

The Sun after sunset: storage unlocks solar's potential

JULY 2026

Solar PV has become the **leader in global renewable capacity growth**, thanks to fast deployment, modularity (from rooftops to utility-scale), and cost declines. In 2025 alone, the world added 510 GW of solar PV, representing **almost three quarters of all renewable power additions**. [\[+\]](#)

However, solar generation is time-dependent, as output is concentrated during daylight hours, while electricity demand in many power systems often rises later in the day. This increasingly drives curtailment, price volatility, and the need for flexibility. [\[+\]](#) This is why **storage becomes a complimentary technology to solar**. Short-duration batteries can shift solar generation into evening peak hours and provide fast grid services. At larger scale, storage helps grids integrate higher shares of variable renewables more securely. [\[+\]](#) Battery storage is one of the fastest-growing clean energy technologies in the power sector and plays a key role across utility-scale projects, households, businesses, and decentralized electricity systems. [\[+\]](#)

Geopolitical instability and the growth in electricity demand are reshaping the role of renewables. In the past, the energy transition has been driven primarily by emission targets and falling technology costs but following the geopolitical events and cost-of-living crisis, **affordability and security are also becoming key priorities**. [\[+\]](#) In this context, solar PV and wind can strengthen energy independence by using domestic resources, limiting exposure to fuel price volatility and to external supply shocks. Additionally, global **electricity demand is expected to grow by more than 3.5% per year on average to 2030**, increasingly influenced by data centers and AI power needs. [\[+\]](#) This also increases the strategic importance of enabling technologies, including storage and grid optimization tools. [\[+\]](#) [\[+\]](#) [\[+\]](#)



Key Facts Page

Solar's role in power generation keeps expanding¹

It is becoming a mainstream power source thanks to low costs and scalability. But its daylight profile increases the need for storage and flexibility

20%: expected solar PV share in electricity generation in some major economies by 2030

Battery economics are improving quickly²

Storage options are evolving quickly. Amongst the storage technologies currently available, short duration batteries dominate the market. Storage costs are experiencing the greatest improvement among transition supporting technologies

27% YoY reduction: global cost for a four-hour battery in 2025

Solar + storage is a good combination³

Combined systems are turning “cost effective solar” to “cost effective reliable energy on demand” combining solar with storage:

Compensates intermittent generation, supports the grid stability, increases power resilience and backup, helps price stabilization and mitigates cannibalization effects

Capital is moving toward solar and storage⁴

Electrification and the need for low carbon energy sources coupled with energy security risks due to geopolitical instability boost investments in these technologies, that are also part of a suitable solution for data centers + AI increasing power demand

USD 365bn / USD 100bn: expected 2026 investment in solar and storage, respectively

Solar + storage still face challenges

Solar + storage growth depends not only on technology costs, but also on grid capacity⁵, policy stability⁶, battery regulation⁷, critical mineral supply chains⁸, and biodiversity impacts⁹

> 2 000 GW: renewable, large load and storage projects currently stalled in grid queues worldwide

Real projects show solar becoming evening power

Solar + storage projects are already being deployed across different geographies and use cases, with examples including agrivoltaics in Colorado¹⁰, project Nexus¹¹ in California; Gannawarra¹² and Lakeland Solar & Storage¹³ in Australia; and the Trujillo, Extremadura hybrid solar-plus-storage Spain¹⁴

1. Solar energy basics

1.1. Solar energy growth explained

There are three main solar energy technologies, where PV (photovoltaic) is currently dominant and one of the most rapidly deployed energy technologies globally due to: [+] [+]

Short building times:
developed in months vs
years for other utility-
scale plants

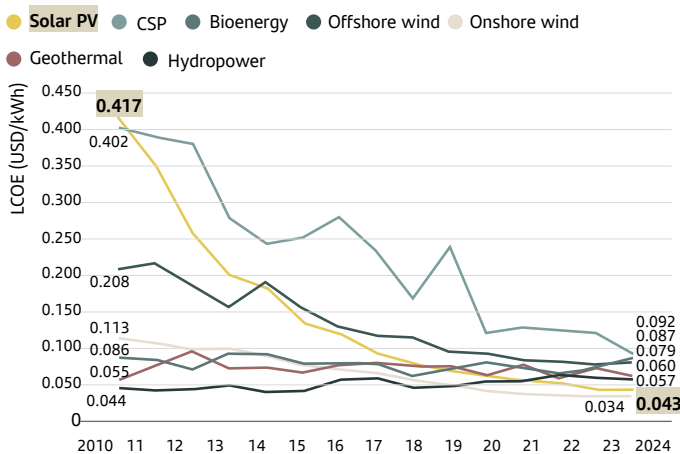
Scalability:
from kW rooftops to
GW-scale parks with the
same core technology

Cost competitiveness:
solar PV remains among
the most competitive
sources of power [+]

Storage-enabled value:
falling battery costs
make solar more flexible,
dispatchable (able to run
when needed), and
valuable for power
systems [+]

Figure 1: Renewable energy LCOE (Levelized Cost of Electricity) decline

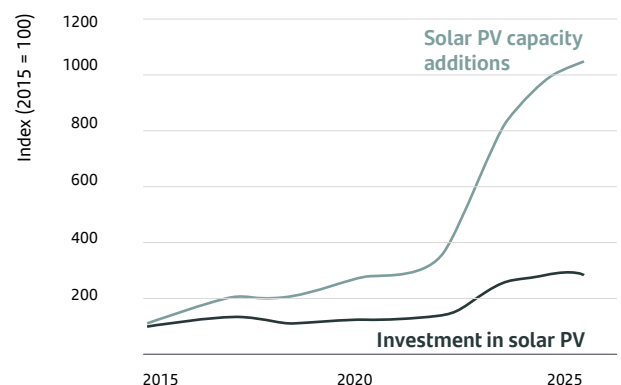
Source: IRENA [+]



Notes: CSP = concentrated solar power; kWh = kilowatt hour; LCOE = levelized cost of electricity; PV = photovoltaic; USD = United States dollar.

Figure 2: c.80% decline in capital expenditure required to add 1 GW of solar PV in the last decade has supported a c.10x increase in annual capacity additions

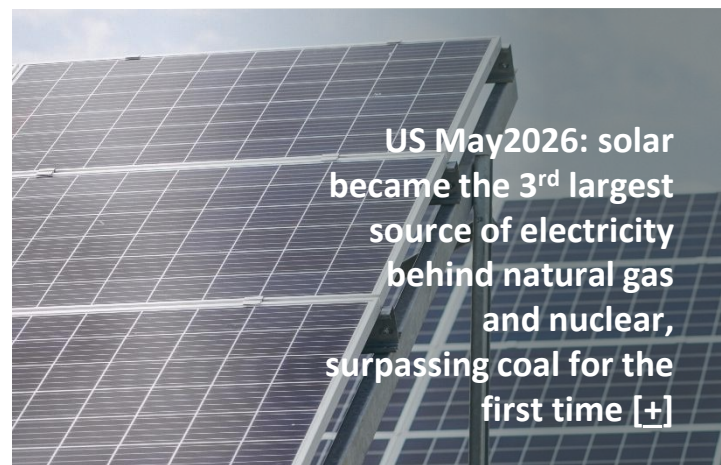
Source: IEA [+]



1.2. How solar differs from other renewables

Solar and wind are “variable renewables”, output depends on weather and time of day. [+] Wind (especially offshore) is generally less modular than solar, projects are more site-specific, require strong wind resources, larger turbines, grid access and more complex permitting. Wind can provide valuable diversification of renewable output. [+]

Hydro and geothermal can be more **dispatchable**, but they are more constrained by geography, water availability, and often longer permitting/build timelines. [+] [+]



US May2026: solar became the 3rd largest source of electricity behind natural gas and nuclear, surpassing coal for the first time [+]

2. Energy storage leverages solar power potential

PV has a **highly predictable daily pattern** (sunrise - midday peak - sunset) and batteries (or other storage) are technically suitable to couple with it. [+] [+] [+]

Combining solar with storage:

01

Compensates for intermittent generation

solar energy is stored during daylight hours, and batteries discharge it during the evening peak

02

Supports the grid stability and reliability

by helping frequency and voltage control and smoothing specific energy variability issues from solar generation, such as those caused by clouds or ramp periods at sunrise/sunset

03

Increases power resilience and security

providing backup power for homes, businesses, and critical infrastructure avoiding blackout damages and costs

04

Addresses price cannibalization

solar generation can create periods of oversupply, grid congestion and curtailment, while also depressing wholesale power prices, especially in mature solar markets. storage mitigates this effect by decoupling generation from delivery



The “solar paradox”: cost efficient energy, but not always at the right time as it produces most electricity around midday, often before the evening peak in many power systems. [+]

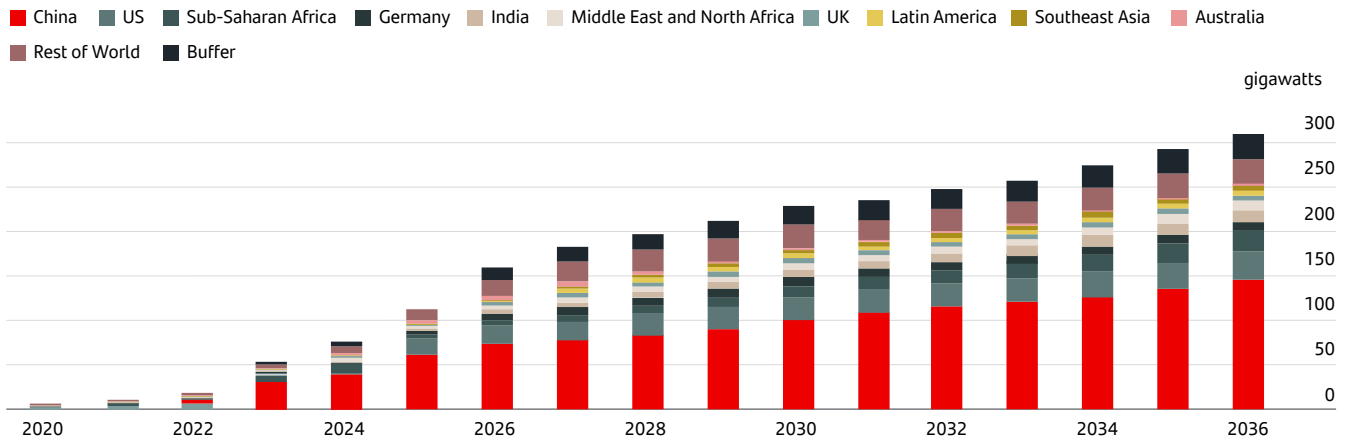
Curtailment: intentional reduction of available wind or solar output relative to what the resource could naturally produce, usually due to system, grid or market constraints. [+]

2.1. Storage technologies linked to solar generation

Storage options are evolving quickly, and **new additions (excluding pumped hydro) reached 112 GW in 2025 (+48% YoY)**. [+] Main types of energy storage are: batteries, mechanical (pumped storage hydropower), thermal (industrial salts), chemical (such as hydrogen storage) or incipient technologies as flow batteries or gravity systems.

Figure 3: Global storage additions keep setting records

Source: BloombergNEF [±]



Note: Excludes pumped hydro plants. Buffer is estimated capacity not explicitly allocated to any specific region or application.

The **storage options that are most efficiently coupled with solar energy** are: [±]**01 Batteries / electrochemical storage**

the storage technology most frequently coupled with PV plants; useful for shifting solar electricity from high-generation periods to higher-demand periods and for smoothing short-term variability

02 Thermal storage

most frequently coupled with CSP plants; it stores heat in fluids or materials and can later use that heat directly or generate electricity

03 Pumped-storage hydropower and other technologies

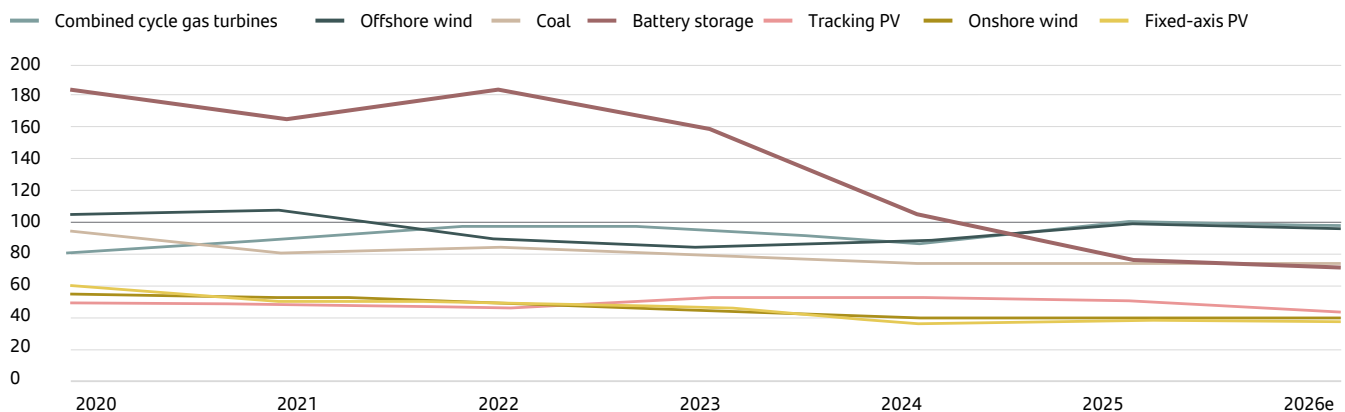
relevant to the wider power system; pumped hydro is mature and widely used, but site-dependent and infrastructure-intensive

2.2. Battery storage is also becoming more efficient cost wise

Same as in solar, **storage leveraged cost is also a key item for its success**. PV remains the most cost-efficient technology in general terms for electricity generation, and **storage costs are experiencing the greatest improvement among transition supporting technologies** in the last couple of years. [±]

Figure 4: Global benchmark levelized cost of electricity, (\$ per megawatt-hour, real 2025)

Source: BloombergNEF [±]



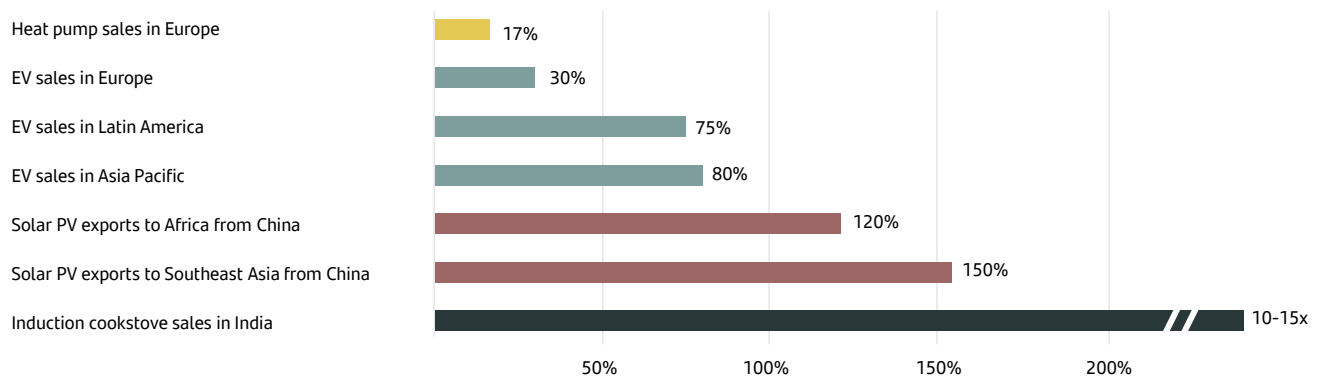
3. Where the capital is flowing

3.1. Why now?

Energy investment is increasingly shaped by **electrification** and the **need for clean power**. **Global electricity demand** is expected to grow by more than 3.5% per year on average between now and 2030, driven primarily by cooling, data centers, AI, and EVs. [\[+\]](#) [\[+\]](#) Additionally, early evidence suggests that energy security concerns and fuel price volatility may **accelerate consumer electrification**, particularly in transport.

Figure 5: Growth of selected electrification indicators by category Q1 2025-Q1 2026

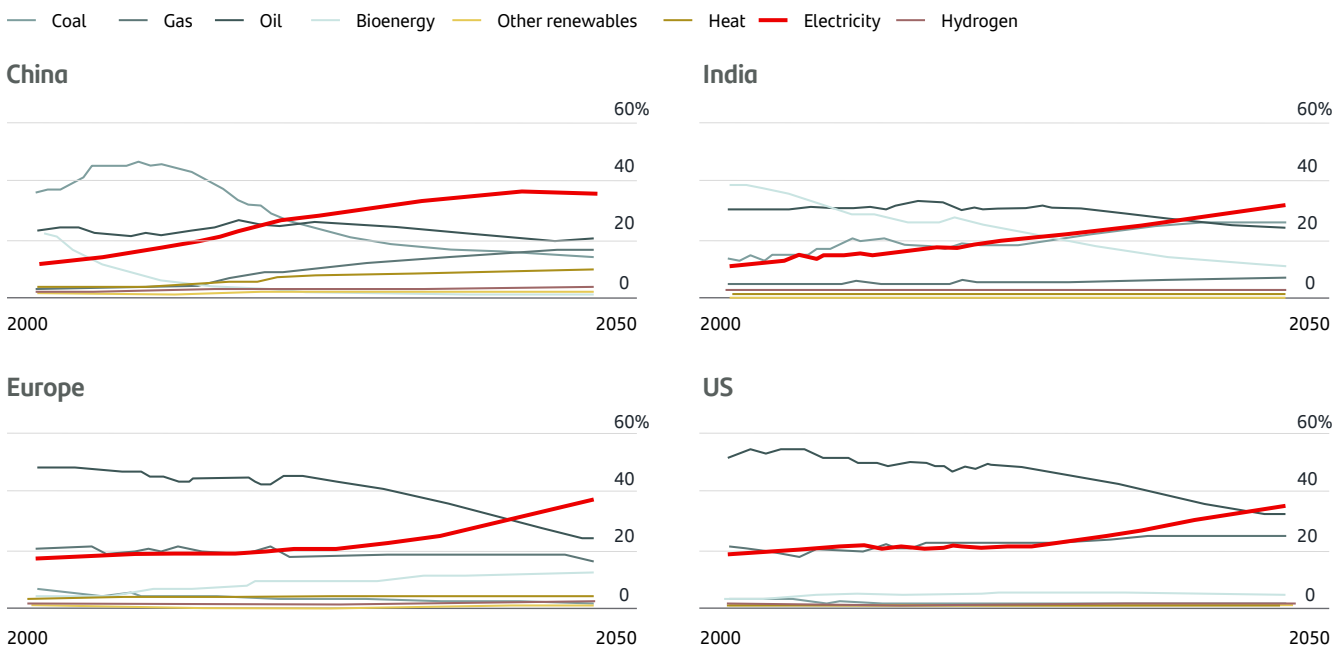
Source: IEA [\[+\]](#)



Additionally, **energy security has re-emerged as a dominant strategic priority**. According to WEF, geoeconomic confrontation has overtaken climate-related risks as the most severe short-term global risk. This has partly shifted the focus in renewable energy investing from decarbonization goals towards providing energy independence. [\[+\]](#) [\[+\]](#)

Figure 6: Final energy Consumption by fuel and region, ETS (Economic Transition Scenario)

Source: BloombergNEF [\[+\]](#)



3.2. From “cost effective solar” to “cost effective reliable energy on demand” [\[+\]](#)

The IEA expects total energy investment to reach **USD 3.4tr in 2026**, with **USD 2.2tr going to low emissions generation technologies** (renewables, nuclear, grids, storage, efficiency, etc.). Solar leads investments as the preferred technology with **USD 365bn in 2026**, while investment directed towards storage is expected to reach **USD 100bn in 2026**. [\[+\]](#) However, **75% of this investment was concentrated in the US, China, and Europe**, highlighting persistent geographic imbalances [\[+\]](#)

Figure 7: Global investment in energy (left, in trillion USD) and change in investment 2016-26e (right, in billion USD)

Source: IEA p. 13 [\[+\]](#)

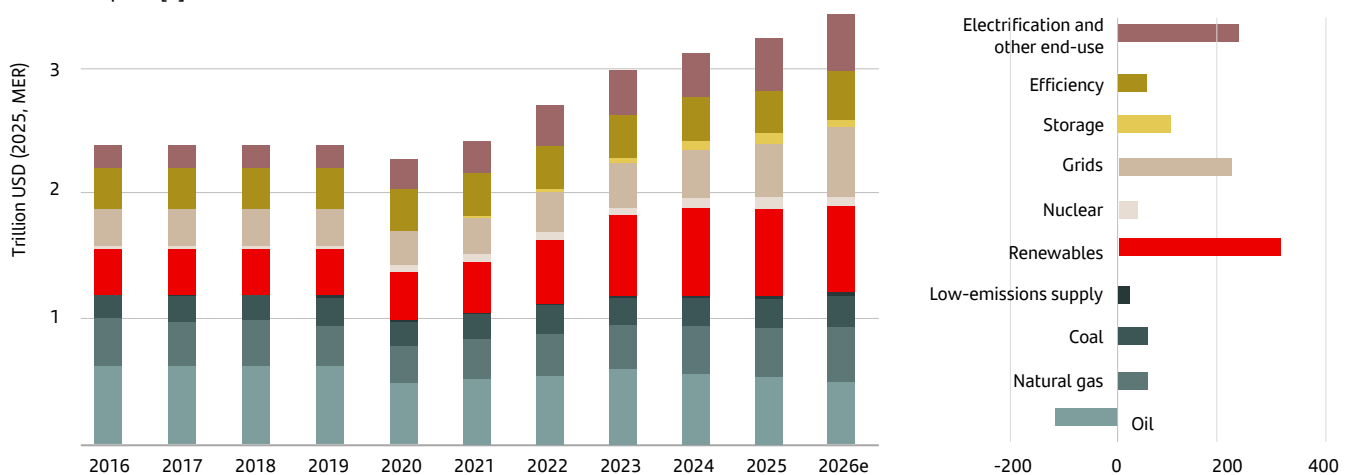


Figure 8: Electricity generation expected evolution by source

Source IEA [\[+\]](#)

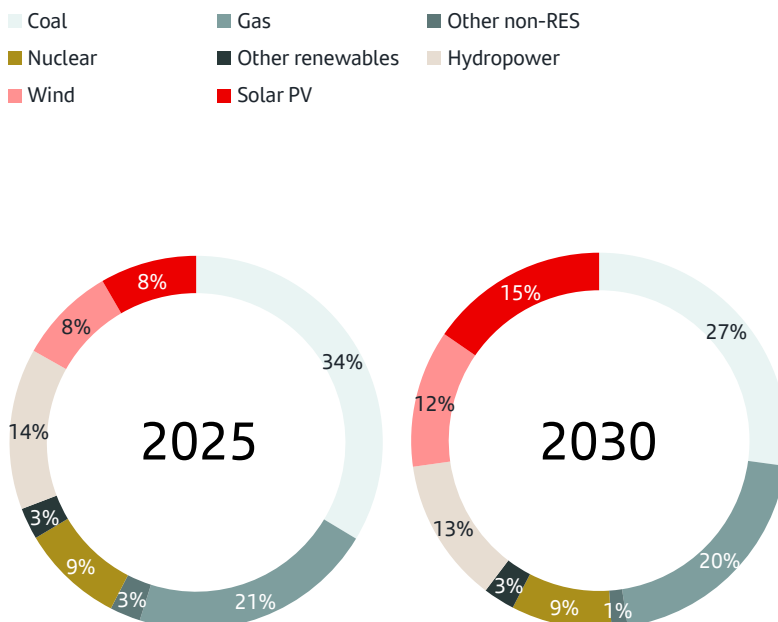


Figure 9: Renewables, especially solar showing significant growth

Source: Ember [\[+\]](#)



43%

Global share of clean electricity in 2025



+30%

Solar generation growth in 2025



-0.2%

Fossil generation decline in 2025

3.3. Data centers and AI are energy hungry

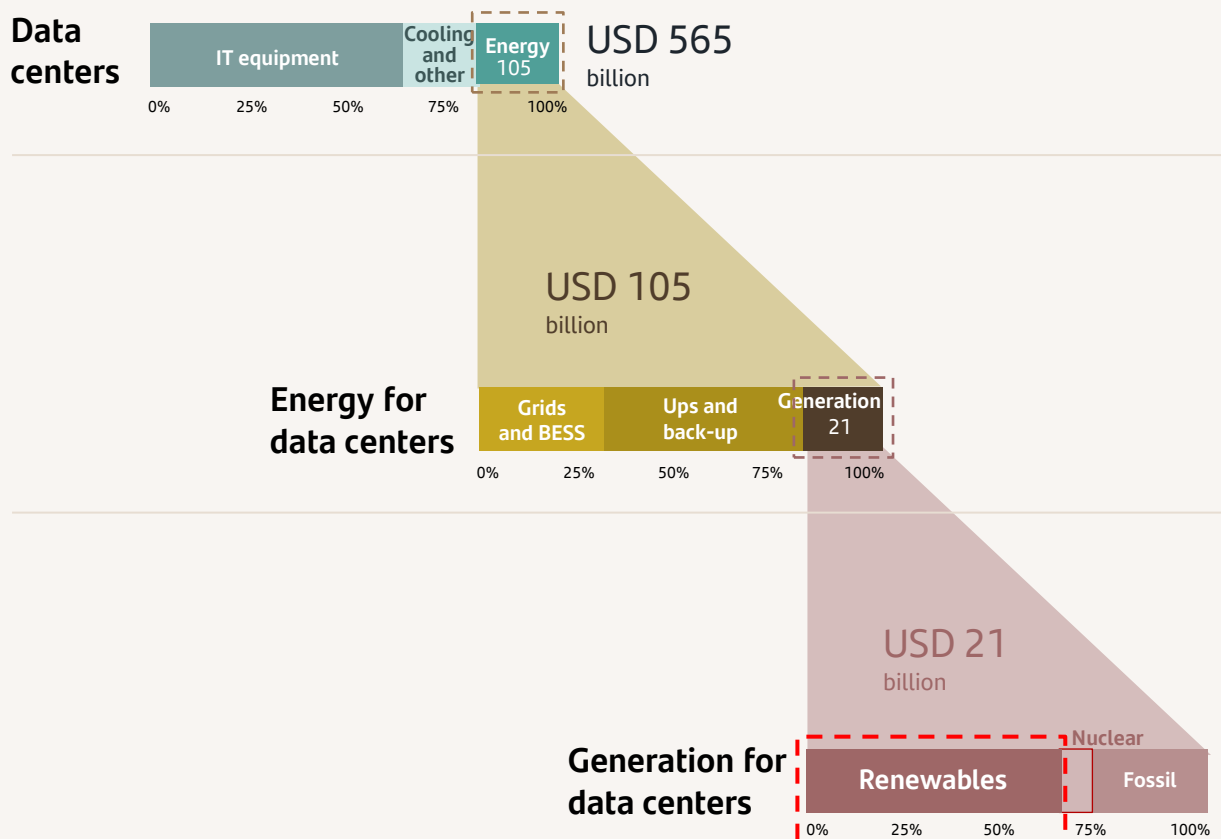
Electricity demand from data centers grew by 17% in 2025, while grid connection delays, transformer shortages, permitting constraints, and local infrastructure bottlenecks are increasingly limiting how fast new facilities can be built. Rising data center power demand is straining local grids, particularly in data-center hotspots, leading operators to test co-location with large renewable power plants to reduce grid reliance and secure cheaper clean electricity.

[+]

Their **electricity consumption is set to double by 2030**, [+] and on-site renewable generation can reduce grid dependence. **Solar can help address data center power demand** because it is modular, relatively fast to deploy and scalable close to point of demand. By generating electricity near consumption points, solar can reduce exposure to grid congestion, improve visibility over long-term clean power costs and support operators' decarbonization targets. **Solar+storage should be seen as one part of a broader energy solutions strategy that will be needed to satisfy data centers + AI power demand.** [+] [+] [+]

Figure 10: Global data center investments

Source: IEA [+]



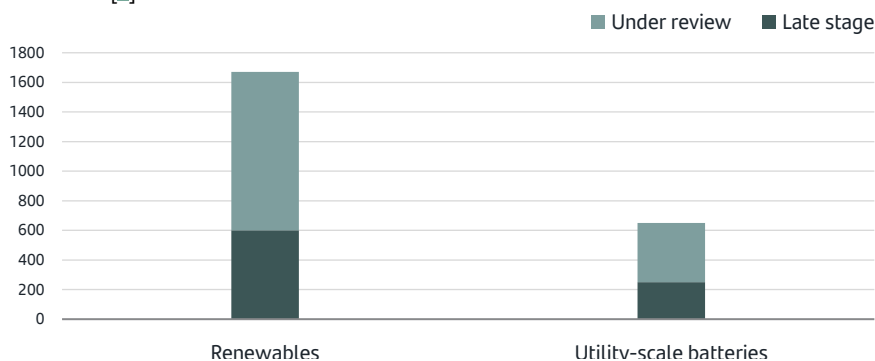
4. Challenges on the radar

4.1. Renewable growth depends on the grid development

Grid capacity and permitting can limit deployment and become a bottleneck for renewable energy growth. This is reflected in investments, c. **USD 400bn** [\[+\]](#) is spent on grids annually, versus **~USD 1tr** [\[+\]](#) on generation assets. There is also an issue with deployment periods, as solar and wind scale faster than grid infrastructure and grid capacity is limited. Thus, grid investing has become another high growth investing area related to transition. [\[+\]](#) [\[+\]](#)

Figure 11: Renewable energy and utility-scale battery capacity in advanced stages waiting in connection queues globally, by project stage (GW)

Source: IEA [\[+\]](#)



Over 2 000 GW of renewable, large load and storage projects are currently stalled in grid queues worldwide

4.2. Critical minerals and material supply chains

PV and batteries rely on different material supply chains. Solar PV uses polysilicon, silver, copper, and aluminum, whereas batteries use materials such as lithium, graphite, nickel, cobalt, and manganese. **The issue is not only mineral scarcity, but concentration.** China accounts for c. 85% and 80% of solar and lithium-ion supply-chain production capacity, respectively. Regarding critical minerals, 73% of the world's cobalt (used in batteries) is extracted in the Democratic Republic of Congo while the refining capacity is concentrated in China. [\[+\]](#) [\[+\]](#) [\[+\]](#)

Figure 12: Clean energy manufacturing capacity by location

Source: BloombergNEF [\[+\]](#)

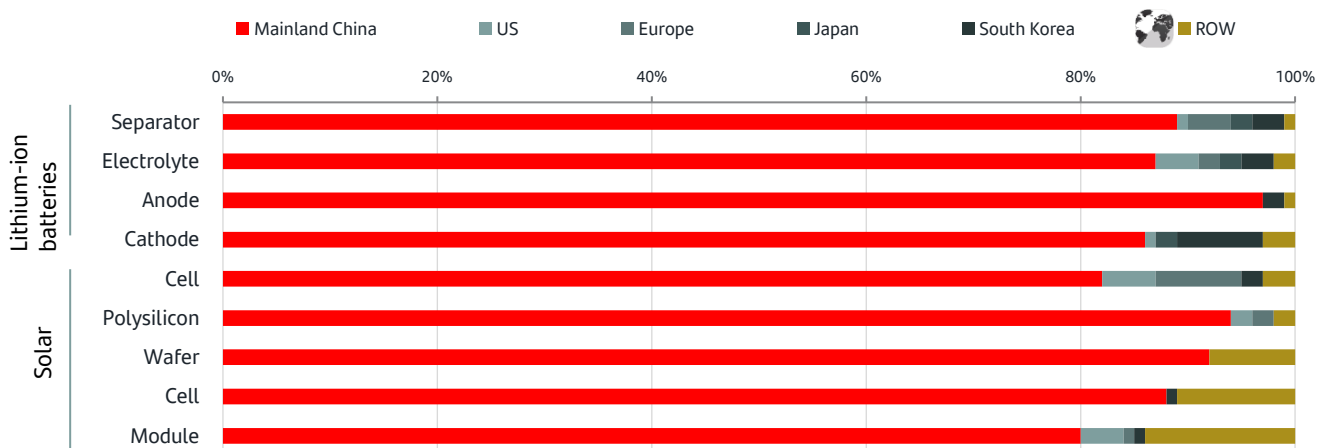
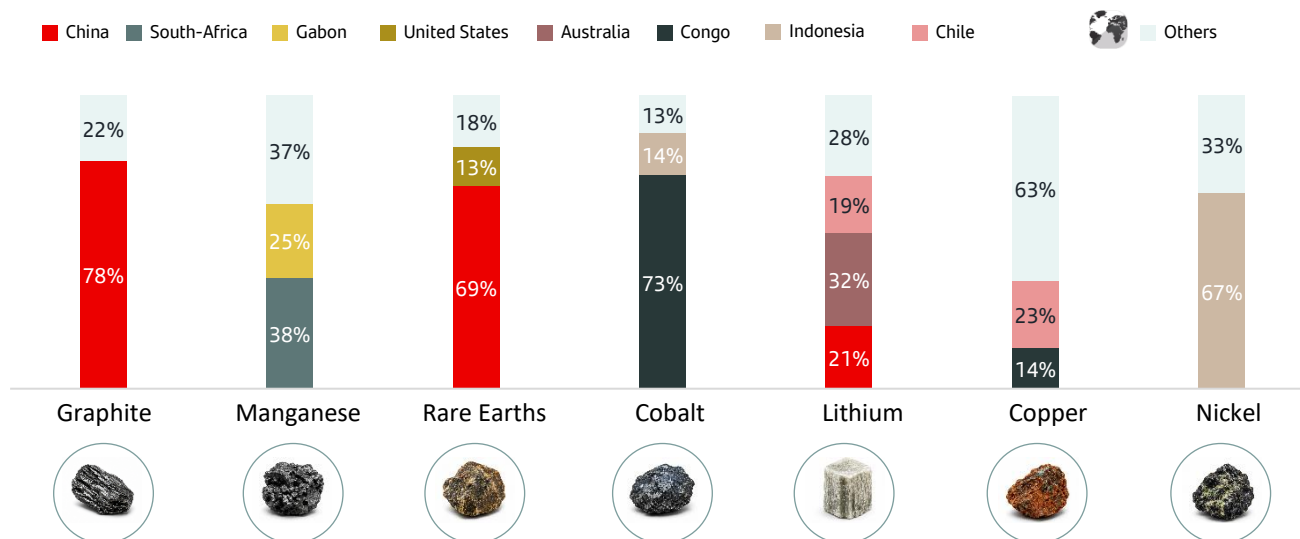


Figure 13: World mine production of clean energy critical materials by major countries show concentration

Source: U.S. Geological Survey, Mineral Commodity Summaries, February 2026 [±]



4.3. Low-carbon technologies, but not nature-neutral

For solar, the main biodiversity risk is land use, as utility-scale solar projects can compete with agricultural land, fragment habitats, alter vegetation, soil conditions, and local hydrology, and affect species such as birds and pollinators. Tripling renewable capacity globally could require up to an additional 600,000 km² of land for utility-scale solar PV (an area the size of France) and onshore wind by 2030, and 2 million km² by 2050. [±] [±]

For batteries, lithium, graphite, nickel, cobalt, and manganese supply chains can create exposure to habitat disturbance, water stress, pollution and social conflict in mining and processing regions, specifically on the overlap between energy transition mineral mining and key biodiversity areas. [±]

Well-designed solar farms can even become **net contributors to biodiversity**, through pollinator-friendly grasslands, conservation grazing and habitat corridors under and around the panels, turning a land-use risk into a nature co-benefit. [±]

4.4. Policy changes and incentives

Policy changes can materially affect the economics of solar and storage, especially in residential markets where incentives are a key part of the payback.

In the US



The 30% Residential Clean Energy Credit applied to eligible solar and battery storage systems, and the credit is not available for property placed in service after December 2025. This is expected to create a near-term policy cliff for residential solar and storage demand. [±] [±]

In the Netherlands



the netting scheme for small-volume solar users will end on January 2027. The government states that the change aims to encourage users to consume more of their own solar generation and reduce stress on the electricity grid. As compensation for grid exports falls, the value of self-consumption, batteries and energy management systems rises. [±]

On a positive impact, in Australia



the federal Cheaper Home Batteries Program funds around a 30% discount on eligible small-scale battery systems connected to new or existing rooftop solar from July 2025. The program is expected to support more than 2 million battery installations by 2030, delivering around 40 GWh of additional storage capacity. [±]

5. Innovation & case studies

USA

Jack's Solar Garden: turning farmland into dual-use clean-power infrastructure

This is an example of agrivoltaics, combining a 1.2 MW community solar project with active farming, pollinator habitat and applied research. Its 3,276 solar panels generate electricity for 300 homes, while the land beneath and around the panels remains productive for crops and biodiversity. The project also serves as a research site, helping test how panel height, shade and changing microclimates affect crop yields, water needs and soil conditions. [\[+\]](#)

Project Nexus: water infrastructure plus clean-energy infrastructure (pilot)

Located in California's Central Valley is an operational pilot that installs solar panels (1.6 MW) above Turlock Irrigation District canals and pairs them with iron-flow battery storage (75 kW). The project pairs both technologies while solar panels are installed above active irrigation canals, an innovative configuration designed to generate renewable electricity while helping reduce water evaporation. [\[+\]](#)

Australia

Gannawarra Energy Storage System: adding batteries to existing solar

It shows how batteries can increase the value of an existing solar farm, rather than only being built into new hybrid projects. The project combines a 25 MW / 50 MWh battery with Gannawarra Solar Farm. The battery can also supply more than 16,000 homes for two hours during peak demand, helping shift solar output to more valuable hours and support grid stability. [\[+\]](#) [\[+\]](#)

Lakeland Solar & Storage: solar + battery at the edge of the grid

It demonstrates how large-scale solar and battery storage can strengthen electricity supply in areas located at the edge of the grid. In these locations, power often must travel over long distances, which can lead to infrastructure limitations and energy losses. By combining solar generation with battery storage, the project tested how storage could operate in different ways, including in "island" mode, where the system can help maintain local power supply if it becomes separated from the main grid. [\[+\]](#) [\[+\]](#)

Spain

Trujillo, Extremadura: hybrid solar-plus-storage PPA: solar energy beyond daylight

Zelestra and EDP signed Spain's first large-scale solar-plus-battery Power Purchase Agreement (a long-term contract under which an electricity buyer agrees to purchase power from a generator at pre-agreed terms), supporting a hybrid project with 170 MWdc of solar PV and 400 MWh of battery storage. The battery is designed to be charged daily by the solar plant, allowing the offtaker to access clean electricity outside normal solar hours and during high-demand, high-price periods. [\[+\]](#)



6. Conclusion

Solar power is expected to become the main renewable technology by 2030 and coupled with storage is a clear way to play the electrification megatrend and the need for energy security.

The combination of these technologies is an interesting use case for clean energy development. Battery storage compensates the solar energy paradox, reduces curtailment, shifts PV production into evening hours, provides short-duration grid services. Additionally, it addresses the financial pressure that pure solar projects currently face in mature markets by mitigating price cannibalization during peak solar hours.

Going forward, this technology combination of solar PV + adequate storage, **still needs to address some issues**, such as grid constraints, permitting delays, policy changes, critical mineral concentration and biodiversity impacts, that can affect returns.

Solar plus storage projects that are already serving isolated areas, providing backup power, operating on 24/7 cycles serving large populated areas or integrated in larger sustainability projects (such as water management) are proof that **these combined technologies are a leverage towards low carbon transition.**

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