

# Solar energy in the EU

## SUMMARY

The EU solar energy strategy proposed under the REPowerEU plan aims to make solar energy a cornerstone of the EU energy system. Boosting renewable energy is also an important part of the European Green Deal in the context of the green transition towards climate neutrality. Solar energy is affordable, clean and has been the fastest-growing energy source in the last decade. It can be used for electricity and heating, while also helping reduce EU dependency on energy imports by replacing them with domestic production.

EU measures to boost solar energy include making the installation of solar panels on the rooftops of new buildings obligatory within a specific timeframe, streamlining permitting procedures for renewable energy projects, improving the skills base in the solar sector and boosting the EU's capacity to manufacture photovoltaic panels.

Several challenges still need addressing, however. These include competition for land use with other sectors, technological issues, skills shortages and the need to prevent a new energy dependency on non-EU solar panel producers.

The ambitious plan includes doubling the current level of solar photovoltaic capacity by 2025 and producing almost 600 GW by 2030. Achieving these goals will depend on continued commitment to renewable energy deployment, success in addressing a number of challenges, and the ability to unlock the full potential of solar energy in the EU, for instance, by boosting domestic solar production and the use of new technologies.



## IN THIS BRIEFING

- Introduction
- Solar energy statistics
- EU policies
- European Parliament
- Stakeholders' views
- Outlook



## Introduction

As the European Union (EU) struggles with the dual challenges of energy security concerns and high energy prices in the aftermath of Russia's invasion of Ukraine, domestic energy production and efficiency gains are becoming increasingly [important](#). The [REPowerEU](#) plan of May 2022 calls for an accelerated roll-out of renewables in order to phase out the EU's dependence on energy imports from Russia (especially gas). Boosting renewables could also help to mitigate the impact of rising energy prices and enable the EU to meet its climate targets for 2030 and 2050, as laid out in the European Green Deal.

The International Energy Agency (IEA) defines solar energy as the 'conversion of sunlight into usable energy forms'. [Eurostat](#) divides solar energy into solar thermal (radiation exploited for solar heat) and solar photovoltaic (PV) for electricity production. Concentrated solar power (CSP) is created through the use of mirrors to concentrate sunlight and produce heat and steam for generating electricity.<sup>1</sup> The most common uses of solar energy are thus electricity generation and heating/cooling systems.

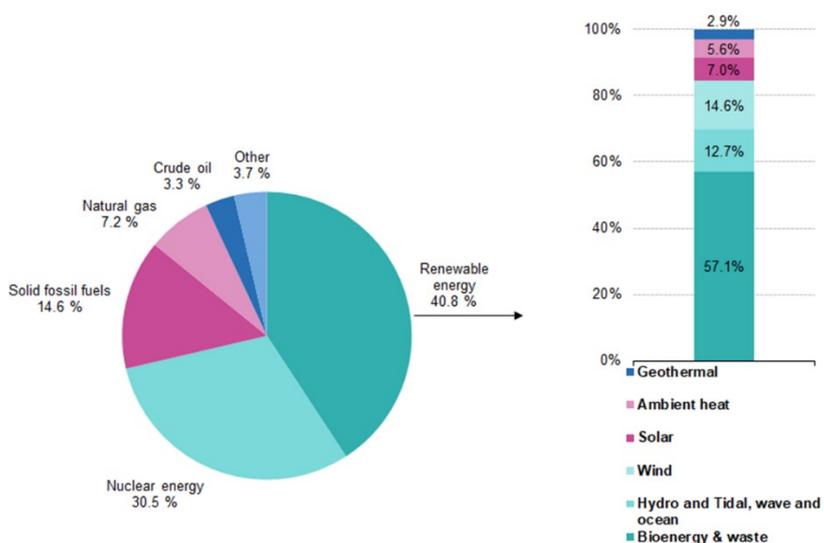
According to the European Commission, solar PV is currently one of the [cheapest](#) sources of electricity, as PV costs went down by [82 %](#) in the past decade. The Commission also [believes](#) that solar energy can not only protect EU citizens against the volatility of energy prices but also give them the autonomy to produce their own energy on an individual or collective scale. Furthermore, in addition to generating electricity and heat, the solar energy sector also creates jobs and businesses. The REPowerEU plan thus aims to unlock the full potential of solar energy in the EU.

Despite these advantages, several challenges remain. In general, renewables are [considered](#) intermittent and variable. The availability of solar energy is weather- and geography-dependent. The initial solar installation costs are high (though they are later offset by low operational costs and energy gains). Other challenges include land-use competition (especially with the agriculture, construction and infrastructure sectors) and concerns over pollution linked to solar-panel waste. Furthermore, the solar energy sector in Europe lacks skilled workers, and the energy storage and conversion rate are also in need of improvement. Lastly, as pointed out in a recent EPRS [note](#) on solar as a source of EU energy security, China is the dominant producer of solar PV panels, which creates a risk of a new dependency from this supplier.

## Solar energy statistics

EU domestic energy production is becoming increasingly [important](#), not least in the context of problems with imported energy supplies exacerbated by Russia's invasion of Ukraine. In 2020, renewables accounted for more than one third ([40.8 %](#), see Figure 1) of EU total [primary energy production](#), exceeding all other sources. Solar energy accounted for 7 % of all renewable sources. Between 2010 and 2020, EU primary energy production from renewables grew (with the exception of 2011), while production from fossil fuels and nuclear declined. However, it is important to put these numbers in perspective. Over half of EU energy

Figure 1 – Production of primary energy, EU, 2020 (% of total)



Source: [Eurostat](#), 2020.

needs are covered by imports (57.5 % in 2020), and thus the EU's net energy imports are greater than its energy production, making the share of renewables relatively smaller.

In terms of EU gross [final energy consumption](#), in 2020 renewables represented [22.1 %](#) of energy consumed, thus exceeding the 2020 target set at 20 %.<sup>2</sup> The share of renewables in EU energy consumption has more than doubled since 2004, when it was only [9.6 %](#). In terms of variation among the Member States, Sweden had the highest share of renewables in its gross final consumption of energy (60 %), followed by Finland (44 %) and Latvia (42 %). The lowest proportion of renewables was observed in Malta (11 %), Luxembourg (12 %) and Belgium (13 %).

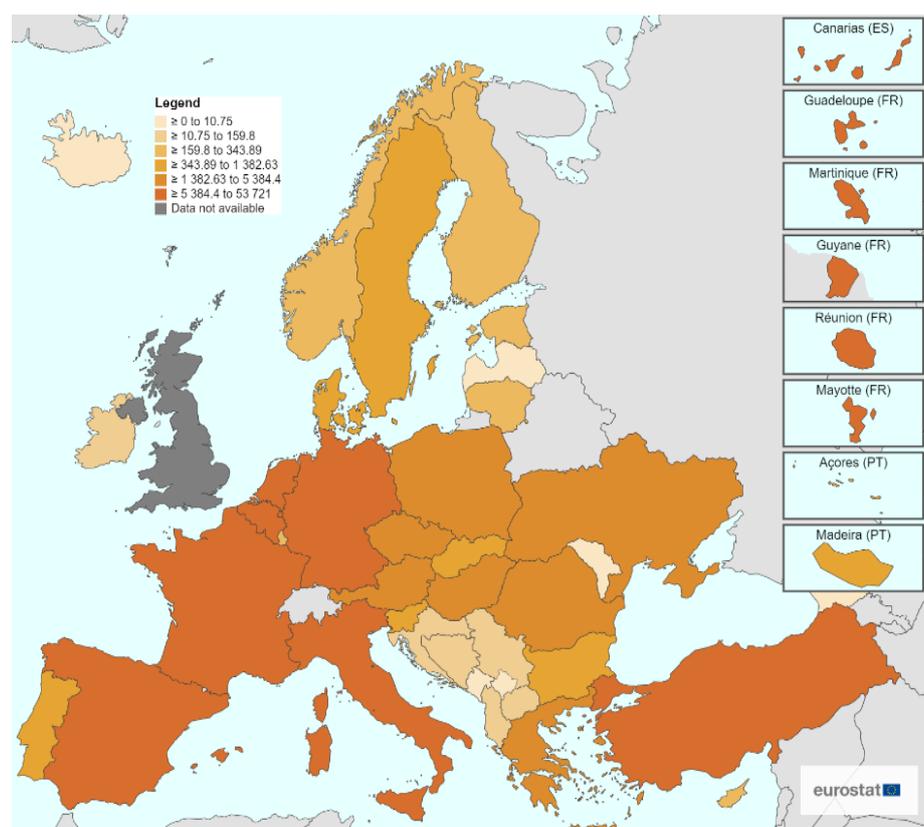
The role of renewables is also growing in [net electricity generation](#), where they accounted for [34.1 %](#) in 2020. The other main energy sources were combustible fuels, such as natural gas, coal and oil (41.3 %) and nuclear power (24.3 %). In terms of specific renewable energy sources (RES), the highest share of net electricity generation came from wind turbines (14.7 %), followed by hydropower plants (13.8 %) and solar power (5.3 %). While wind and water provided most of the renewable electricity, solar was the fastest-growing energy source (increasing from 0.8 % in 2010 to 5.3 % in 2020). Furthermore, the EU net maximum electrical capacity [increased](#) from 176 MW to 120 000 MW between 2000 and 2019. In 2020, solar electricity production capacity varied between countries (see Map 1), with the majority of production coming from solar photovoltaic energy and only Spain producing electricity from solar thermal.

In terms of energy use for heating and cooling, renewables accounted for 23.1 % in 2020 EU-wide (an increase from 11.7 % in 2004). In terms of energy use in transport, the share of renewables grew from 1.6 % in 2004 to 10.2 % in 2020 (thus exceeding the EU target of 10 % RES in transport, set in the 2009 Renewable Energy Directive, (RED)).

According to the International Renewable Energy Agency (IRENA), in 2021 the estimated installed solar PV capacity in the EU was over 158 GW, compared with over 306 GW in China and almost 94 GW in the US. China is currently the world's leader in solar energy production. Moreover, it plans to boost traditional production methods through a solar power plant in outer [space](#), transmitting solar power back to Earth. Other countries, including the United Kingdom, are also [exploring](#) the technology of beaming solar energy from space.

A 2021 EU solar jobs [report](#) estimates that the EU solar PV sector provided 357 000 full-

Map 1 – Electricity production capacities for solar power, 2020 (MW)



Source: [Eurostat](#), 2020.

time equivalent (direct and indirect) jobs in 2020, while the installation sector was a particularly strong provider of local jobs, accounting for 80 % of the total (with the operation and maintenance sector accounting for 10 %).

## EU policies

### Legislation

Key legislation in the area of renewable energy includes Directive 2009/28/EC on the promotion of the use of energy from renewable sources ([Renewable Energy Directive \(RED\)](#)). Originally [adopted](#) in 2009, it set the target of a 20 % share of renewable energy sources in final energy consumption by 2020. The [recast](#) RED of 2018 (Directive (EU) 2018/2001) increased this objective to 32 % of RES in final energy consumption by 2030. The adoption of the [European Green Deal](#) and the more ambitious EU climate goals enshrined in the [European Climate Law](#) (-55 % greenhouse emissions by 2030 and climate neutrality by 2050) required further changes in order to achieve a higher share of RES in EU energy use. This was addressed by the 'Fit for 55' package adopted by the Commission in July 2021, which included another proposed [revision](#) of the RED seeking to increase the share of RES in final energy consumption to 40 % by 2030. This target would also be accompanied by a series of higher EU and national targets for 2030, e.g. on the percentage of renewable energy use in buildings, industry, heating and cooling, and transport. The legislative procedure on revising the RED is [ongoing](#), with a plenary vote in the European Parliament expected in September 2022.

In the context of the energy supply concerns and sanctions linked to Russia's invasion of Ukraine, in May 2022 the Commission proposed the [REPowerEU](#) plan, aimed at phasing out the EU's dependence on Russian fossil fuels and further boosting the roll-out of renewables. The plan included a legislative [proposal](#), involving a revision of the RED and two other directives: Directive 2010/31/EU on the energy performance of buildings (the Energy Performance of Buildings Directive, (EPBD)) and Directive 2012/27/EU on energy efficiency (the Energy Efficiency Directive (EED)). The revision of the RED proposes raising the RES share target to 45 %. It also introduces an obligation for Member States to identify 'renewables go-to areas' (i.e. suitable land and sea areas for renewable energy projects) and additional provisions on speeding up permitting procedures for renewables, including a shortening of the permit-granting process for establishing solar installations to a maximum of three months. The revision of the EPBD introduces a new obligation for the Member States: to deploy solar energy installations on buildings by the end of 2026 on all new public and commercial buildings with a useful floor area over 250 m<sup>2</sup>, by the end of 2027 on all existing public and commercial buildings with a useful floor area over 250 m<sup>2</sup>, and by the end of 2029 on all new residential buildings. The proposed target for energy efficiency under the EED is raised to 13 % (from 9 % as proposed under the 'Fit for 55' package; the percentage refers to reduced energy consumption).

Under Regulation (EU) 2018/1999 on the governance of the energy union and climate action (the [Governance Regulation](#)), the Member States are required to report on renewable energy deployment in their national energy and climate plans ([NECPs](#)). This includes reporting on electricity and heat generation from renewable energy in buildings with disaggregated data on 'energy produced, consumed and injected into the grid' by solar photovoltaic systems and solar thermal systems.

While the Recovery and Resilience Facility ([RRF](#)) under [Next Generation EU](#) has already promoted the use of funding for the green transition, the REPowerEU plan includes a legislative [proposal](#) to add a REPowerEU chapter in the recovery and resilience plans prepared by the Member States. Such a chapter should outline reforms and investments, with corresponding milestones and targets, contributing to the REPowerEU objectives of boosting the share of renewable energy.

## A new solar energy strategy under REPowerEU

The REPowerEU plan also includes a [solar energy strategy](#) that aims to bring about 320 GW of solar photovoltaic by 2025 (i.e. double the current solar PV capacity) and almost 600 GW by 2030. In its communication outlining the strategy, the Commission estimates that these additional capacities would displace the consumption of 9 bcm (billion cubic meters) of natural gas annually by 2027. The strategy also aims to 'reinforce the EU's industrial leadership' and 'expand its manufacturing base'. The solar energy strategy includes four initiatives:

- the European Solar Rooftops Initiative;
- the EU large-scale skills partnership for onshore renewable energy;
- the European Solar PV Industry Alliance;
- the permitting package.

The European Solar Rooftops Initiative aims to promote quick and massive PV deployment through the requirement on Member States to make buildings 'solar ready' (see revision of the EPBD above). The EU large-scale skills partnership under the Pact for Skills addresses the challenge of skills shortage in the solar sector, while the European Solar PV Industry Alliance is intended to facilitate an innovation-led expansion of a resilient industrial solar value chain in the EU, in particular the PV manufacturing sector. The permitting package aims to streamline permitting procedures for renewable energy projects.

In terms of funding, the Commission [admits](#) that most of it will have to be private. The Recovery and Resilience Facility offers funding for the roll-out of renewables, while additional suggested EU instruments include: the cohesion policy funds, InvestEU, the Innovation Fund, the Modernisation Fund, Horizon Europe and the LIFE programme. In addition, the Connecting Europe Facility and the EU renewable energy financing mechanism can support cross-border cooperation on solar energy projects. The Commission also recommends looking for synergies with transport infrastructure or research and innovation programmes, and using the Technical Support Instrument to enhance the roll-out of solar energy.

## European Parliament

In a [resolution](#) of April 2022, the European Parliament stressed the need to invest in renewable energy in order to phase out the EU's dependency on Russian gas, and furthermore underlined the importance of sustainable long-term investments in line with the European Green Deal.

In its October 2021 [resolution](#) on the 2021 UN Climate Change Conference in Glasgow (COP26), Parliament highlighted 'the central role of renewable energy and energy efficiency in the transition towards a climate-neutral economy' and underlined 'the importance of increasing renewable energy and energy efficiency targets to achieve climate neutrality by 2050 at the latest and to comply with the Paris Agreement, seizing the opportunity of the current decrease in costs of renewable energy and storage technologies'.

In its May 2021 [resolution](#) on a European strategy for energy system integration, Parliament stressed the importance of renewables in the context of climate neutrality and energy transition. It pointed out 'the potential for citizens, industries and the public sector to further harness solar energy at distribution level' and called for removing administrative barriers to renewable production. It also advocated for 'recognising renewable energy technologies as a strategic value chain' and establishing an alliance to support efforts in scaling up these technologies.

In its January 2020 [resolution](#) on the European Green Deal, Parliament emphasised the need to increase renewable energy use and phase out fossil fuels in the context of EU climate and sustainability goals. It also called for a revision of the Renewable Energy Directive in order to meet the net-zero ambitions.

In its September 2020 [resolution](#) on maximising the energy efficiency potential of the EU building stock, Parliament pointed out Europe's leadership in building integrated photovoltaics and called for recognition of renewable energy technologies as a key strategic value chain. It suggested a European solar rooftop programme as part of the renovation wave and pointed out possibilities for heat decarbonisation through community-owned district heating networks powered by solar heat, heat pumps and biomass.

## Stakeholders' views

Solar Power Europe, an association for the European solar PV sector, believes that the EU could reach [1 TW \(terawatt\) of solar capacity](#) by 2030 and calls on the European Commission to increase its ambitions laid out in the REPowerEU plan.<sup>3</sup> It also proposes eight [actions](#) for the 'solar terawatt age': accelerated deployment of projects, integrating solar projects into the grid, developing a skilled workforce, deploying solar PV applications (e.g. agrisolar, floating solar and building-integrated PV), securing supply chains and raw materials, reinvesting in domestic manufacturing, boosting deployment of rooftop solar PV during the renovation wave, and developing a framework for consumer-driven solar. The details of these actions and several possible future scenarios are outlined in a position [paper](#) presented to the European Commission in March 2022.

In its [reaction](#) to the REPowerEU plan in May 2022, the European Consumer Organisation (BEUC) welcomed the Commission's support for consumers' investment in renewables and energy efficiency measures, such as consumer take-up of solar panels. It highlighted the importance of the proposals on streamlining the permit procedure for installing solar panels and recommended supporting consumers through advisory services on home improvement projects, for instance, through 'one-stop shop' services that could be made part of the post-Covid recovery plans.

Friends of the Earth Europe, in its [analysis](#) of the REPowerEU plan of May 2022, welcomed the acknowledgement of the role of energy communities in the energy transition but pointed to the existing barriers such as financing and grid availability. It also called for more targeted funding or programmes on providing solar panels to energy-poor households.

The Solar Europe Now coalition, encompassing over 90 players from the solar value chain, such as research centres and industry representatives, presented its [call to action](#) in May 2020. It urged for a 'recognition of solar energy as a key driver to deliver the European Green Deal', for tapping into the potential of European industrial PV production and for better integration of solar PV into EU climate and energy policies. It also highlighted the need to recognise the strategic value of solar PV in future research and innovation (R&D) and sustainable finance initiatives, in order to stimulate Europe's solar PV production capacity.

## Outlook

Renewable energy is becoming increasingly important in the context of efforts to reduce the EU's energy import dependency and accelerate the green transition outlined in the European Green Deal. As the EU moves to harness the potential of solar energy and significantly increase the deployment of solar PV capacity, it will have to tackle several challenges, such as overreliance on external solar panel providers, competition for land use, and technological challenges in terms of energy storage and conversion. As pointed out in the 2022 IEA [study](#) on global solar supply chains, solar PV is a crucial part of the clean energy transition, and the security of manufacturing supply deserves particular attention. Some future [solutions](#) to the above-mentioned challenges could include boosting EU domestic production and exploring new technologies such as agrisolar (dual use of land for agriculture and solar power generation), embracing floating solar (solar installations floating on water) and even capturing solar energy from outer space in order to magnify capacity. With the solar energy strategy announced under REPowerEU, coupled with other legislative measures on renewable energies, the EU is taking the steps necessary to make solar energy one of the cornerstones of its future energy system.

## MAIN REFERENCES

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Van Wieringen K., Hüntemann J., [Making solar a source of EU energy security](#), EPRS, July 2022.

## ENDNOTES

- <sup>1</sup> In Eurostat statistics, concentrated solar power is included as solar thermal that undergoes transformation and becomes electricity (transformation output in the energy balance).
- <sup>2</sup> The target of an at least 20 % share of energy from renewable sources in the EU's gross final energy consumption in 2020 was set in Directive 2009/28/EC on the promotion of the use of energy from renewable sources (the Renewable Energy Directive). This directive was superseded by Directive (EU) 2018/2001, which established 'a share of at least 32 % of energy from renewable sources in the Union's gross final consumption of energy by 2030'. The latter directive is currently under revision, with the latest proposed share of renewables amounting to 45 %.
- <sup>3</sup> A European Commission representative during a [debate](#) at the ITRE committee meeting at the European Parliament on 27 June 2022, pointed out that Solar Power Europe expresses capacity in direct current (DC), while the Commission figures focus on electricity that can actually enter the grid (i.e. alternating current (AC)). The values thus are not directly comparable, but according to the Commission representative the capacity of 600 GW proposed by the Commission is relatively close to 1 TW, if DC and AC values are converted.

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