

TRANSIZIONE 5.0: UNA SFIDA CHE L'ITALIA DEVE VINCERE

ROMA - 9 APRILE 2025

SALA DEI CENTO GIORNI

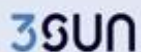
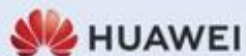
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Ordine degli Ingegneri
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Cultura e Tecnica per Energia Uomo e Ambiente





LE PROSPETTIVE DELLA COOPERAZIONE TECNOLOGICA CON LA CINA PER L'INNOVAZIONE NELLE ENERGIE RINNOVABILI

CORRADO CLINI

Distinguished Scientist of the Chinese Academy of Sciences

Già Ministro dell'Ambiente

THE GLOBAL LANDSCAPE : EMISSIONS&CLEAN ENERGY TECHNOLOGIES

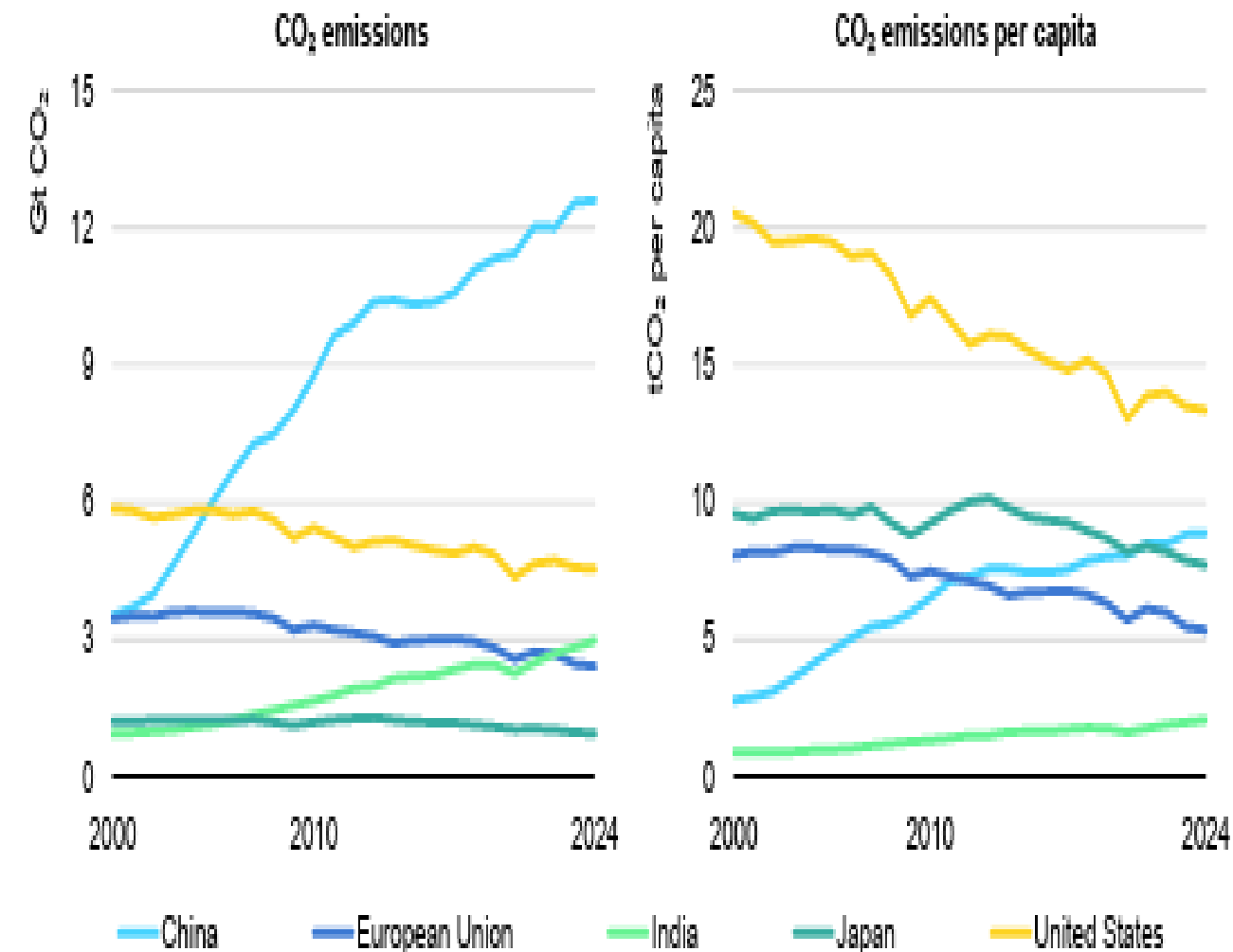
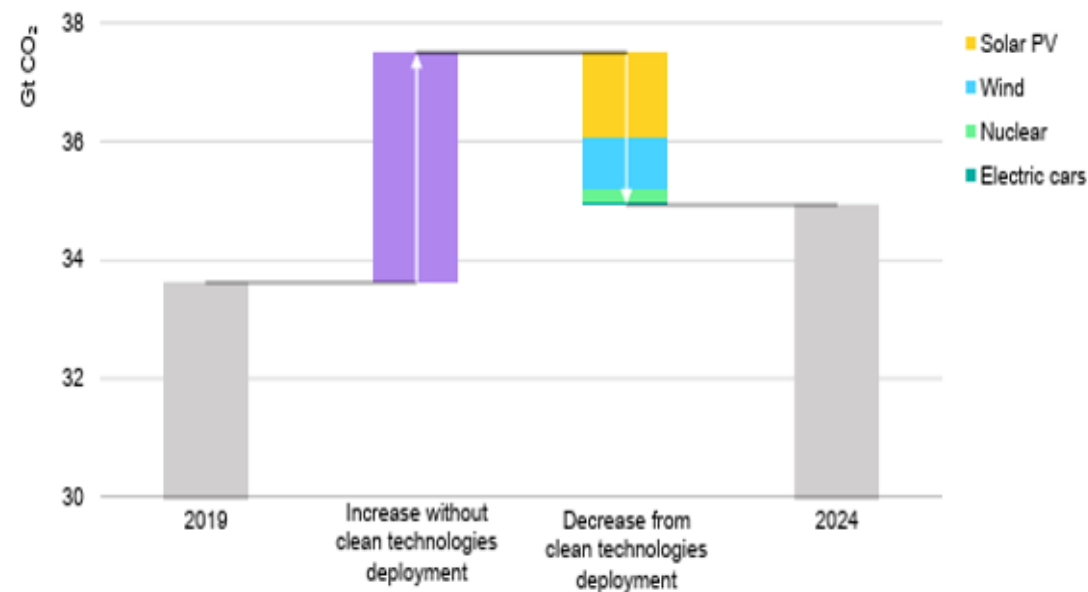
CO₂ total emissions and CO₂ per capita emissions by region, 2000-2024

Global Energy Review 2025

Despite the increase in emissions, clean energy technologies are making a difference

The rapid deployment of five key clean energy technologies – solar PV, wind power, nuclear power, electric cars and heat pumps – from 2019 to 2024 avoided annual fossil fuel energy demand of more than 30 EJ. This is equivalent to 6% of total global fossil fuel demand in 2024, or more than the combined total energy demand of Japan and Korea last year.

Change in CO₂ emissions from fuel combustion and avoided emissions from deployment of selected clean technologies, 2019-2024



Tracking Clean Energy Innovation

Focus on China

International
Energy Agency

China's transformation from a solar PV technology importer to innovator

From solar PV manufacturer to innovator

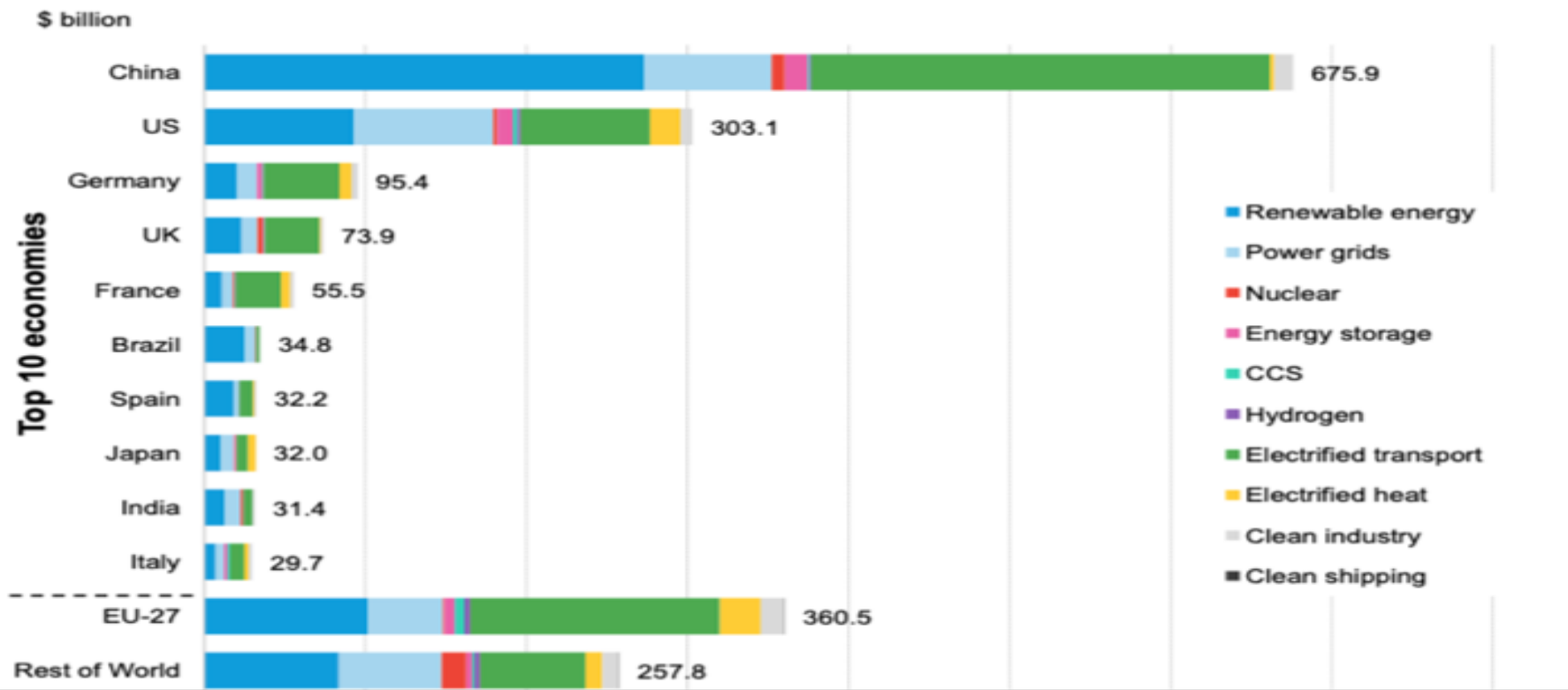
It is common knowledge today that China is a global manufacturing powerhouse for solar PV technologies. In recent years, it has also become a major source of PV [cell](#)- or [module](#)-level innovations, and accounts for an increasingly important share of global patenting. This transition from having almost no technological competences in PV to being a frontier innovator did not happen overnight, although it was quick by historical standards.

The [story of solar PV innovation in China](#) starts in the 1950s with the first publicly funded R&D in the field, which primarily focused on space applications. In the 1980s, despite R&D projects focusing on crystalline silicon cells, overall manufacturing capacity, performance and quality remained low. Innovation efforts really took off in the early 2000s. In 2002, PV cells co-developed by a Chinese researcher at an Australian university began production in a factory owned by the researcher's company, Suntech, in China. A combination of low manufacturing costs, ambitious scale and cheap capital – Suntech was backed by a municipal government in Jiangsu province – gave the factory an edge in export markets just as public support for PV deployment was starting to expand in Europe.

CHINA IS DRIVING THE WORLD'S ADVANCED ENERGY SOLUTIONS DEPLOYMENTS

Jan 8, 2025

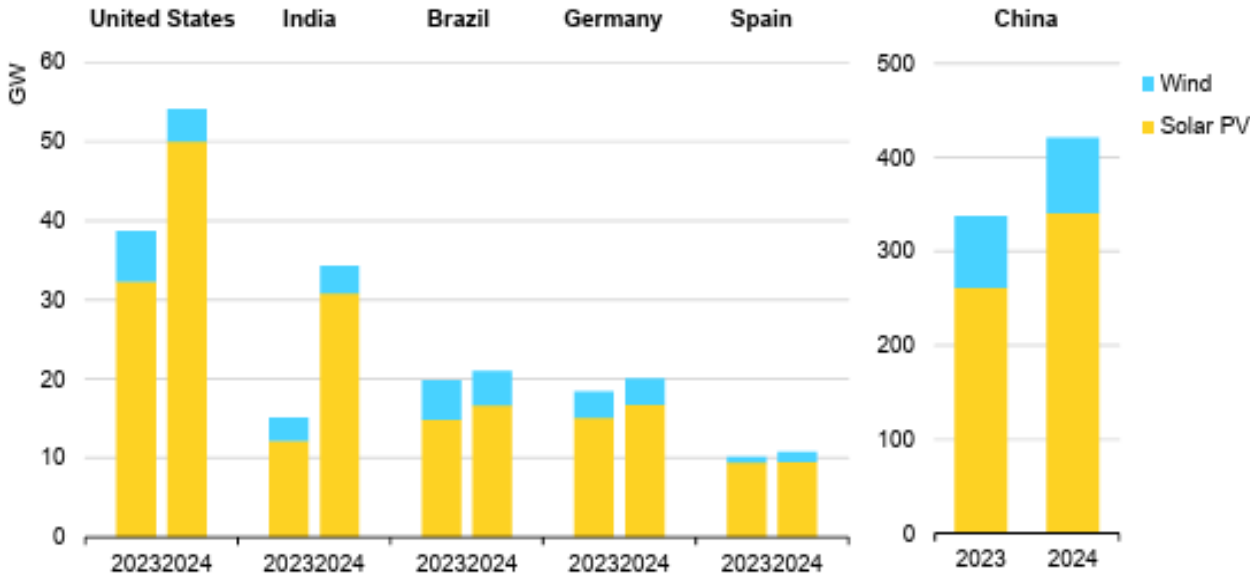
Top 10 economies for 2023 energy transition investment, plus the EU-27 and rest of the world



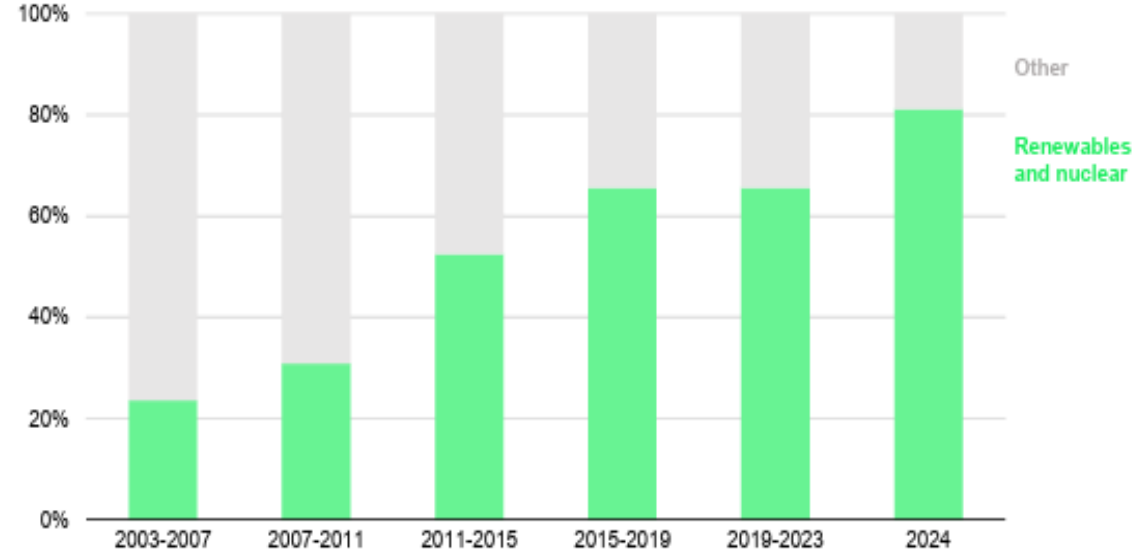
China continues to drive renewable capacity additions

China once again saw record expansion, making up almost two-thirds of all renewable capacity connected to the grid in 2024. Solar PV capacity additions (DC, direct current) reached over 340 GW, a 30% increase compared with 2023. Utility-scale plants drove over 60% of China's PV expansion, followed by distributed commercial and industrial installations. Incentives targeting rural economic development have significantly boosted the installation of residential solar systems in China since 2019, with these systems accounting for approximately one-fifth of the country's annual PV additions on average. However, last year, China's residential PV market (30 GW) accounted for less than 10% of the country's solar PV additions as incentives phased out. Meanwhile, wind growth remained stable but strong at 80 GW. The country surpassed its 2030 ambition of 1 200 GW of combined solar PV and wind capacity six years early, in mid-2024.

Solar PV and wind net additions in selected markets



Share of increase in global electricity generation, 2003-2024



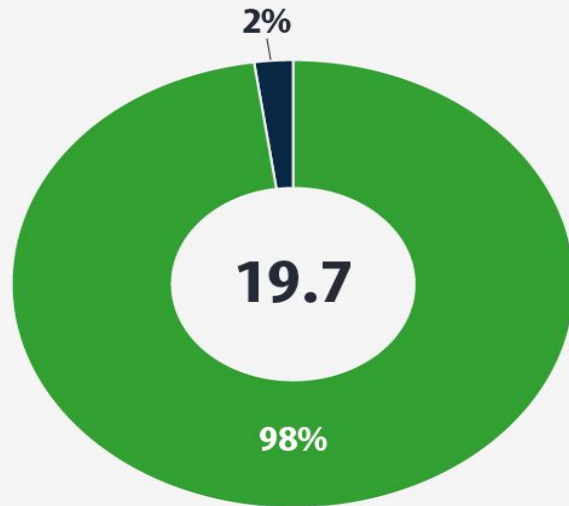
In 2024, renewables alone made up almost three-quarters of the overall increase in power generation. Solar PV led the way, increasing by about 480 TWh – the most of any source and far exceeding the previous year. Global generation from solar PV has been doubling approximately every three years since 2016, and it did so again between 2021 and 2024. Wind expanded by about 180 TWh in 2024 as new projects were brought online. However, the annual growth rate of 8% was the lowest in the last two decades due to a high base, as well as permitting and licensing challenges in several regions. Hydropower generation also increased by 190 TWh in 2024, mainly due to wet weather in several major markets. Nuclear power output increased by nearly 4%, boosted by new projects and restarted operations at several reactors in France and Japan.

THE EUROPEAN SOLAR CHARTER VS. THE RELIANCE FROM CHINA: JUST AN ASPIRATIONAL GOAL?

'The solar photovoltaic manufacturing sector is key for achieving our energy, climate and competitiveness goals. We must ensure the solar industry remains strong for Europe's future, renewables-centred energy mix. The European Solar Charter brings together the Commission, national authorities and the industry, fostering cooperation and bringing support to the production of solar panels made in Europe.' 2024

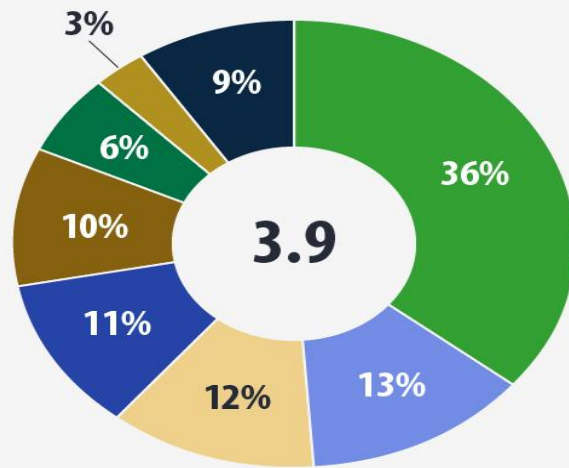
EU partners for imports of selected energy products, 2023

(value in € billion and %)



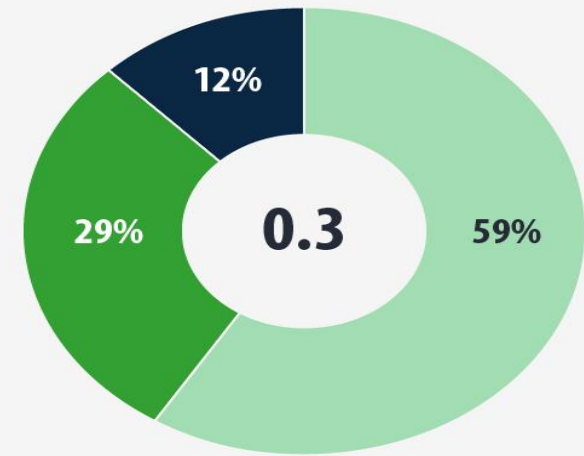
SOLAR PANELS

China Other



LIQUID BIOFUELS

China United Kingdom Brazil
Malaysia Argentina United States
South Korea Other



WIND TURBINES

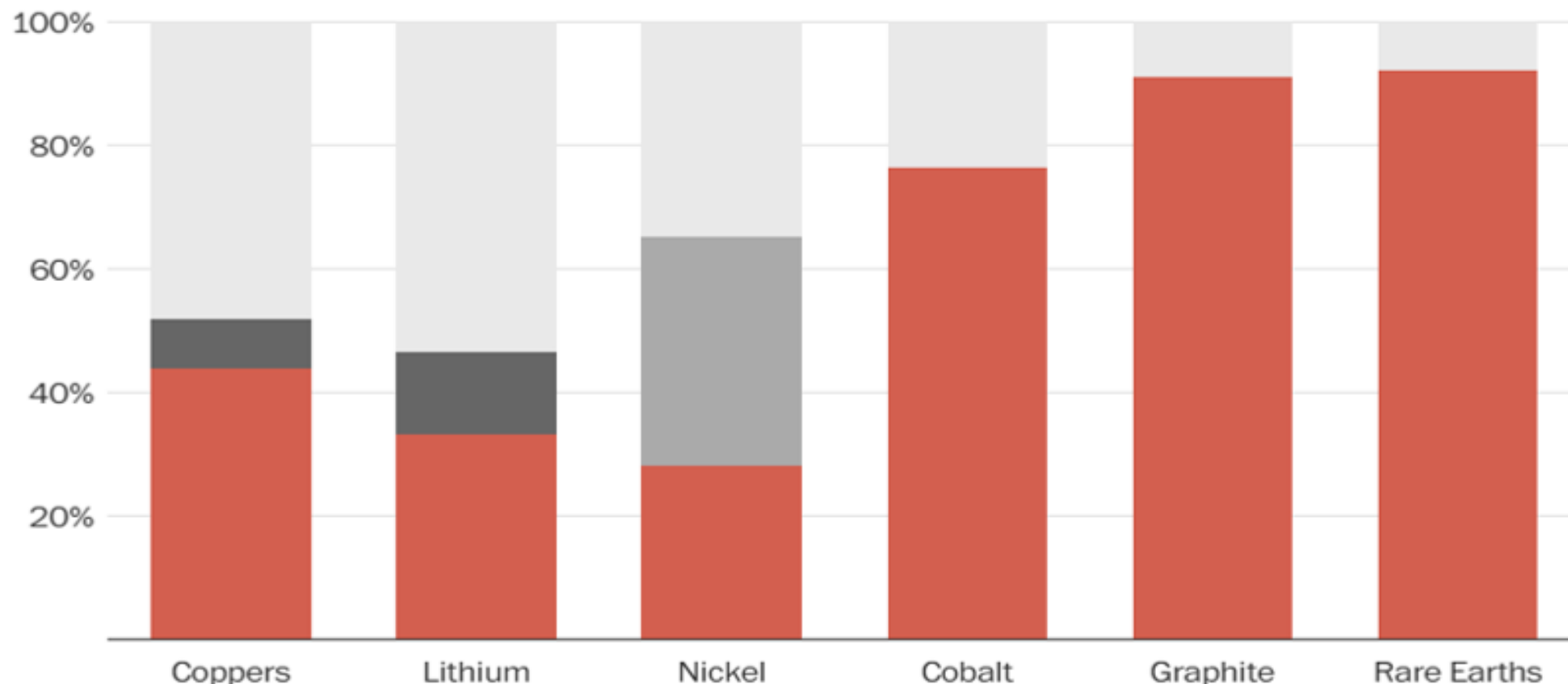
India China Other

Note: Shares may not add up to 100% due to roundings.

China dominates the processing of critical minerals used in green tech

Global share of minerals processed in each country

China Chile Indonesia Rest of world



Processed raw materials for green products controlled by China. Countries selected have processed raw materials above 10 percent. Data from 2023.

Source: IEA, Global Critical Minerals Outlook 2024

Europe's reliance is the result of two key factors:

- the Chinese solar systems dominance in the world market, due to the combined effect of the processing and refining technologies of critical minerals and rare earths developed in China since at least 15 years;
- the European obligations for decarbonization that have not been supported by adequate investments for the construction of its own industrial supply chain of solar energy.

The case of the Italian solar [molten salt thermodynamic](#) technology is the example of the European failure more than 20 years ago, while Northvolt is the most recent one

The “side” effect of reliance is also that of having equipped most of the European territory with fast-obsolescent solar systems due to the development of new technologies led by China. This is particularly the case in Southern Europe.

The EU currently contributes to 6.40% of global emissions.

Since 1990, the EU has reduced CO2 emissions by 38%, and the Gross Domestic Product has grown by 29% :

- the EU economy is the lowest in carbon intensity among the planet's large economies;
- the 55% reduction of our emissions by 2030 correspond to – 1,5% reduction of global emissions .

Europe should manage the the decarbonization objectives for promoting the development and the use in the European market of highly efficient solar systems.

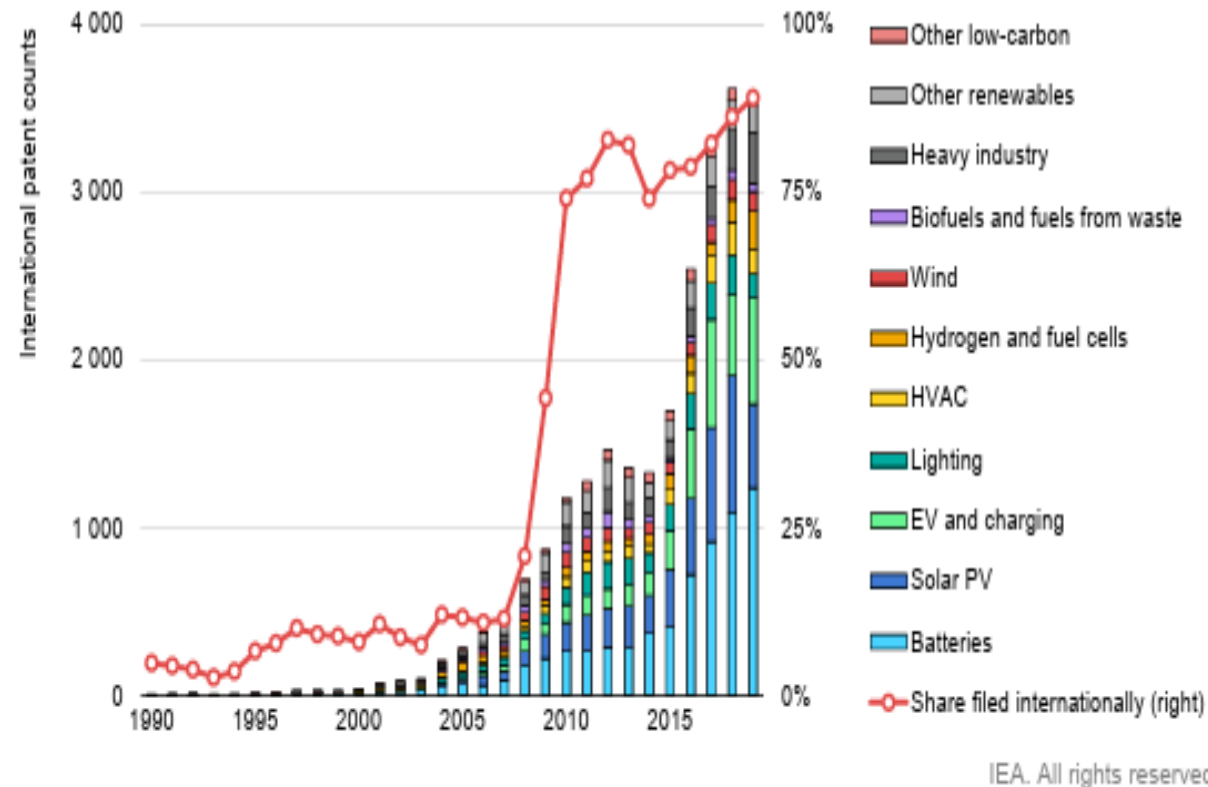
To this end, it is necessary to concentrate European research funds on a few high strategic objectives .

As Mario Draghi pointed out, "*the EU has an important program for R&I - Horizon Europe - with a budget of almost 100 billion euros. But it is spread over too many fields and access is excessively complex and bureaucratic.*"

In this perspective Europe can change the reliance into a scientific and industrial partnership with China to build innovative technologies and in solar energy to be competitive in the global market : ***From buyer to seller***

THE CHINA LEADERSHIP IN LOW-CARBON ENERGY TECHNOLOGIES R&D IS A DRIVER FOR EU-CHINA COOPERATION IN THE RENEWABLE TECHNOLOGY INNOVATION : A WAY TO REDUCE THE EUROPE'S RELIANCE

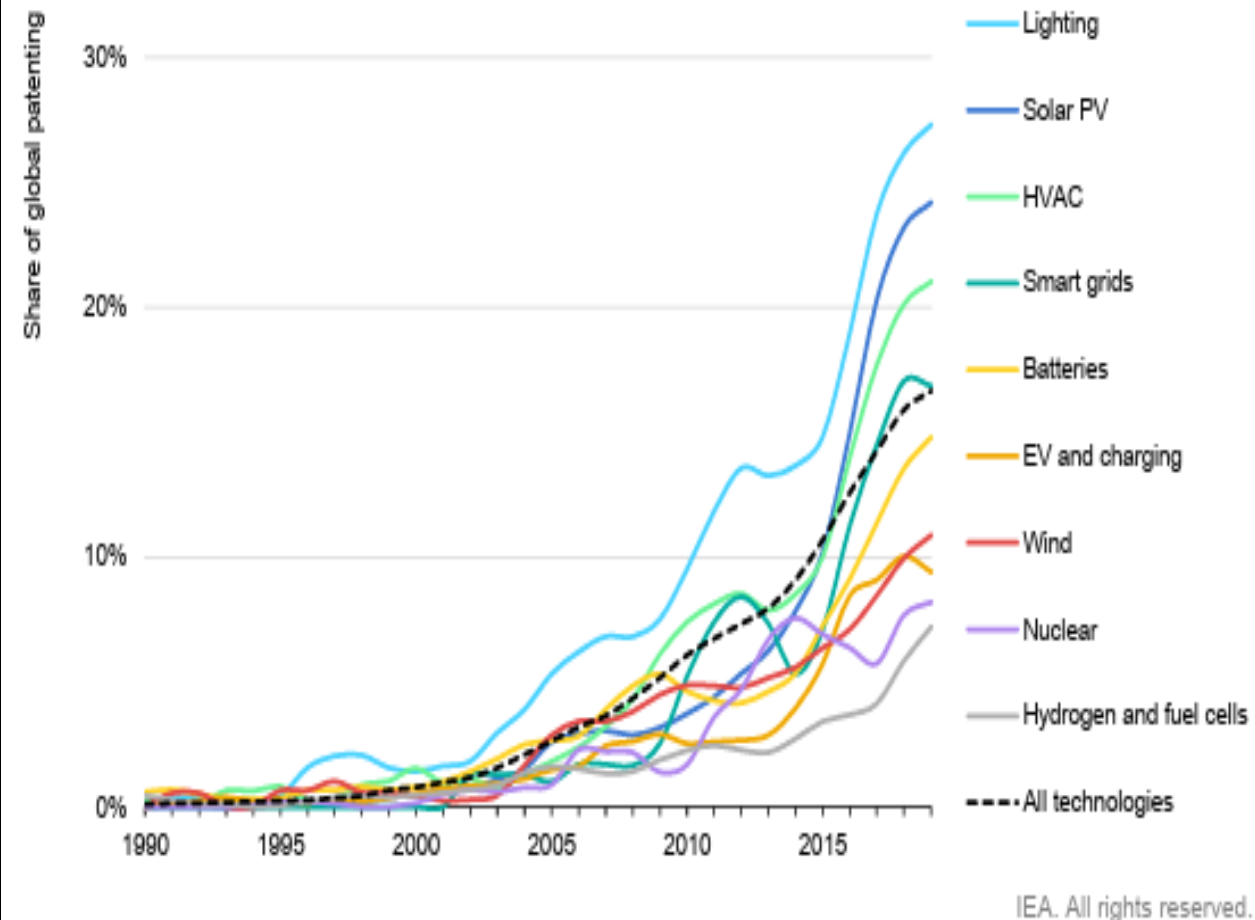
International patents in selected low-carbon energy technology areas filed by Chinese inventors, and share of these patents that are international (1990-2019)



Notes: Patent counts in climate-change mitigation technologies relating to energy, filed in at least two geographical offices. HVAC = heating, ventilation and air conditioning. "Other renewables" includes the integration of renewables in buildings, geothermal, hydro, marine, solar thermal and hybrid thermal-PV energy sources. "Heavy industry" includes the production and/or processing of chemicals, cement, lime and metals. "Other low-carbon" includes technologies relating to air and maritime transport, capture or disposal of carbon dioxide, nuclear power generation and smart power grids. The share of patents filed internationally refers to the ratio of patents filed by Chinese inventors in at least two patent offices relative to all patents filed.

Source: IEA analysis based on OECD data on [innovation in environment-related technologies](#).

China's share of global patenting in selected low-carbon energy technology areas and for all technologies (1990-2019)



Notes: Patent counts in climate-change mitigation technologies relating to energy, filed in at least two geographical offices. Three-year moving averages are used.

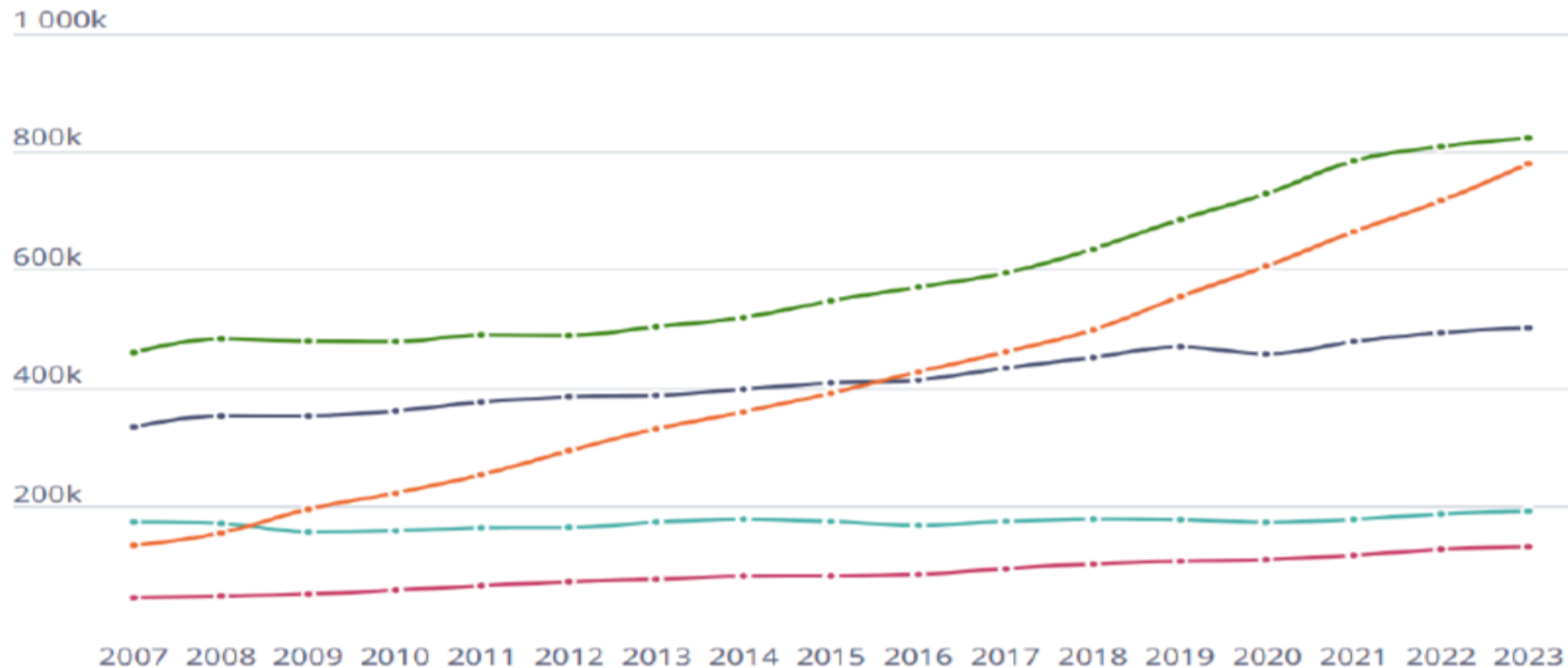
Source: IEA analysis based on OECD data on [innovation in environment-related technologies](#).

R&D spending growth slows in OECD, surges in China

Gross Domestic Expenditure on R&D (GERD), selected economies

Constant USD PPPs, million

--- European Union --- Japan --- China (People's Republic of) --- United States --- Korea

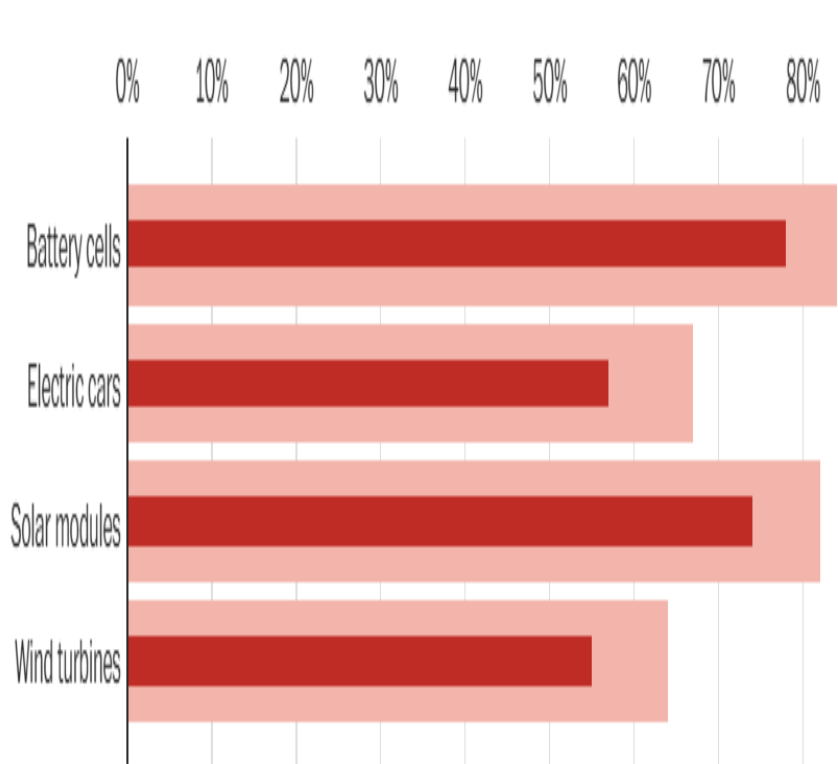


Source: OECD, Main Science and Technology Indicators Database, March 2025, <https://oe.cd/msti>

Green technology manufacturing is concentrated in China

Chinese share of global installed production capacity

2023 2021

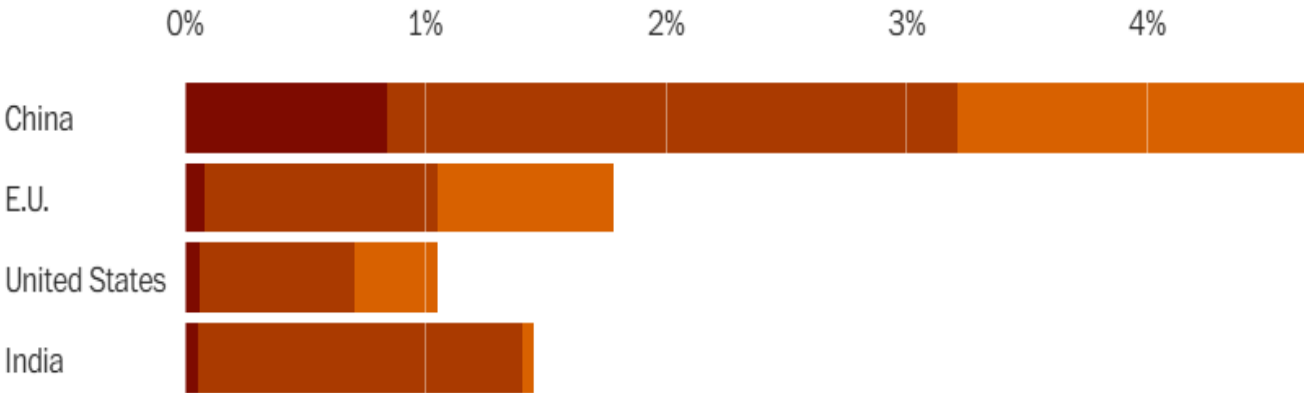


Source: IEA, Energy technology Perspective 2024

China's economy relies on clean technology more than others

Investment in renewables and the sale of carbon-replacing technologies as a share of GDP

- Manufacturing of clean energy technologies
- Deployment of clean power capacity
- Sales of electric vehicles and heat pumps



Clean energy technology manufacturing includes investments in solar panels, wind turbines and battery production. Clean power deployment covers investments in clean power sources like solar, wind, nuclear and battery storage.

Source: IEA, Advancing Clean Technology Manufacturing Report, 2024

Green tech contributed significantly more to the economy in China in 2023 than in the E.U., the United States or India, according to an International Energy Agency analysis.

ITALY CAN DRIVE THE CHINA-EUROPE COOPERATION

Action Plan for Strengthening the China-Italy Comprehensive Strategic Partnership (2024-2027)

On the occasion of the 20th anniversary of the China-Italy Comprehensive Strategic Partnership, on **July 28, 2024**, a meeting was held in Beijing between the Prime Minister of the People's Republic of China Li Qiang and the President of the Council of Ministers of the Italian Republic Giorgia Meloni.

1. Sustainable growth.

The parties agree on the importance of reconciling economic growth and development with the global objectives of energy and ecological transition, in line with the ambitious commitments undertaken by both Nations. To this end, they intend to increase collaboration in the field of renewable energy and related technologies.

3. Scientific and technological innovation, education

The Parties underline the importance of strengthening scientific and technological cooperation and cooperation in joint research in areas of common interest, as well as the importance of implementing joint higher education projects in specific areas such as environment, energy, polar research and sustainable development.

4. Green and sustainable development

The Parties agree to promote cooperation in areas such as environmental protection policies and technologies, raw materials and clean energy technologies, energy efficiency, climate change response, biodiversity conservation, circular economy and capacity-building.

EMERGING R&D AND INNOVATION IN SOLAR ENERGY TECHNOLOGIES IN EUROPE AND CHINA



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Yttrium doped CuInSe₂ solar cells: higher conversion efficiency and promising candidate for top cell of tandem cells

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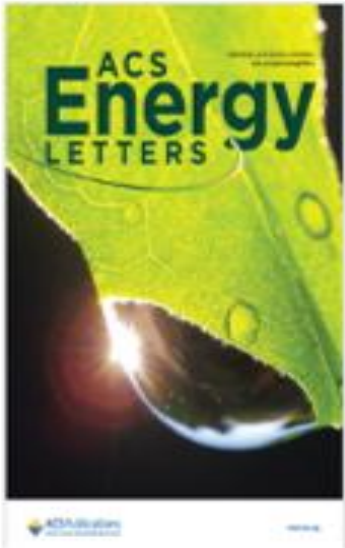
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LETTER | April 1, 2025

Post-Treatment Free Yttrium Phosphotungstate Anode Interfacial Material for Organic Solar Cells with 20.55% Efficiency

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EMERGING R&D AND INNOVATION IN SOLAR ENERGY TECHNOLOGIES IN EUROPE AND CHINA

3SUN, CEA reach 30.8% efficiency for tandem perovskite-silicon cell

Jan 29, 2025

3SUN, the Italian solar cell and module maker owned by Enel Group, and the French Alternative Energies and Atomic Energy Commission (CEA) have achieved 30.8% efficiency on tandem perovskite-on-silicon solar cell technology.

The cell was developed in the CEA laboratories at France's National Institute for Solar Energy (INES). It is a 9 sq cm cell, which is expected to pave the way to scaling to industrial production as most international records are achieved on surfaces of 1 sq cm, the partners say. In the space of a year they have managed to increase the efficiency for this type of cell by 2.4 percentage points, up from 28.4% in January 2024.

Can we achieve the increasing efficiency of solar cells and modules up to 40%-50% and above?

In the framework of the China-Italy Comprehensive Strategic Partnership, Italy could ask European Union to bring skills and resources of China and Europe to build joint scientific and industrial projects for the innovation in solar energy.

China-Europe cooperation can be aimed at two main objectives :

Innovation

Increased efficiency of solar cells and modules

R&D in new materials and technologies

Revamping of existing solar plants with new more efficient ones and reduction of land use

Recycling of replaced modules with recovery of silicates and critical minerals

Industrial solar technology development in Europe

Construction of innovative and advanced solar cells and modules JV factories in Europe.