

Spurred by solar power, the energy transition continues through thick and thin

Key points

- ▶ **Lower CO₂ emissions in China:** for the first time during a period of growth, China's CO₂ emissions fell in the first quarter of 2025 (by 1.6% year-on-year) thanks to increased production of low-carbon electricity¹.
- ▶ **Solar power production at a record high, for the first time in a month:** the solar power industry is expanding on the back of increased global demand for electricity and new technologies.
- ▶ **Growth in renewable energies:** low-carbon sources accounted for 40% of the global electricity mix in 2024, with China proving to be the biggest installer of new solar capacity².
- ▶ **Energy sovereignty gaining ground in the USA:** although renewable energy subsidies are on the decline, the country's current energy policy is actually boosting its solar power output.
- ▶ **A global approach is necessary to achieve a successful transition:** besides producing renewable energies, there is also a vital need to invest in energy efficiency, upgrade and expand power grids, invest in storage solutions like batteries, and electrify energy demand.



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Two recent statistics have gone relatively unnoticed but reflect the progress being made on the energy transition: a year-on-year reduction in China's CO₂ emissions and a record high level of solar power output worldwide in April 2025, overtaking nuclear. The media may be focusing its attention on the Trump administration's efforts to bulldozer the energy transition, but the transition is moving forward nonetheless. Solar power, especially, is riding high on both a technological wave and a market wave and its momentum is clearly prevailing over all the political turmoil and decline in public support, even in the USA. Here at Mirova, we continue to invest with conviction in the long-term climate theme.

1. Source: Carbon Brief. Data validated by a former senior Chinese economy ministry official, according to Bloomberg..

2. Source: [ourworldindata](https://ourworldindata.org)

01 | China's CO₂ emissions down on a year-on-year basis... and for good?

On 15 May, specialist media website Carbon Brief published an article entitled: "[Clean energy just put China's CO₂ emissions into reverse for the first time](#)" with estimates suggesting that China's emissions fell by 1.6% year-on-year in the first quarter of 2025 and by 1% in the latest 12 months. Power sector emissions, in particular, dropped by 2% year-on-year in the 12 months to March 2025. This corresponds to a 43 million tonne reduction in CO₂.

This is not the first time that China's emissions have fallen, the latest episode dating back to Covid, but past occurrences have always coincided with a slowdown in economic activity. This time they have reversed despite robust economic growth and a 2.5% year-on-year increase in power production. The generation of low-carbon electricity (from wind, solar and nuclear sources) has helped to reduce the generation of coal and gas-fired electricity in absolute terms (by -4.7%).

Growth in the amount of renewable energy produced in China in 2024 covered as much as 81% of the increase in power demand. The Carbon Brief article notes that **growth in China's renewable energy generation is now structurally outpacing current and long-term growth in electricity demand, which is likely to result in a decline in fossil fuels**. Power sector emissions are set to continue falling in 2025, even though there is some uncertainty surrounding the impact that Trump's trade war will have on China's domestic consumption.

Looking beyond 2025, the outlook hinges largely on the clean energy targets set in China's five-year plan due to be published next

year. So China's emissions might possibly have peaked in February 2024, i.e. 6 years ahead of schedule under its international climate pledges.

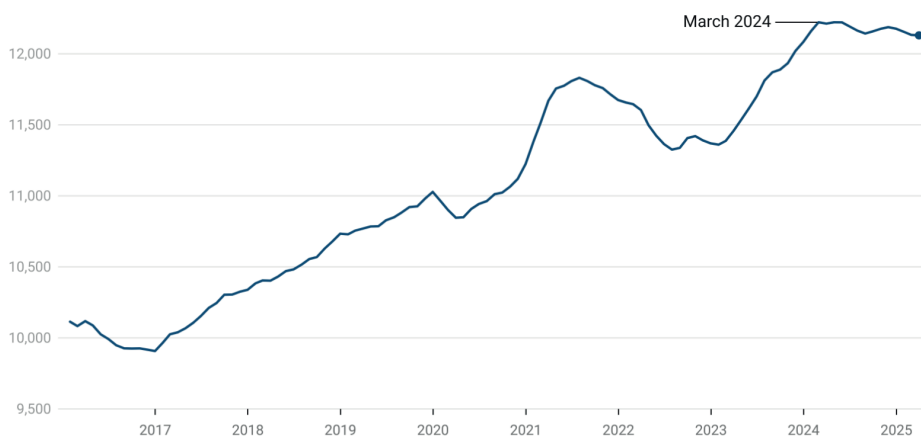
If this is indeed the case, it would lend further credibility to the theory that economic growth is becoming dissociated from emissions growth as renewable energies displace fossil fuels.



3. Source: Carbon Brief (for all the data in the paragraph).

China's CO₂ emissions drop due to clean energy for first time

Emissions from fossil fuels and cement, MtCO₂, rolling 12-month totals



Source: Analysis by Lauri Myllyvirta for Carbon Brief

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02 | Solar power hitting new records and still growing at unprecedented rates

The world generated 2,330 TWh of solar power in April 2025: this is the first time that solar power has surpassed nuclear power over the space of a month, according to think tank [Ember](#). It took solar energy 8 years to jump from 100 TWh to 1,000 TWh but just 3 years to then overtake the 2,000 TWh mark: never in the history of electricity has a source achieved such rapid growth.

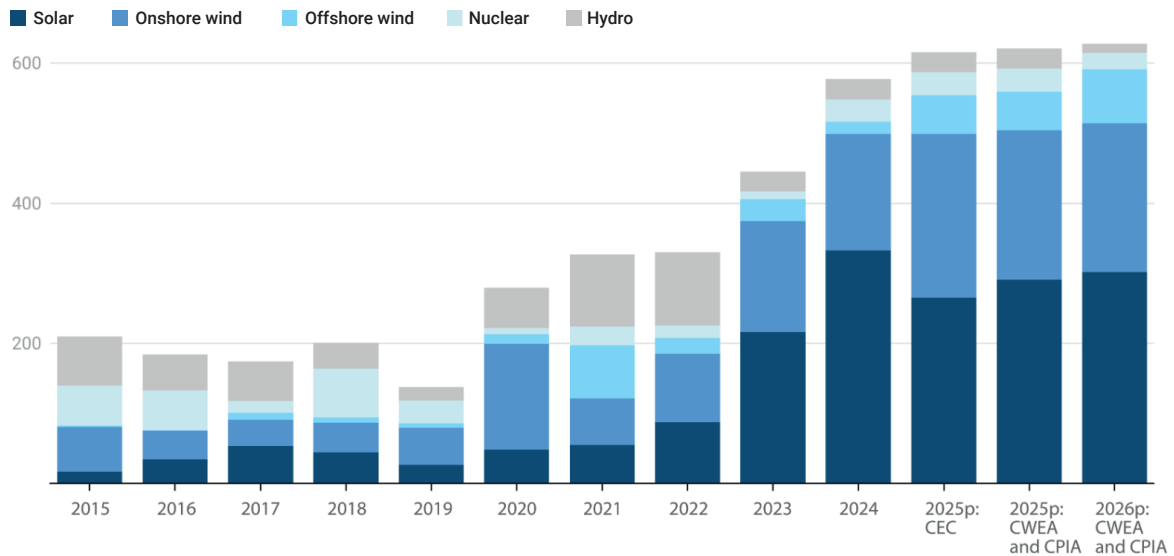
According to [ourworldindata](#), growth in solar and wind energy generation increased the share of low-carbon sources in the world's electricity mix to 40% in 2024. This, too, is a first. China has, of course, spearheaded this revolution as it accounted for 55% of the world's new solar installations in 2024 (597 GW in total). In second place was the USA, followed by India, Brazil and then Germany. Yet solar energy is by no means confined to countries enjoying the best conditions: the 10 countries with the largest shares of solar energy in their electricity mix include a poor

country, El Salvador (17%), a country with little sunshine, the Netherlands (18%), and, in first place, a country that has for the past 13 years been led by a head of state who opposes Europe's climate agenda, Hungary (25%).

If solar power is rolling out at such speeds and in such a wide variety of regions, it is because it offers inherent advantages. First of all, solar energy is currently the most competitive source of energy in most of the world's regions: the levelized cost of electricity (LCOE) for solar power plants is \$35 per MWh, according to [BNEF](#). Solar panel prices are now roughly only a tenth of what they were 10 years ago. One advantage of solar power generation is that it is very modular in nature: a solar farm is made up of panels, which themselves consist of modules, which in turn are made up of cells. This means it is possible to mass produce small parts, allowing improvements to be made rapidly, construction methods to be fine-tuned, and costs to fall. This puts it at a huge advantage over other low-carbon technologies that are far more complex. Solar also generally enjoys high local acceptance rates, unlike onshore wind for example. The most competitive solar projects do require a

Newly added clean generation is set to remain above the record levels set in 2024

Annual output of clean power capacity, terawatt hours



Source: Analysis by Lauri Myllyvirta for Carbon Brief

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large amount of ground coverage and sometimes face local opposition due to land use change, but solar can be deployed very well in a decentralised manner both at the corporate and individual level, despite cumbersome local permitting procedures.

[Bent Flyvberg](#), author of *How Big Projects Performed*, says the average cost overrun of a solar farm relative to its initial cost is 1%, compared with 13% for a wind farm, 16% for a thermal plant, 75% for a hydroelectric dam and 120% for a nuclear plant.

Such technological progress has China's stamp on it: the country controls 80% of the solar panel value chain, covering everything from polysilicon to ingots, wafers⁴, cells and modules (note that panels do not contain any critical minerals such as nickel, cobalt or rare earths). This quasi-monopoly raises social risks: roughly 45% of global polysilicon supplies come from Xinjiang, a region where the [UN](#) has recorded serious violations of human rights against Uyghurs and

other Muslim communities. In 2021 the USA passed the Uyghur Forced Labor Prevention Act (UFLPA) to ban imports of products manufactured with the help of forced labour in China. The act forms part of an arsenal of protectionist measures brought in by the USA (tariffs, financial support for local manufacturing) aimed at building a local solar power industry.

03 | Grids, batteries, electrification: the other drivers of a successful energy transition

Variable renewable energy is being rolled out so fast that the focus now is more on the capacity that power grids have to absorb these new sources of energy. First of all, it is worth noting that renewable energies are generally more competitive and faster to roll out than thermal sources of energy even after factoring in grid connection costs, according to the

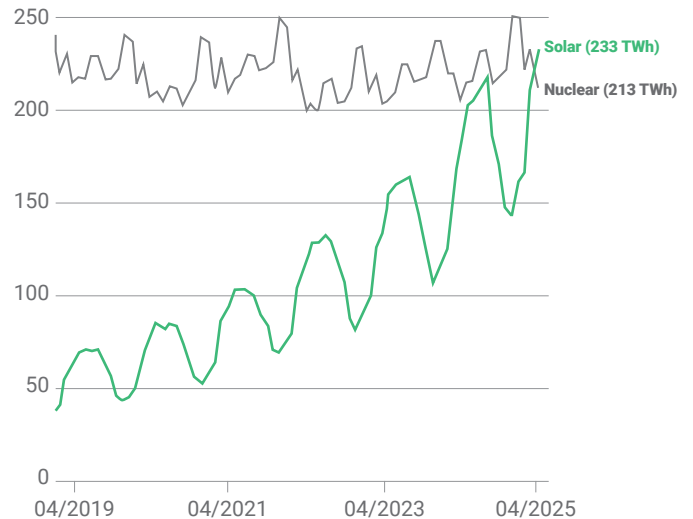
4. Wafer: very thin slice or wafer of monocrystalline semiconductor material used to manufacture microelectronic components.

IEA's⁵ [World Economic Outlook 2024](#). Secondly, the large-scale installation of electric batteries is progressing at an exceptionally fast pace, one that can only be compared with... solar power, thanks precisely to this same modular approach to deployment. It therefore looks like one of the top priorities today is to upgrade and invest in power transmission and distribution grids (2 million kilometres of new lines need to be built annually between now and 2030 under the IEA's NZE⁶ scenario); this will involve deploying the full range of flexibility solutions such as battery and hydroelectric energy storage, demand response solutions, and thermal plants to ensure enough flexibility to meet seasonable needs as a last resort.

Battery storage solutions are thus vital to supply security at a time when supply and demand are fluctuating owing to increasing electrification and the integration of intermittent sources of energy. The IEA estimates that storage capacity will have to increase

six-fold in order to triple the world's renewable energy capacity by 2030 while safeguarding the reliability of its power grids.

April 2025: For the first time ever, solar power generated more electricity than nuclear worldwide



Source: Monthly electricity date, Ember.

EMBER



5. IEA (International Energy Agency)

6. The share of electricity in final energy consumption jumps from 20% to 50% in the IEA's net zero scenario.

The State of California, for example, is making strides towards achieving its goal of 100% renewable electricity by 2045 - with over 30% of its electricity output generated from solar. Batteries already play a key role and are fast becoming the grid's biggest power contributor during short peak periods in the evening.

Progress in rolling out renewable energies and batteries is dragging thermal capacity utilisation rates down in China but also in Europe

(where renewables now account for 50% of the electricity mix) and the USA. This means fewer emissions from the power sector, which is often the most polluting emitter. All this should encourage decision makers to further speed up the race towards electrification with the aim of reducing the use of fossil fuels, not only in power generation but also in transport, industry and buildings. As the [IEA](#) points out in its most recent NZE scenario update in 2023, the technologies needed to keep the 1.5°C goal within reach are already available and have already been tried and tested: the deployment of solar, wind and electrification⁷, the replacement of fossil fuels with renewable sources, and the application of electrification and energy efficiency measures will contribute 80% of the emission reductions needed by 2030.



04 | Solar is helping to reinforce the USA's energy sovereignty, despite President Trump

The start of Donald Trump's second term in the White House sent the renewable energy sector a warning shot, raising fears that the energy transition would be derailed not only in the USA but also across the world. Trump was certainly quick to show his hostility towards climate policy, confirming his support for fossil fuels on his very first day back in office by signing the Unleashing American Energy order⁸.

The political turmoil did indeed stop the sector in its tracks temporarily, but the situation needs to be considered through the prism of some broader trends sweeping through the energy market.

7. The share of electricity in final energy consumption jumps from 20% to 50% in the IEA's net zero scenario.

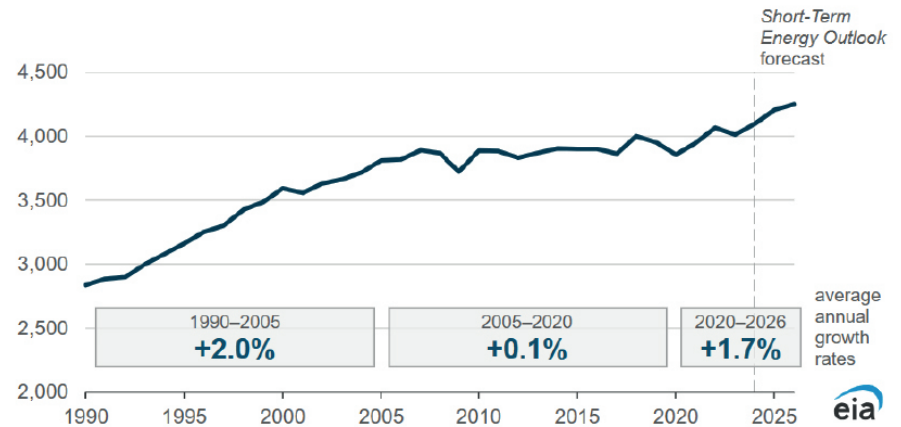
8. The Unleashing American Energy order refers to a series of measures taken by the Trump administration to spur energy output in the USA, especially fossil fuels (oil, gas, coal).

The first shockwave came when the Inflation Reduction Act (IRA) was compromised. Signed by Joe Biden in August 2022, the act consisted of a programme of support measures for rolling out renewable energies on a scale never before seen, with 386 billion dollars to be allocated over a ten-year period. The IRA extended and expanded a 30% tax credit on renewable projects, with different types of rebates that could increase the tax credits further depending on specific criteria; its aim was to spur growth in renewables by making them more economically competitive and encouraging supply chains to relocate.

The One Big Beautiful Bill, a budget reconciliation law adopted by Congress in early July, establishes a new regulatory framework and generally outlines the current administration's energy policy. It reflects a determination to scale back renewable project subsidies by hitting certain segments hard (electric vehicles, solar panel purchases by individual homeowners) and bringing forward the end of tax credits for new developments. On the other hand, like the IRA, the law intends to keep offering incentives to produce nationally and encourage supply chains to relocate by maintaining tax credits (section 45x of the US tax code) for local manufacturers (except makers of wind turbine parts, for which tax credits are set to discontinue after 2027).

U. S. electricity consumption (1990-2026)

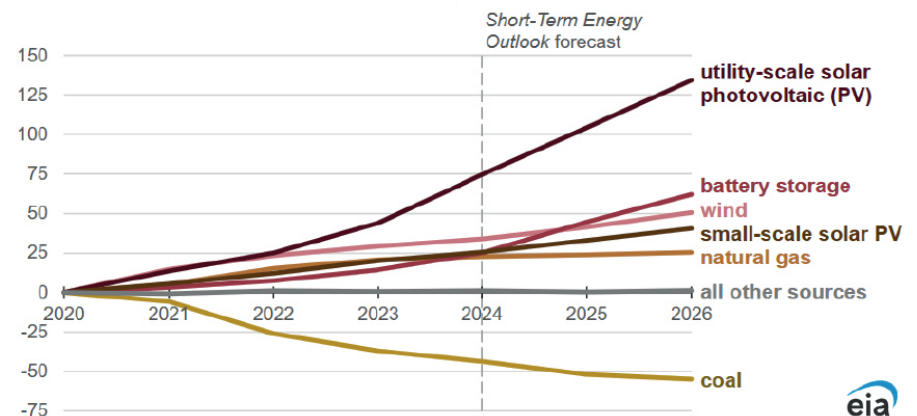
billion kilowatthours



Data source: U.S. Energy Information Administration, *Monthly Energy Review* and *Short-Term Energy Outlook*, May 2025
Data values: *Electricity Overview* (history) and *U.S. Electricity Industry Overview* (forecast)

U. S. electric generating capacity (2020-2026)

change since 2020, gigawatts



Data source: U.S. Energy Information Administration, *Short-Term Energy Outlook*, May 2025
Data values: U.S. Electric Generating Capacity

This financial aid for domestic production is seen by both parties as essential to reindustrialising the USA and creating jobs in the country. Additional restrictions on supplies from certain countries and higher trade tariffs also add to the momentum. Accordingly, the value chain, while still heavily dependent on Chinese industry, is in the process of reorganising itself. A US solar industry appears to be taking shape, with 8.6 GW⁹ of solar module

9. Source: SEIA (Solar Energy Industries Association)

production capacity added in the first quarter of 2025 alone, making it the third biggest quarter ever recorded in terms of new production capacity.

The hastened elimination of government subsidies is likely to encourage developers to bring their project launch dates forward in order to secure their tax credits in the short term. This transition phase could prove beneficial to electrical equipment and green technology manufacturers, which are expected to make the most of this opportunity to expand their backlogs. Development costs will rise as subsidies are phased out, which will create a new supply-demand equilibrium in the solar energy market: slowing installations and higher solar energy prices are therefore expected. Consumers are highly price sensitive, so the residential solar sector is likely to be hit particularly hard by these new regulations when the tax credits granted to individual homeowners for buying solar panels are wound down. On the other hand, large-scale solar farm developments should continue to enjoy healthy demand.

Setting aside all the political and regulatory turmoil, **there is after all an underlying trend supporting the solar industry: electricity demand is on the increase again after having remained flat for a long time (+2% per year, according to the IEA). It is trending upwards on the back of technological progress, especially artificial intelligence which requires massive amounts of energy to keep data-centres running.** A ChatGPT search uses up ten times more energy than a Google search, so the IEA expects power demand from datacentres worldwide to double between now and 2030 to about 945 TWh, which is slightly more than the amount of electricity currently consumed by the whole of Japan. The USA is expected to account for most of this in-

crease, followed by China. Meanwhile, industrial relocation is progressing at a faster pace because of geopolitical tensions; this is also likely to push demand up further and increase the need for more local energy production capacity in order to boost economic growth.

The solar industry is perfectly placed to meet this increased demand. It boasts a competitive cost advantage in many US regions, even without subsidies, and above all it can be deployed rapidly. Whereas the gas turbine industry faces shortages (manufacturers are out of stock and will be unable to honour any new orders until 2028) and the nuclear industry operates on long timeframes, solar technology combined with batteries offers the most agile solution when it comes to expanding production capacity. Private sector demand for large-scale projects is therefore expected to sustain the industry's momentum, one example being the agreement signed by Microsoft last year with Brookfield Renewable to develop 10.5 GW of renewable energy capacity in the USA and Europe between 2026 and 2030, making it the biggest renewable power purchase agreement to date¹⁰.

There is currently some regulatory uncertainty overshadowing the short-term outlook, but such projects show that the USA's solar industry still boasts solid demand fundamentals that go beyond the sole issue of government aid. The energy transition and relocation of a competitive solar industry to the USA are now considered essential levers for boosting economic growth and reducing dependence on China.

10. Sources: <https://bep.brookfield.com/press-releases/bep/brookfield-and-microsoft-collaborating-deliver-over-105-gw-new-renewable-power> et <https://gasoutlook.com/analysis/costs-to-build-gas-plants-triple-says-ceo-of-nextera-energy/>

Mirova: Investing in the energy transition to achieve sustainable returns.



“
Mirova has for a long time opted to invest in firms that offer green solutions.”

As a responsible investor, Mirova has for a long time opted to invest in firms that offer green solutions. **Current circumstances by no means undermine our conviction in this area, even though they do pose some short-term challenges; if anything, they make us more determined than ever to support energy transition initiatives.**

If the sector's sustainable development is to be secured, the economic outlook also needs to be viable. **This is why we take a selective approach when making our investment choices and pay particularly close attention to each firm's competitive positioning.** The solar industry has enjoyed rapid expansion and exponential growth, but this has not always translated into solid business models. The sector today is to a large extent dominated by China, where surplus capacity is creating fierce price competition. Without regulatory support for local production (such as subsidies and restrictions on imports from certain countries), companies struggle to maintain a foothold in the market. This is particularly true in Europe, where the solar industry has practically vanished. So, when it comes to solar technology equipment manufacturers, we have a preference for US companies: demand in the USA is stronger thanks to the country's fast-growing energy needs and protectionist measures in favour of domestic firms.

If we are to support the transition and capitalise on the resulting structural growth prospects, we need to take a global approach by investing in the entire value

chain. Renewable energy generation is, of course, a vital upstream element of this chain. But it is just as crucial to upgrade power infrastructure, especially transmission and distribution grids which are essential for integrating renewable energy sources on a large scale and electrifying our energy uses. We are currently seeing the first stages of a massive investment cycle worldwide aimed at stabilising grids and securing energy supply.

We would also emphasise another fundamental aspect of the energy transition: energy efficiency. We absolutely need to rethink our energy consumption as resource optimisation is one of the top priorities when it comes to tackling global warming and boosting industrial productivity. This is all the more important because of the push towards industrial relocation, which is expanding the manufacturing footprint. So, **a successful transition towards a low-carbon economy will hinge largely on efforts to make industrial processes, new technologies and buildings more energy efficient.**

Faced with climate change, such as global warming and more frequent extreme weather events, it is inevitable that we will have to thoroughly transform our energy uses. The need to take action in support of the energy transition requires a long-term approach, one that is uninhibited by political eventualities. This is why Mirova opts to invest in firms that are strategically placed to provide lasting support for this transition while tapping into the structural trends in their respective sectors.

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