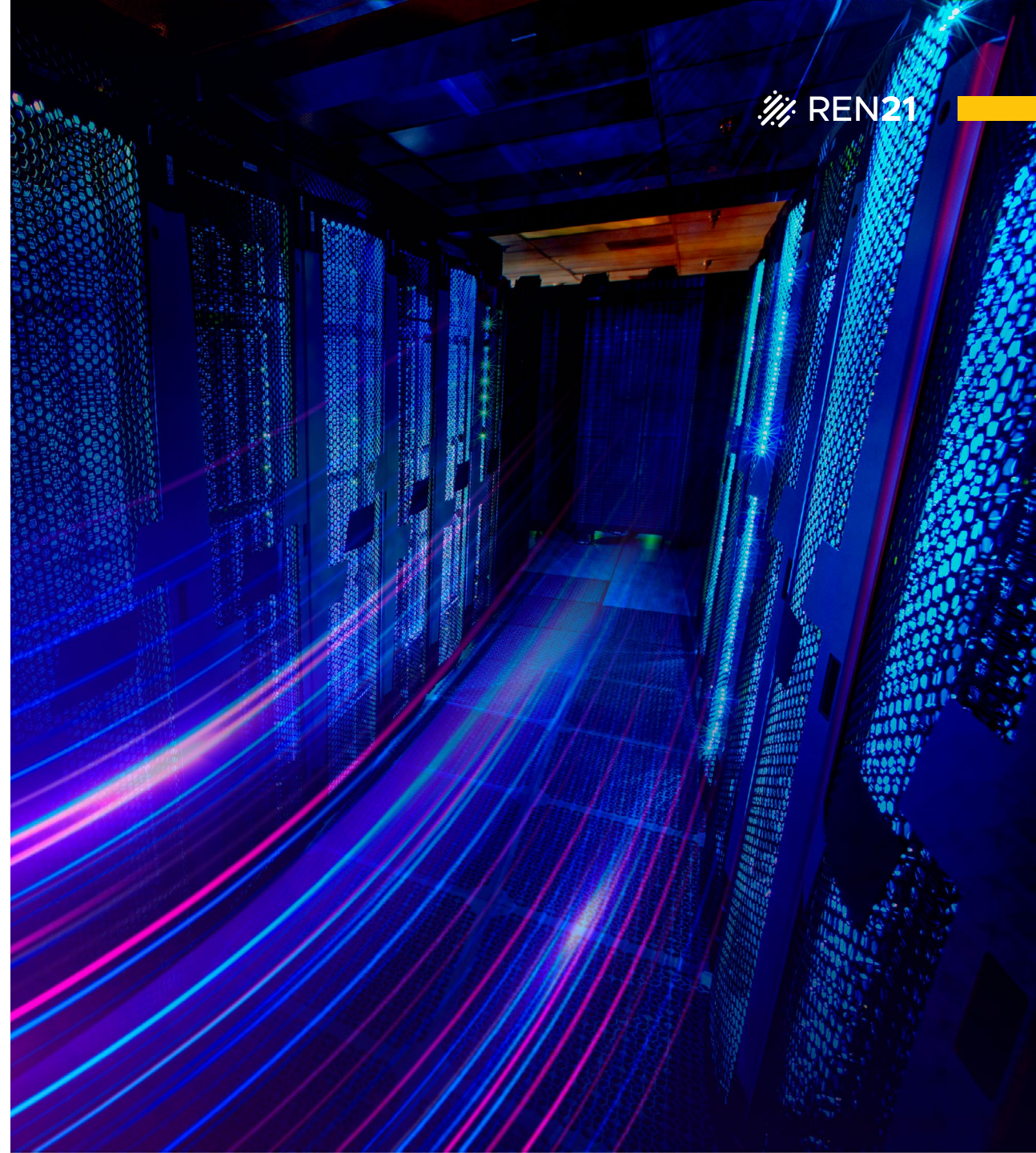
- Investment and consumption are highly concentrated in a few high-income countries and regions (United States, Europe, and Republic of Korea)¹⁴
- Africa accounts for only 1% of global datacentre capacity, despite growing digitalisation¹⁵

→ Pressure on local grids

- ~50% of electricity demand in the Dublin region in 2024¹⁶
- ~30%-42% of electricity demand in Amsterdam, London and Frankfurt in 2023¹⁷

→ Driving the installation of new gas-fired power plants

- Some technology companies are turning to fossil fuels and nuclear for meeting increasing demand





RENEWABLES-BASED POWER SYSTEMS



WHY COUNTRIES ARE ELECTRIFYING WITH RENEWABLES

- ➔ Competitive
- ➔ Secure
- ➔ Resilient
- ➔ Low-carbon
- ➔ Available everywhere



WHAT CHANGES IN A RENEWABLES-BASED POWER SYSTEM

- ➔ From fuel supply to demand led energy services
- ➔ From centralised to decentralised supply, transmission and distribution
- ➔ From linear to circular and integrated



THE INFRASTRUCTURE AND POLICY GAP



RENEWABLES ARE GROWING, BUT ENABLING SYSTEMS ARE LAGGING

Renewables are meeting a rising share of new power demand. They accounted for most of global power capacity expansion in 2025 and generated around one-third of global electricity, with regional shares varying widely. This progress shows that renewable electricity is no longer marginal; it is becoming central to power systems in many regions.

But the enabling infrastructure is not keeping pace. As of 2025, about **1,600 GW of renewable energy projects were awaiting grid connection**, highlighting the rising pressure on electricity systems as renewable energy deployment accelerates, especially in regions where grid expansion, modernisation and system flexibility are not advancing fast enough to absorb new generation capacity.¹⁸

There is also a **policy gap**. Only a few countries have policies that support renewables and electrification across all main demand sectors: buildings, industry, transport and agriculture. In many cases, policies still focus on individual sectors rather than approaching electrification as an economy-wide transformation.¹⁹ The result is a mismatch. Electricity demand is growing and renewable power is expanding, but the systems needed to support this shift are not yet aligned. Effective electrification with renewables calls for cross sectoral planning, timely infrastructure investment and policies that connect electricity demand and supply across the economy.



RENEWABLES ARE MEETING NEW DEMAND



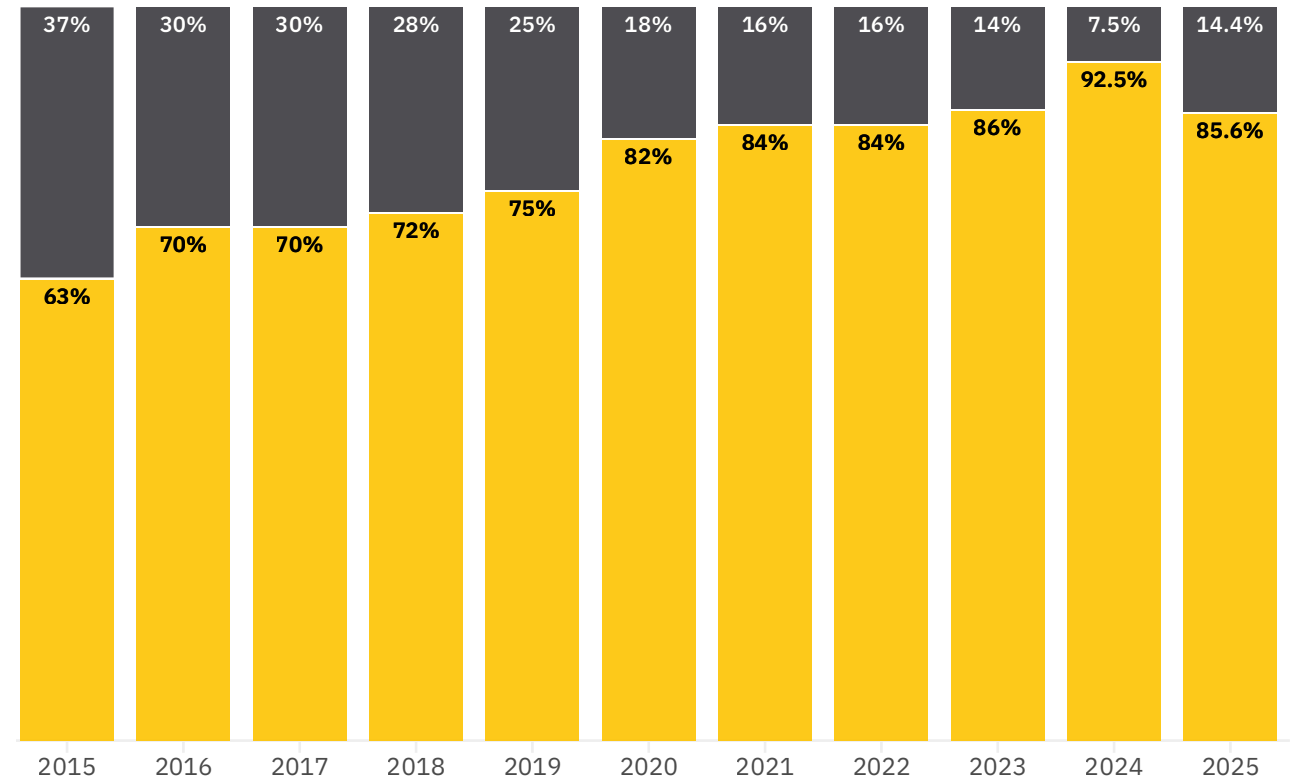
SHARE OF RENEWABLES IN NET CAPACITY ADDITIONS (%)

Most growth in global electricity generation capacity is now being met by renewables.

- Renewables
- Non-renewables

85.6%

Renewables share of all power capacity expansion worldwide in 2025.



Source: IRENA. See endnote 20.²⁰



RENEWABLE ELECTRICITY IS RESHAPING POWER SYSTEMS ACROSS REGIONS



RENEWABLE ENERGY SHARE OF TOTAL ELECTRICITY GENERATION, BY CONTINENT, 2015-2025

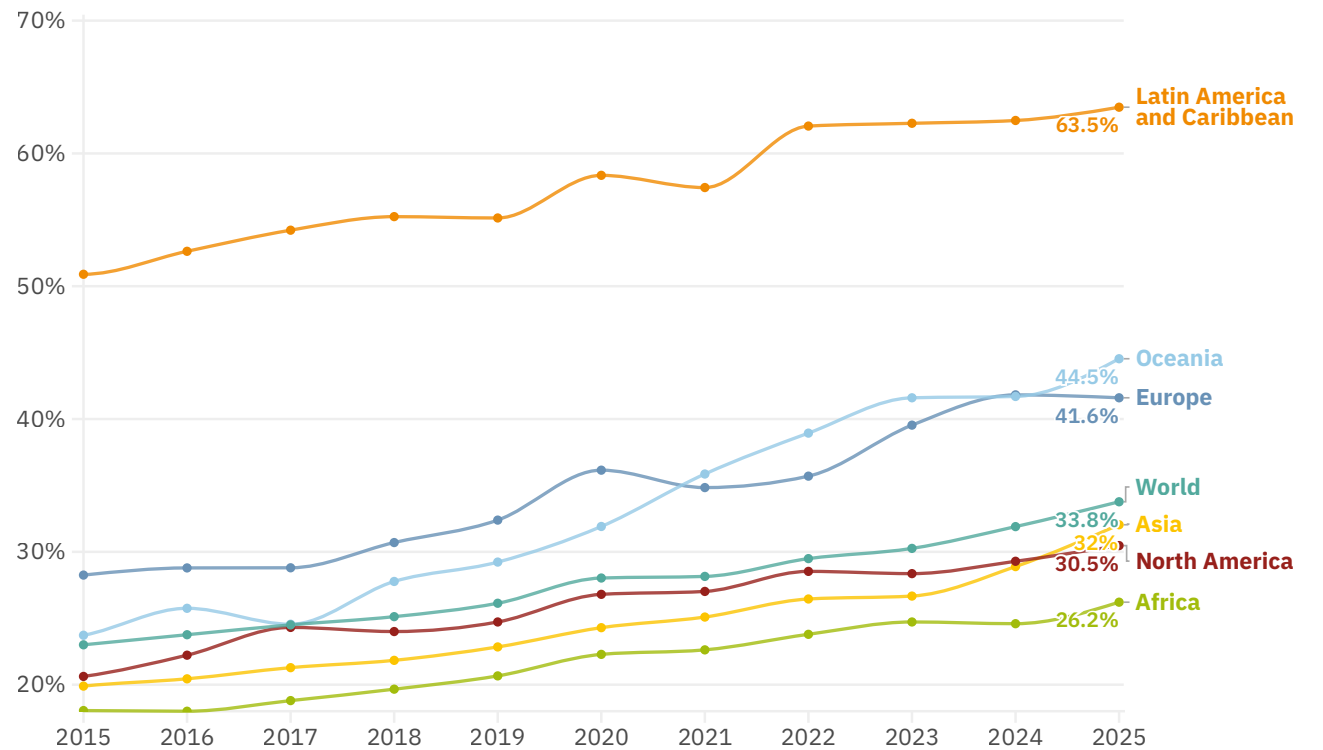
All regions increased their renewable electricity share between 2015 and 2025, although progress remains highly uneven.

33.8%

Renewables share of global electricity generation in 2025.

Renewables now generate one-third of global electricity, with regional shares ranging from **26% in Africa** to **64% in Latin America and the Caribbean**.

Share of electricity generation (%)



Source: EMBER. See endnote 21.²¹

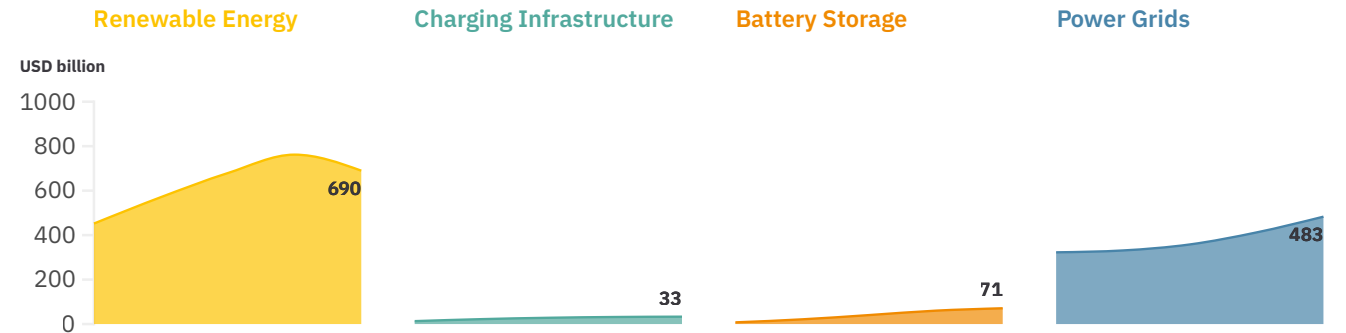


THE INVESTMENT GAP



GLOBAL INVESTMENT IN RENEWABLES AND LOW-EMISSION TECHNOLOGIES, 2021-2025

Investment is rising across most technologies, but renewable energy investment has declined in 2025.



Source: BloombergNEF. See endnote 22.²² • Note: Investment in electrified transport include spending on all types of electric vehicles (electric cars, two- and three-wheelers, buses and trucks and fuel cell vehicles) and charging infrastructure (home and public charging but private charging investment for commercial vehicles is not included). Battery Storage only includes utility-scale.

1,600 GW

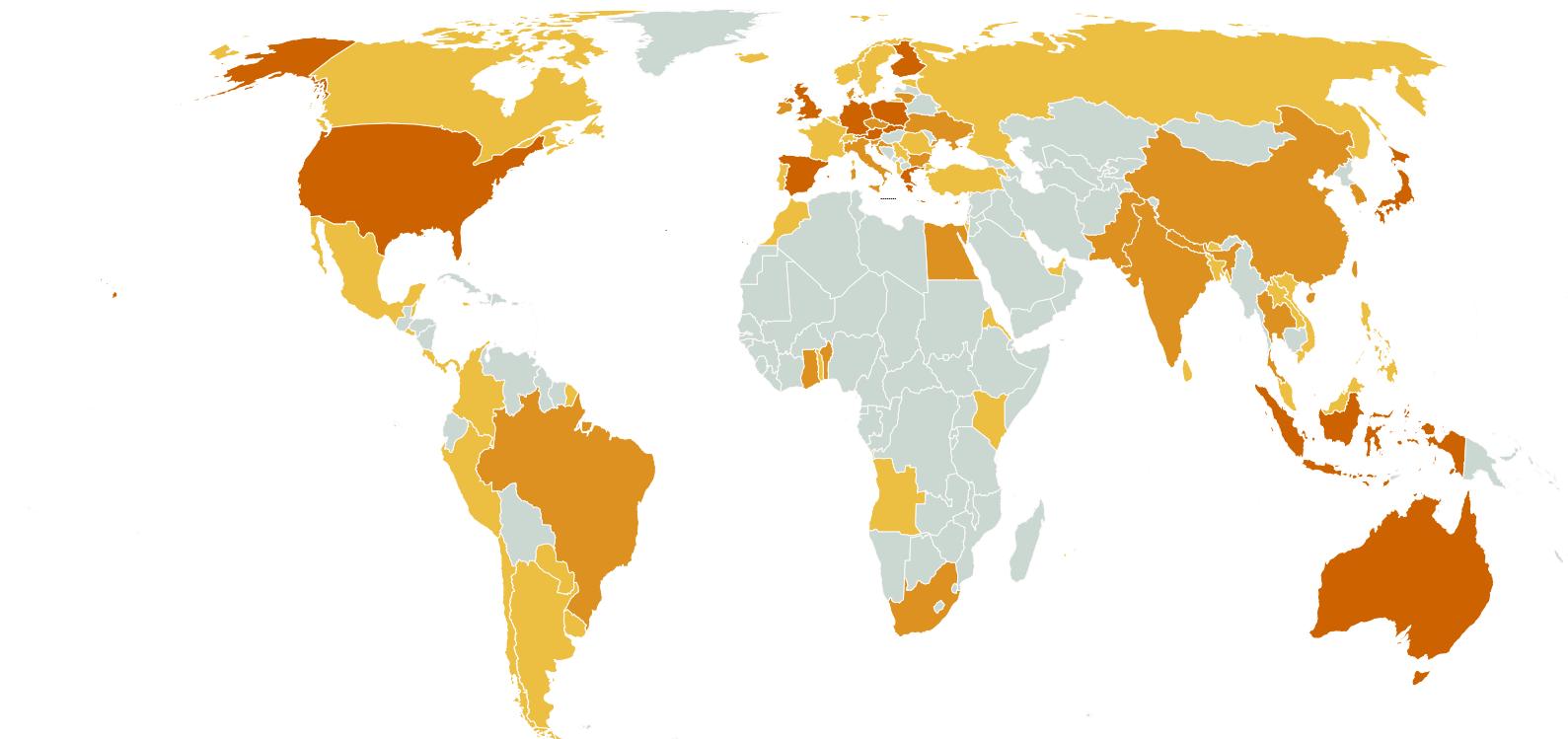
of renewable energy projects were awaiting connection to the grid in 2025.



DEMAND SECTOR RENEWABLE ENERGY POLICIES REMAIN SILOED



POLICIES FOR THE ELECTRIFICATION OF END-USE
SECTORS, AS OF 2025



Number of sectors 1 2 3

Only 14 countries

have policies supporting electrification across the demand
sectors of buildings, industry, and transport.

Source: REN21 Database. See endnote 23.²³

Policies include targets, strategies, regulations and fiscal and financial incentives at the national level to foster electrification of buildings, industry and transport: heat pumps, electric vehicles and charging infrastructure, and battery storage. Are also included policies for energy efficiency and support for the phase out of fossil fuels in buildings, as well as hydrogen for the industry and transport sectors. They include 367 policies from 99 countries.



DEMAND LED ELECTRIFICATION IN PRACTICE



THREE EXAMPLES OF HOW ELECTRIFIED DEMAND CAN SUPPORT RENEWABLE ENERGY INTEGRATION AND POWER SYSTEM FLEXIBILITY

→ FLEXIBLE INDUSTRY (HYBRIT)

Demonstrates how electrified industrial processes can become active participants in power system management by matching demand with renewable energy availability.²⁴



→ SMART EV CHARGING (UNITED KINGDOM)

Smart charging automatically shifts EV charging to periods of lower electricity demand and higher renewable generation, reducing costs and easing pressure on the grid.²⁵



→ DISTRIBUTED ASSETS (GERMANY)

Thousands of rooftop solar and battery systems are coordinated as a single resource, reducing peak demand and providing flexibility services to the grid.²⁶





KEY TAKEAWAYS



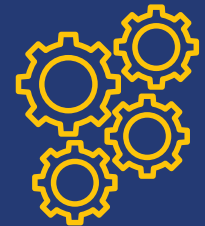
ELECTRIFICATION CAN ACCELERATE THE ENERGY TRANSITION, BUT ONLY IF DEMAND GROWTH, INFRASTRUCTURE AND RENEWABLE DEPLOYMENT EVOLVE TOGETHER.



THE SHIFTS NEEDED:

- **Plan for demand, not only supply.**
Requires coordinated, cross-sectoral planning
- **Invest in enabling infrastructure.**
Grids, storage, flexibility, demand sector electrification
- **Combine electrification with renewable energy.**
Pathway to harness the benefits of electrification
- **Align electrification with economic development.**
Support value creation and resilience

**ELECTRIFICATION IS NOT ONLY AN ENERGY TRANSITION PATHWAY.
IT IS AN ECONOMY-WIDE DEVELOPMENT STRATEGY.**



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REN21 is the global multi-stakeholder network of governments, industry, NGOs, science and academia that enables the necessary changes to build the renewable-based economy for prosperous lives and societies.

Our vision is a world where renewable energy is the foundation for strong, equitable and resilient economies. Renewables are the undeniable choice for people, nature and prosperity.

Founded in 2004, we've built a powerful and diverse network of 121 institutions and a community of more than 4,000 players, from the energy ecosystem and other key sectors. Our inclusive governance structure and collaborative culture enable us to build on the insights and intelligence of our global community to drive the solutions needed for economic prosperity and societal well-being.

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