# LAND FOR RENEWABLES

## Briefing on spatial requirements for a sustainable energy transition in Europe

EEB
European Environmental Bureau

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The European Environmental Bureau (EEB) is the largest network of environmental citizens' organisations in Europe. It unites 180 civil society organisations from 38 countries, working for a better future where people and nature thrive together.


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# EXECUTIVE SUMMARY

Land is a crucial resource for Europe's energy transition, but the extent and type of land needed for renewable energy expansion have sparked heated debates across the bloc. This report aims to clarify these questions by making the spatial needs to achieve a 100% renewable-powered Europe tangible and comparing them to current land uses and available areas. **Here are the main takeaways:**

- **Renewables do not need much land:** Only 2.2% of the EU's total land will be required by current and future solar and wind projects to achieve climate neutrality by 2040, phasing out both fossil and nuclear generation in the process.

- **There is enough suitable land to roll out renewables sustainably:** When taking into account strict agricultural, environmental, and biodiversity constraints, along with appropriate buffer zones and technical factors, 5.2% of the EU's land area is suitable for onshore wind and solar projects. This figure is also based on the technical potential by technology and area.

- **Rural areas hold the highest potential for renewables:** Under the JRC's assessment criteria, most of the suitable land for renewables in the EU is located in rural areas, with 78% for ground-mounted solar photovoltaic (PV) systems and 83% for onshore wind.

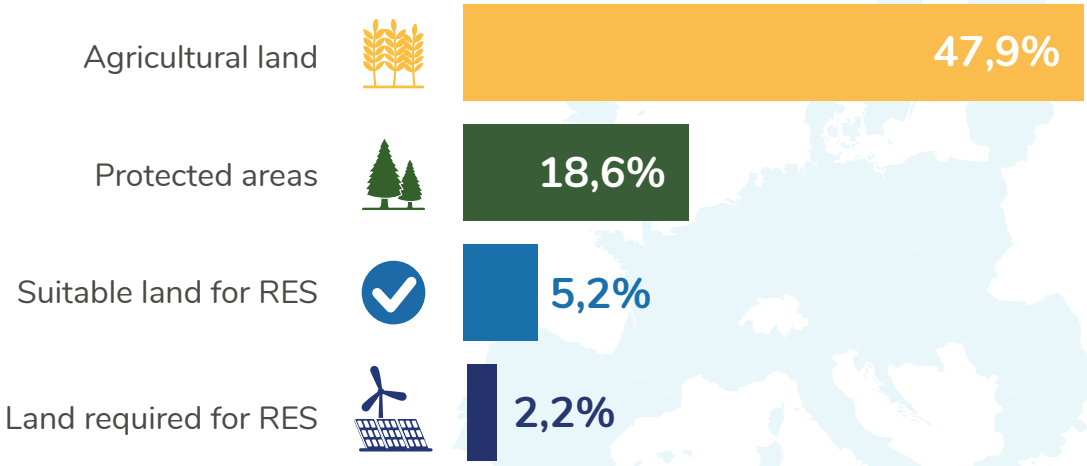
- **Rooftops alone aren't enough:** Urban and industrial areas alone cannot host all the solar capacity needed to decarbonise Europe. Nevertheless, there is sufficient available land to greatly expand solar energy, in harmony with current biodiversity protection needs, existing economic activities, and future nature restoration targets.

- **Solidarity and interconnection:** Some countries, such as Germany and Italy, do not have enough suitable land for their renewable energy needs. Meanwhile, countries such as Spain and Romania have abundant land resources to develop renewables away from sensitive sites, well beyond their energy needs. Realising a European interconnected supergrid will be essential to achieve 100% renewables, allowing solidarity and reducing energy waste.

- **Participation and benefit-sharing:** Land-use changes needed for the transition must be conducted in a participatory way, ensuring that the needs of communities are reflected in siting decisions and that adequate benefits remain with the territories hosting renewables.

Our findings show that there is sufficient land across Europe for the expansion of solar and wind energy sources to be conducted in harmony with the needs of nature, food production, and local communities.

# EU27 FACTSHEET
## Share of total land



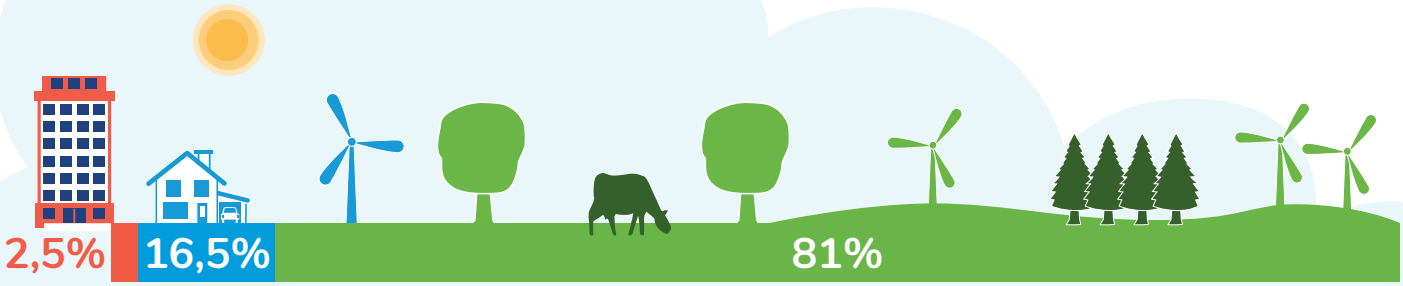

## Types of current land use

**5,51%** consists of built-up areas

**47,9%** consists of agricultural land, including **2,75%** for industrial crops

**18,61%** are protected areas, with an additional **16,67%** for nature restoration

## Suitable land for renewables




in cities

in towns and suburbs

in rural areas

# METHODOLOGY

The report builds on the preliminary territorial analysis carried out by the EU's Joint Research Centre (JRC), which identified suitable land for renewable energy projects inter alia by excluding protected natural areas and high-value agricultural land. Developing from the JRC's analysis, we have assessed current land use and cover types based on available datasets and EU documents, and estimated the surface needed to host enough renewable energy capacity to meet the Paris Agreement Compatible (PAC) scenario goals: 100% renewable energy across all sectors and climate neutrality by 2040. We calculated the space requirements of onshore wind and solar photovoltaic (PV) technologies, providing a breakdown between needed space for rooftop and ground-mounted PV systems, by considering their foreseen installed capacity and referring to values available in the literature.

# INTRODUCTION

The achievement of the European Union's (EU) climate targets, depends largely on accelerating the deployment of renewable energy sources (RES). This transition towards a renewables-powered economy is critical not only for mitigating climate change, but for enhancing energy security and fostering wider social and economic sustainability.

A crucial part of accelerating the deployment of renewables is getting spatial planning right. The new EU Renewable Energy Directive (RED) requires member states to map out their territories and identify the potential and available land to install enough renewables and grids to meet (at least) the binding EU 2030 target[1]. Countries will also have to designate 'acceleration areas' for renewable energy projects, where approval processes will be streamlined and potentially derogate from some existing EU environmental legal requirements. This acceleration has raised concerns about potential conflicts in territories hosting renewable projects due to changes in land use or failure to coexist with nature conservation or broader community needs. It Is therefore essential that spatial assessments meet the highest environmental standards and are conducted with meaningful input from local communities to ensure a nature-positive and community-inclusive transition to renewables.

The deployment of renewable energy in Europe and beyond has faced various challenges, including lengthy permitting processes, grid connection issues, and local acceptance. Although specific requirements vary by country and region, land availability is also often claimed to be a constraining factor for renewables expansion.

[1] Art. 3 of the RED III raises the EU's binding renewable energy target for 2030 to a minimum of 42.5% in the EU's overall energy mix by 2030.

This is particularly felt in rural areas, where most of the potential to deploy solar and wind assets is located, making effective spatial planning of strategic importance to balance renewable energy development with agricultural activity, biodiversity conservation and restoration, and the socio-economic needs of surrounding communities.

The EU's Joint Research Centre (JRC) has mapped the technical potential and land suitability for the roll-out of renewable energy in EU countries, under sustainability criteria aimed at preserving both biodiversity and agriculture. Their criteria excludes biodiversity-rich areas and natural reserves as suitable sites for RES deployment, favouring instead built-up and artificial surfaces and degraded land with limited agricultural prospects. In line with the EU recommendations, areas identified as suitable for land-intensive renewables deployment exclude Natura 2000 sites, key biodiversity and bird areas, and high-value natural farms – among other protected areas. Agricultural land has been deemed unsuitable for renewables deployment. Only arable land, mixed crops and livestock systems that are already in an advanced state of erosion, and showing low productivity and high risk of abandonment, have been selected as suitable.

The JRC found that EU countries have a significant untapped potential (12,400 TWh) for both solar and wind generation, located mainly (78% for solar, 83% for wind) in rural areas. Importantly, this potential is identified on the basis of "suitable" areas only, i.e. selecting only areas that have the right technical characteristics to allow solar and wind production and excluding types of land that are rich in biodiversity or have a high agricultural value:

- **For ground-mounted solar PV:** areas with high natural or agricultural value are completely excluded. This means that areas such as Natura 2000 sites, nationally designated nature protected areas, wetlands, peatlands, and forests are not considered for the installations of ground-mounted PV systems. Only severely eroded agricultural land is considered, excluding all the remaining agricultural land. With regards to technical characteristics, the JRC only considered land with good technical potential (i.e. sufficient solar irradiation and avoiding north facing slopes) and in reasonable proximity (< 5km) to existing road networks. Buffer areas around residential settlements (700m) and industrial sites (500m) are also excluded from what is considered suitable land.

- **For rooftop solar PV:** only built-up areas that present the right technical profile are considered, excluding all surfaces with unfavourable conditions such as poor orientation/ inclination or shaded by nearby constructions.

- **For onshore wind:** following the same exclusion criteria used for ground-mounted PV systems, the JRC measures the suitable land for the installation of onshore wind turbines by further excluding areas with too harsh orographic conditions (slope < 2.1°) and only considering land that offers good wind conditions (i.e. a capacity factor of more than 20%). The same distance criteria as with ground-mounted PV are observed for roads and settlement proximity to define suitable land for onshore wind installations.

These criteria are not prescriptive as to where the additional needed renewable capacity to meet the EU's targets should be located. However, they provide a tangible measure of the amount of land available in EU countries that can effectively host renewable energy installations without threatening biodiversity conservation, agricultural activity, or community well-being.

The level of deployment of rooftop solar PV, dual-use applications for land hosting ground-mounted PV and wind turbines, and the uptake of community-owned energy projects can play a significant role in optimising land use and enhancing local benefits. Moreover, policies that support community involvement and address public concerns are vital for the successful implementation of renewable energy projects beyond purely physical and land use planning concerns.

With regards to the renewable capacities required to achieve climate neutrality, this report looks at the Paris Agreement Compatible (PAC) scenario—a pathway to decarbonise Europe by 2040. The PAC scenario demonstrates the possibility of reaching 100% renewable energy a decade ahead of the EU's current targets[2], relying on significant energy savings and the rapid deployment of renewable energy sources.

This briefing examines the space required by solar photovoltaics (PV) and onshore wind energy installations under the PAC scenario results in six EU countries: Germany, Spain, France, Italy, Poland, and Romania. Based on the PAC capacity results for solar PV and wind energy technologies, we estimated the required land by using land intensity factors (i.e. installable capacity expressed in GW/km2) for PV and wind technologies from available literature, and contrasted this information with statistical data regarding current types of land use or cover in the selected countries. We also compare our spatial requirements results to the JRC's estimates on suitable land for each analysed country, and provide key policy and spatial planning recommendations to integrate renewables effectively in the EU's different territories.

[2] The Paris Agreement Compatible (PAC) scenario is an EU-wide energy scenario developed by civil society in cooperation with grid operators, industry representatives, economists, and researchers, to demonstrate that Europe can reach climate neutrality by 2040: 10 years earlier than currently agreed by EU governments. The PAC scenario has three main goals:65% reduction in GHG emissions by 2030; Net-zero emissions by 2040; and 100% renewable energy by 2040 across all sectors.

# DISCUSSION OF COUNTRY CASES

# GERMANY

## Key takeaways:

- When comparing the space required by renewable energy installations with suitable land available, Germany face spatial constraints for onshore wind farms. Whilst there is enough suitable land available to host the needed solar PV capacity, the land requirements for onshore wind exceed the available land identified as suitable, making it imperative to develop a comprehensive mitigation toolbox to ensure the compatibility of future onshore wind projects with areas that may have specific environmental and socio-economic sensitivities.

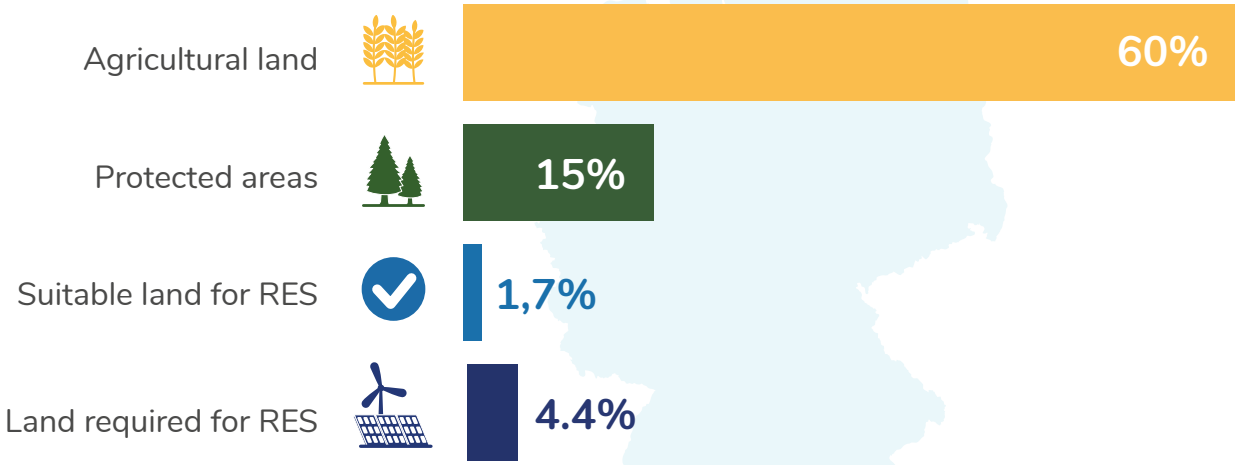
- Mitigation measures remain important, but less so if only suitable land is used to host additional ground-mounted PV capacity. Germany's nature restoration needs are likely to require around 2% of the country's total land area, making it highly feasible to find distinct areas for both renewable energy development and nature restoration.

- Tackling grid congestion issues is critical to ensuring that Germany can make the best use of its wind and solar capacities. Improved intra- and international grid connections will allow the country to access the offshore wind hub located in the North Sea and tap into neighbouring countries' surplus energy when necessary.

- Further key challenges for spatial planning in Germany include ensuring consistency among state-specific planning laws, strongly prioritising utility-scale PV projects on artificial, industrial areas and land facing severe degradation issues. Adopting clear criteria to facilitate and prioritise the uptake of agri-PV systems in rural areas is also essential.

# GERMANY

## Share of total land



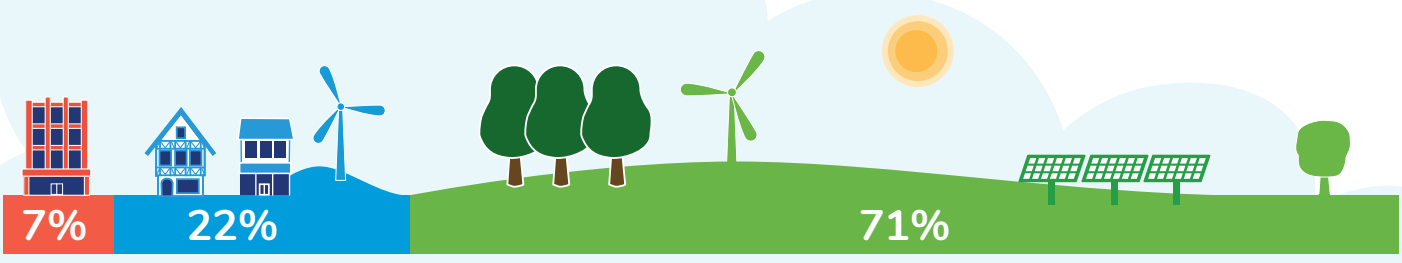

## Types of current land use

**10,02%** consists of built-up areas

**59,62%** consists of agricultural land, including **0,71%** for potatoes

**15,44%** are protected areas, with an additional **1,98%** needed for nature restoration

## Total suitable land for renewables is located*




in cities

in towns and suburbs

in rural areas

* Suitable land for renewables refers to areas identified by the EU's Joint Research Centre as optimal for sustainable deployment of renewables, excluding biodiversity-rich zones, natural reserves, and productive agricultural land, while favouring built-up areas and degraded agricultural land with limited prospects.

# GERMANY

In the PAC scenario, Germany relies on a significant expansion of solar PV (346 GW) and onshore wind (113 GW) capacity to decarbonise its economy by 2040. These installations will contribute to around 74% of Germany's electricity production and satisfy around 52% of the country's final energy demand by the same year. We estimate that meeting these capacity targets will require around 2.8% of Germany's total land by 2030, and 4.4% by 2040. These figures are significantly higher than the EU average of 1.3% and 2.2% by 2030 and 2040 respectively, and entail specific regulatory and spatial planning challenges.

Germany's land cover includes a significant portion of agricultural areas (59.62%) and protected areas (15.44%). Future nature restoration needs are projected to require an additional 1.98% of land. Against this backdrop, the JRC has estimated that suitable land for onshore wind in Germany amounts to 0.66%, for ground-mounted solar PV, 0.62%, and for rooftop solar PV, 0.43%.

The growth in solar PV installations projected under PAC translates into 0.33% of the land needed for ground-mounted installations and 0.54% to host rooftop and building-integrated PV systems. This means that most of the required solar capacity in Germany can be located in areas that offer good production potential while completely excluding valuable sites for biodiversity conservation and high-value agricultural land. Only the space required by rooftop solar PV slightly exceeds (+0.12%) what the JRC considers suitable. The relative abundance of suitable land for ground-mounted systems without using natural areas or high-value farmland, means that there would be enough space to deploy an additional 72 GW of ground-mounted systems in these particularly suitable sites, more than making up for any reduced rooftop PV capacity due to siting constraints. Thus, the priority for national and local regulators is to designate RAAs quickly on degraded and low-productivity agricultural land and around towns and suburbs, so as to achieve a clear prioritisation of these territories for ground-mounted PV developments.

The land required (3.35%) for the growth in onshore wind foreseen in PAC instead largely exceeds the available suitable land, posing the need to look elsewhere to find adequate siting solutions. Against this backdrop, the quick designation of Renewables Acceleration Areas (RAAs) remains important on land that presents the right characteristics. However, considering that the space requirements of onshore wind take into account the entire project area but the turbines themselves occupy only roughly 1% of that, onshore wind projects can be ideal candidates for dual-use applications of land, including potentially on high-value agricultural land, if the right measures are in place and all existing environmental assessments under EU law are implemented.

At present, grid capacity constraints and congestion issues hinder the effective integration of, in particular, abundant offshore wind resources both from Germany's own marine areas and from neighbouring countries. Solving these grid bottlenecks by expanding and reinforcing electricity transmission infrastructure is key for Germany to reap the full benefits of renewable generation beyond land-based solar and wind.

Establishing a robust mitigation toolbox will be crucial for Germany to roll-out its needed onshore wind assets, as a significant part of this will have to be located in sites that don't adhere to strict suitability criteria. Rather than planning new wind energy projects in protected nature areas or other biodiversity-rich sites, clear rules should be adopted to allow onshore wind development on agricultural land where coexistence with other uses can be ensured. Mitigation measures should particularly focus on minimising the project's impact during construction and the need for ancillary works such as access roads.

Accelerating offshore wind projects and their connection to the mainland is central to Germany's energy transition.The German government's ambition to install 70 GW of wind capacity in its waters by 2045 highlights the renewable potential of its coastline. This would significantly alleviate land-based constraints for onshore wind farms.

# SPAIN

## Key takeaways:

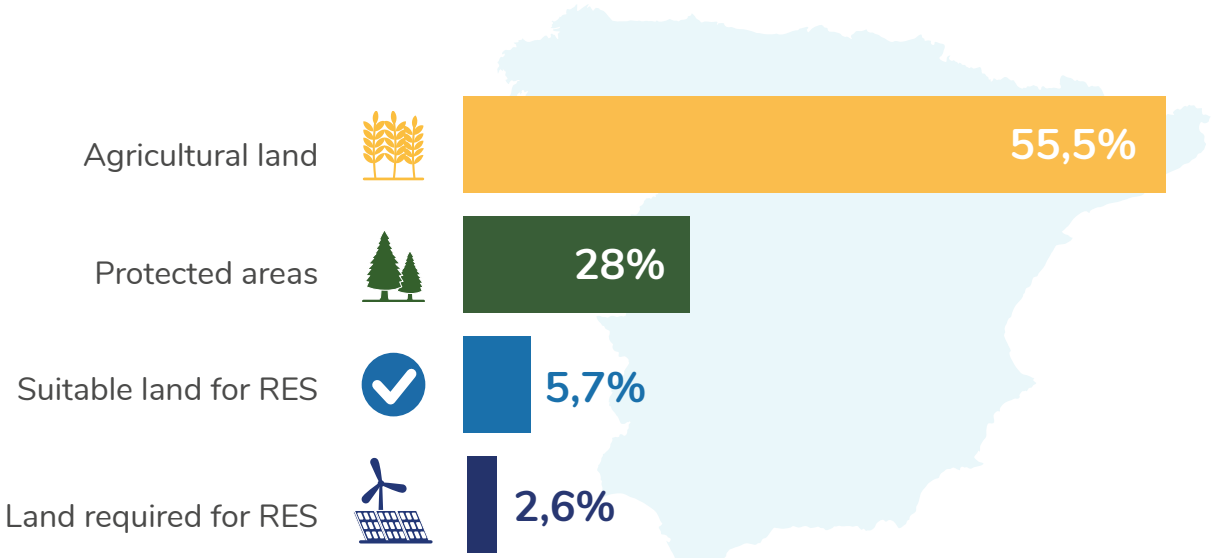
- Spain does not present land constraints for the installation of both ground-mounted solar PV and onshore wind systems. Enough suitable land is already available to host the entire needed capacity by 2040, in particular for ground-mounted solar PV which would require around 0.49% of land compared to the 3.28% available for developments away from protected areas or high-value farmland.

- To achieve the right spatial planning decision, current data gaps and coordination issues between different levels of government at the planning level need to be addressed as soon as possible to avoid wrong siting decisions and have sufficient clarity on what mitigation measures are more suitable. RAAs for both solar and wind should be designated quickly by prioritising suitable sites in line with the JRC's suitability estimates.

- Spain has achieved remarkable success in expanding renewable energy generation. However, local opposition is already growing, threatening the future quality and success of future projects. High and consistent public participation standards are essential to address this. Additionally, the reduction of environmental guarantees in favour of accelerated renewable area designation has led to some natural areas not receiving adequate protection, with the 'express environmental processing' mechanisms resulting in projects being developed in highly sensitive areas.

# SPAIN

## Share of total land




## Types of current land use

**4,59%** consists of built-up areas

**55,54%** consists of agricultural land, including **1,53%** for vineyards

**27,74%** are protected areas, with an additional **14,03%** needed for nature restoration

## Total suitable land for renewables is located


in cities

in towns and suburbs

in rural areas

In the PAC scenario, Spain develops significant solar PV (247 GW) and onshore wind (98 GW) capacity by 2040. These capacities will contribute to around 86% of Spain's electricity production and satisfy around 84% of the country's final energy demand by the same year. To host such solar and wind capacity, we estimate that Spain will need around 1.4% of its total land by 2030, and 2.4% by 2040. These figures are broadly in line with the EU average.

Spain has extensive agricultural areas (55.54%) and a significant proportion of its territory (27.74%) is located inside Natura 2000 sites. Future nature restoration needs are projected to require an additional 14% of the country's total land, making it important to plan space for renewables and nature restoration comprehensively. For Spain, the JRC has estimated that suitable land for onshore wind amounts to 2.35%, for ground-mounted solar PV, 3.28%, and for rooftop solar, 0.09% of the national territory. For both technologies, more than 70% of suitable land is located in rural areas.

By 2040, under the PAC scenario capacity trajectory, the land required by ground-mounted PV installations (155 GW) will be just short of 0.5% of the total land in Spain, leaving around 2.8% of total Spanish land available for ground-mounted PV development without infringing on high biodiversity or agricultural value sites, and provided that electricity infrastructure is expanded to reach those suitable sites. By comparison, the required land by ground-mounted PV systems would be less than one third of what Spain currently uses (1.64%) for the cultivation of crops dedicated to fodder production, meaning that food production is not threatened by rural solar energy expansion. Rooftop solar systems as modelled in PAC will require just 0,09% of total land, matching the JRC's estimated suitable surface and thus posing no siting issues if permitting barriers are removed and access to financing schemes for self-consumption is improved.

Spain also presents minimal land availability constraints when it comes to onshore wind. The amount of land required (1.62%) for the growth in onshore wind foreseen in PAC by 2040 in Spain implies that all the needed capacity could be developed in suitable areas. RAAs for onshore wind should thus be designated as quickly as possible in areas that match the JRC's suitability criteria, while the use of sensitivity mapping tools and data should be improved and further coordinated between different levels of government.

# FRANCE

## Key takeaways:

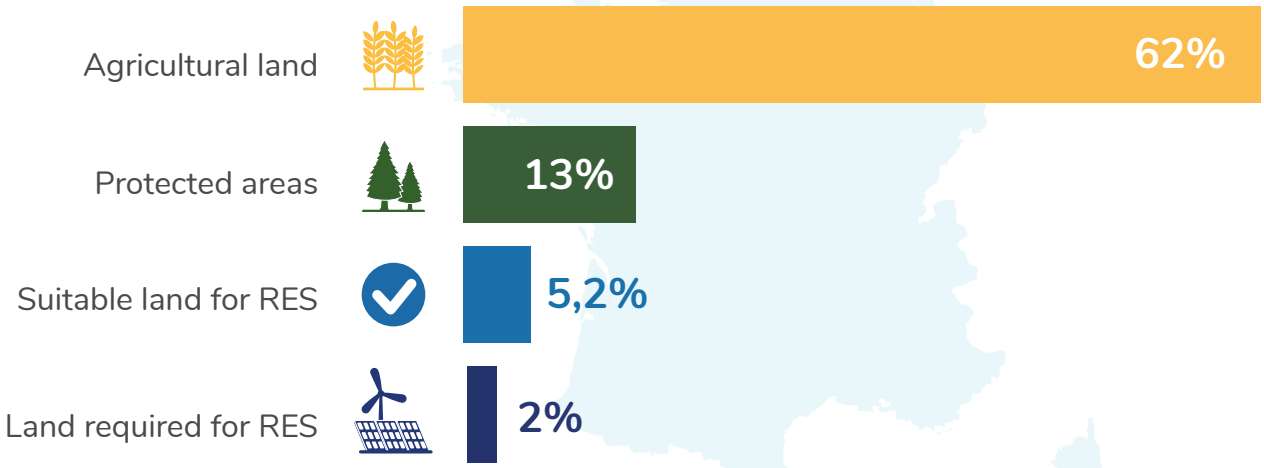
- The space required by onshore wind and solar PV installations fits comfortably within the available suitable land, including rooftop PV systems. Significant amounts of land (1.26% for onshore wind, 1.91% for ground-mounted solar PV) would also remain available for further developments and still adhere to strong siting sustainability criteria.

- Considering jointly the extent of suitable land and the expected grid availability issues - especially in rural areas, which host more than 90% of France's suitable land for renewables - planning authorities should prioritise sites where existing grid can be used or would require minimum extension works.

- In France, bureaucratic complexity has historically posed a significant challenge to the effective deployment of renewable energy. The Renewable Energy Acceleration Bill (APER) aims to streamline permitting procedures, but its success will depend on its implementation (deadline 1 July 2026). Additionally, accelerating projects without thorough consultation risks long-term failure to meet renewable energy targets, as local opposition to wind and solar developments grows. Mayors or prefectural referents are empowered to organise and conduct the consultation processes, but uniform and meaningful consultation procedures will be essential to achieving renewable energy ambitions.

# FRANCE

## Share of total land



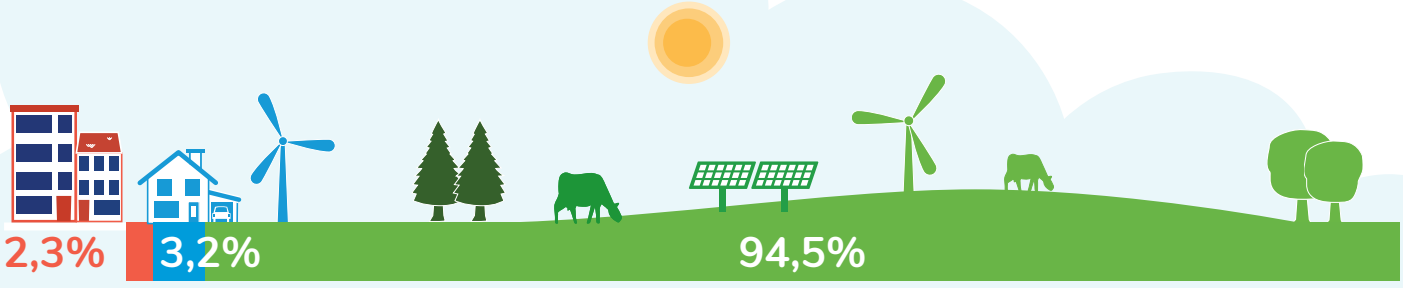

## Types of current land use

**7,22%** consists of built-up areas

**61,8%** consists of agricultural land, including **0,92%** for vineyards

**12,97%** are protected areas, with an additional **15,27%** needed for nature restoration

## Total suitable land for renewables is located




in cities

in towns and suburbs

in rural areas

France's path to 100% renewables in the PAC scenario features significant growth in solar PV and onshore wind installations, reaching around 260 GW of solar and 83 GW of onshore wind capacity by 2040. These assets will contribute to around 46% of France's electricity production and satisfy around 30% of the country's overall energy demand by the same year. To host such solar and wind capacity, we estimate that France will need around 0.8% of its total land by 2030, and 2% by 2040, finding itself in an advantageous position to achieve strategic spatial planning decisions for renewables.

France's land cover is characterised by a vast amount (61.8%) of agricultural areas. Around 13% of the country's territory is located inside Natura 2000 sites, but this applies to only 7% of agricultural land. Based on data from the Nature Restoration Law's Impact Assessment, an additional 15% of the country's land will be needed for nature restoration purposes. The JRC has estimated that 2.72% of France's land is suitable for onshore wind installations, followed by 2.22% suitable for ground-mounted PV capacity and 0,24% for rooftop PV systems. For both technologies, more than 90% of suitable land is located in rural areas.

Considering the renewables growth trajectory in the PAC scenario, we estimate that by 2040 France will need around 0.3% of its land to install the necessary ground-mounted PV capacity (101 GW). Even when considering only the suitable siting options that match the JRC's suitability estimates, France is well placed to develop significant solar capacity in rural areas without clashing with agricultural production or nature conservation efforts. By comparison, France currently uses more land to grow potatoes (0.35%) than it would need to host all the ground-mounted solar PV it needs by 2040, while 11 times more land is currently used to produce crops destined for fodder production. Thanks to its large building stock, France is also ideal for installing rooftop and building-integrated PV systems. The required 158 GW capacity foreseen in the PAC scenario would require only 0.17% of France's total surface, while 0.24% is available for suitable developments.

Similarly, the required installed onshore wind capacity by 2040 (82 GW) will require 1.46% of France's total land. However, up to 2.72% is estimated to be complying with the JRC's suitability criteria, meaning that all the needed onshore wind capacity can be installed in suitable areas, a large portion of which should be designated as RAAs. An ex-ante exclusion of Natura 2000 sites under both the Habitats and Birds Directives could also help avoid potential environmental adverse effects without impacting the availability of suitable sites for onshore wind development.

# ITALY

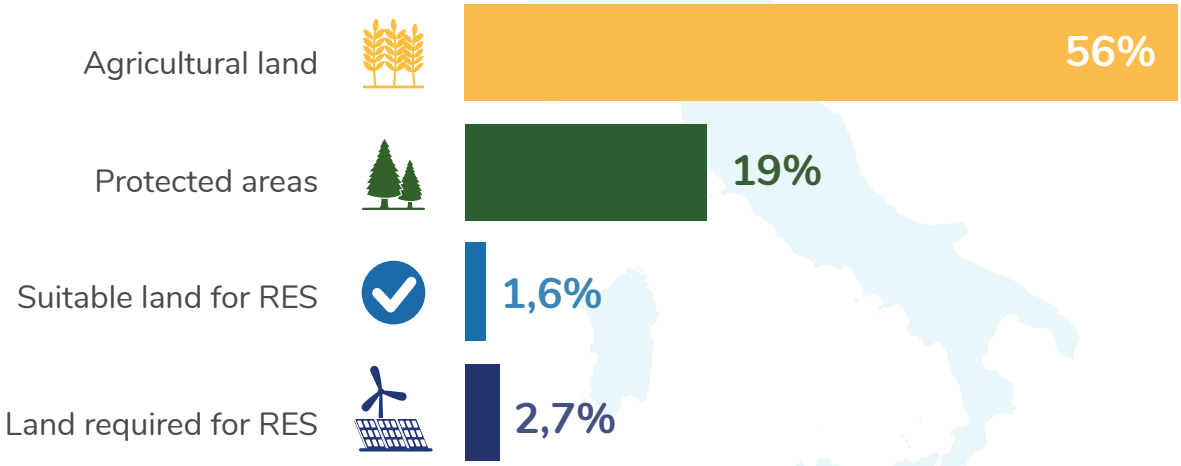
## Key takeaways

- Italy shows no significant land constraints to the development of solar PV systems, both ground-mounted and rooftop. The needed space for ground-mounted solar PV is 28 times less than the share of agricultural land facing high or very high degradation phenomena, and 13 times less than the agricultural land currently used in Italy to grow fodder crops. The quick designation of RAAs for solar PV is key, in combination with clear and robust criteria for dual land-use to favour the uptake of agri PV solutions.

- Developing sufficient onshore wind capacity in Italy will require strategic spatial planning solutions to identify additional sites that do not fall within the JRC's suitability criteria. Development of onshore wind turbines should be prioritised on agricultural land where coexistence with other economic activities can be ensured, and supported by a clear set of reasonable mitigation measures.

# ITALY

## Share of total land




## Types of current land use

**8,79%** consists of built-up areas

**56,4%** consists of agricultural land, including **2,55%** for vineyards

**18,99%** are protected areas, with an additional **12,01%** needed for nature restoration

## Total suitable land for renewables is located


in cities | in towns and suburbs | in rural areas

In the PAC scenario, Italy achieves a 100% renewables-based system by 2040 dominated by solar PV (228 GW) and onshore wind (39 GW) generation capacities. By 2040, these two technologies will contribute to around 68% of Italy's electricity production and satisfy around 41% of the country's final energy demand by the same year. To host those capacities, we estimate that Italy will need around 1.7% of its total land by 2030, and 2.7% by 2040. These figures slightly exceed the EU average.

Agricultural land in Italy amounts to around 56% of the country's total land surface, but a significant portion of it (23%, or 13% of the total land) is facing high or very high degradation. Almost 19% of Italy's territory is located within Natura 2000 sites, including more than one third of its forests. Based on EU projections, an additional 12% of Italy's territory will be needed for nature restoration purposes under the EU Nature Restoration Law. The JRC has estimated that 0.91% of Italy's land is suitable for ground-mounted solar PV development, 0.46% for onshore wind, and 0.25% for rooftop solar PV. For both wind and solar, around 10% of that suitable land is located in cities, 42-46% in towns and suburbs, and 43-48% in rural areas.

Based on the PAC scenario capacity results, we estimate that by 2040 Italy will need 0.47% of its territory to host the required ground-mounted solar capacity (78 GW). Based on the JRC's estimates, this means that there's almost twice as much land available in Italy than is needed to accommodate ground-mounted PV systems without impacting on nature reserves, other biodiversity-rich sites or valuable farmland. Rooftop PV in Italy will require around 0,25% of the country's surface by 2040 (for 150 GW capacity), almost exactly corresponding to the JRC's estimated suitable sites, which are mainly located in cities.

The deployment of the required capacity (39 GW) of onshore wind could pose some land availability problems if only suitable areas, in line with JRC's suitability estimates, are considered. In fact, Italy would need 1.32% of its land to host the needed onshore wind installations, posing the need to identify additional suitable sites. Like in the case of Germany, it is useful to consider that the space requirements of onshore wind do not imply the use of the full surface: only the space used for pylons entails a loss of land. Onshore wind projects can be ideal candidates for dual-use applications, including potentially on high-value agricultural land, if the right measures are in place and all existing environmental assessments under EU law are implemented.

Furthermore, in order to achieve strategic and effective spatial planning for renewable energy in Italy, it is crucial to clearly identify RAAs and ensure that their designation remains effective even if the required grid connection works extend beyond these areas; and to minimise bureaucratic and speculative barriers by discouraging speculative land markets and ensuring that national regulations override conflicting regional and local land use restrictions.

# POLAND

## Key takeaways

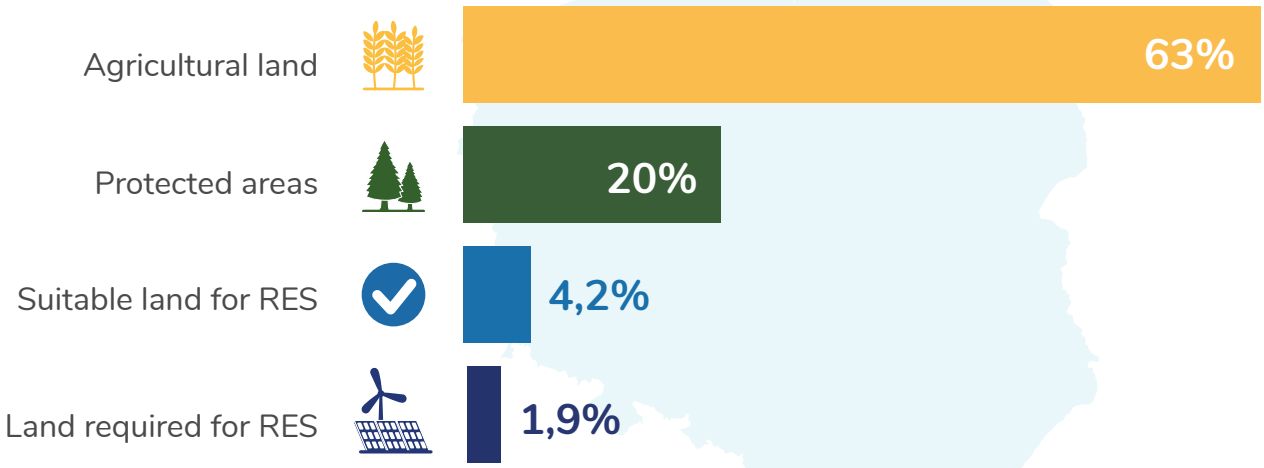
- Poland does not present issues for land availability to host the needed renewables capacity largely or completely in suitable areas. The required space for ground-mounted solar PV systems is around one tenth of the available space matching the JRC's suitability criteria. RAAs should be designated quickly and prioritise those sites, particularly industrial areas and decommissioning/ed coal power plants (e.g. Belchatow).

- Onshore wind facilities can also be developed in harmony with biodiversity conservation and wider nature restoration needs, without reducing valuable agricultural land. The available suitable locations amount to roughly double the needed land for wind turbines.

- Grid extension and modernisation are urgent priorities, and the designation of RAAs should always encompass electricity infrastructure or be coupled with specific grid planning.

# POLAND

## Share of total land



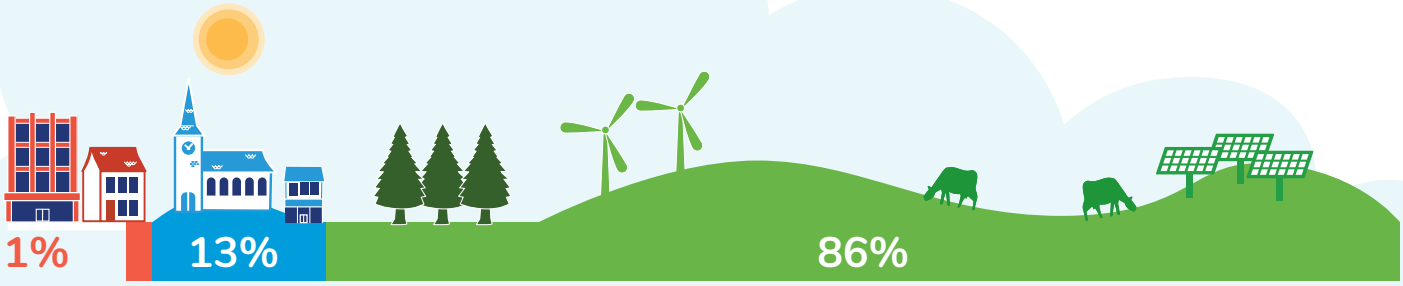

## Types of current land use

**4,74%** consists of built-up areas

**62,59%** consists of agricultural land, including **0,67%** for potatoes

**19,64%** are protected areas, with an additional **4,58%** needed for nature restoration

## Total suitable land for renewables is located




1% in cities

13% in towns and suburbs

86% in rural areas

# POLAND

In the PAC scenario, Poland develops significant solar PV (84 GW) and onshore wind (51 GW) capacity by 2040. These installations will contribute to around 57% of Poland's electricity production and satisfy around 30% of the country's final energy demand by the same year. To host such solar and wind capacity, we estimate that Poland will need around 0.8% of its total land by 2030, and 1.8% by 2040, far below EU-27 average estimates.

Poland's land cover is characterised by almost two thirds (63%) of agricultural land, 11% of which falls inside Natura 2000 areas. Chemically contaminated land constitutes about 2.7% of the country's total land, while protected natural areas amount to almost 20% of the country's total surface, and additional nature restoration needs will require a further 4.5% of land. Against this land-use backdrop, and considering the technical production potential for solar and wind technologies, the JRC estimated suitable land for onshore wind at 2.44%, for ground-mounted solar PV at 1.63%, and for rooftop PV at 0.15% of the Polish land territory. For both technologies, more than 80% of the suitable land is located in rural areas.

By 2040, under the PAC scenario capacity trajectory, the land required by ground-mounted PV installations (23 GW) will be around 0.16% of the total land in Poland, leaving an additional 1.47% of total Polish land available for ground-mounted PV development without infringing on high biodiversity or agricultural value sites, and provided that electricity infrastructure is expanded to reach those suitable sites. By comparison, the required land by ground-mounted PV systems would be less than one third of the currently highly or very highly degraded agricultural land in Poland (1.75%). Rooftop solar systems as modelled in PAC will require just 0.15% of total land, matching the JRC's estimated suitable surface and thus posing no siting issues if permitting barriers are removed and access to financing schemes for self-consumption is improved.

Similarly, Poland has a lot of potential to install onshore wind turbines without obstructing valuable farmland or Natura 2000 sites. By 2040, onshore wind installations will require 1.24% of Poland's land, all of which could be located in suitable sites. However, Poland faces issues of grid scarcity that could act as the primary bottleneck to faster and wider renewables penetration in the electricity systems. Like in the rest of Europe, this is particularly true in rural areas.

Local municipalities are required to create new 'general plans' with special rules for RES development as part of spatial planning reforms, which must be implemented by the end of 2025. However, slow bureaucracy and reluctance from some municipalities risk hindering this process. Further, the Polish electrical grid will need substantial upgrades and spending to meet the transmission and distribution needs of a renewables-based energy system.

# ROMANIA

## Key takeaways

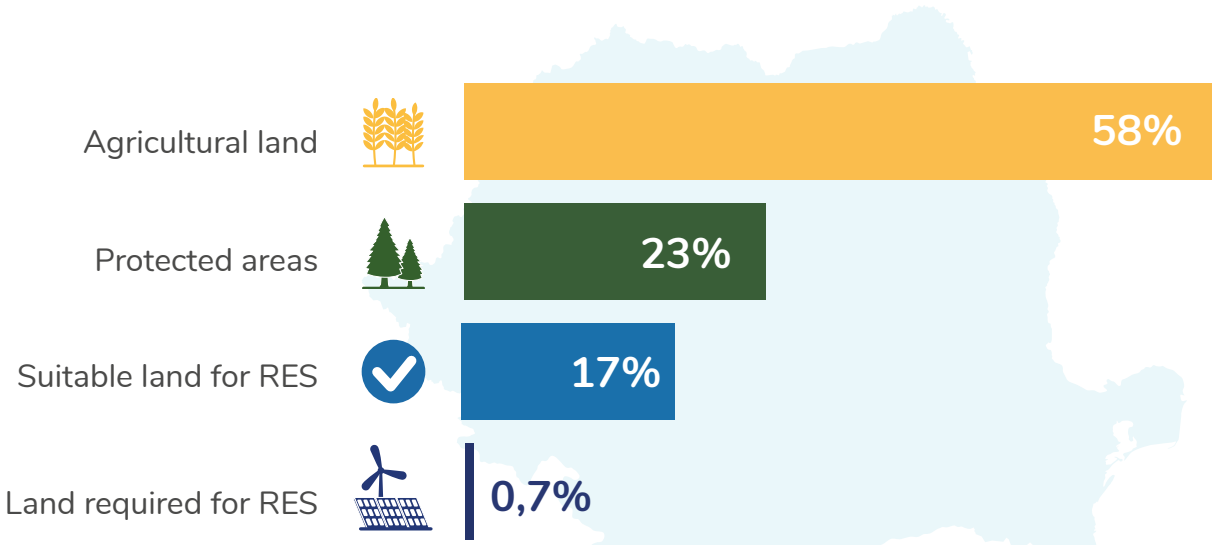
- Considering the significant excess of suitable land for both ground-mounted PV and onshore wind systems development, Romania is the country analysed with significantly fewer land availability constraints. The fast designation of RAAs in areas that match the JRC suitability criteria is a top priority. Establishing a robust set of credible mitigation measures will also allow for the upscaling of developments outside RAAs and in sites that are not protected but are located close to nature reserves.

- Much as in the case of Poland, grid availability looks set to be the main bottleneck to the development and integration of renewables. RAAs should be selected first in proximity of existing grid infrastructure, while important anticipatory investments in new and modernised grids will have to take into consideration the location of suitable land for the realisation of further acceleration areas.

- Romania needs to abandon its emphasis on hydropower and focus only on repowering existing structures, thereby freeing up the financial and political capital needed to accelerate solar and wind.

# ROMANIA

## Share of total land




## Types of current land use

**3,78%** consists of built-up areas

**57,98%** consists of agricultural land, including **0,67%** for vineyards

**22,74%** are protected areas, with an additional **14,61%** needed for nature restoration

## Total suitable land for renewables is located

Romania's path to 100% renewables in the PAC scenario is dominated by the growth in solar PV and onshore wind installations, reaching around 74 GW and 7 GW respectively by 2040. These assets will contribute to around 48% of Romania's electricity production and satisfy around 40% of the country's final energy demand by the same year. To host such solar and wind capacity, we estimate that Romania will need around 0.3% of its total land by 2030, and 0.7% by 2040, finding itself in an advantageous position to achieve strategic spatial planning decisions for renewables.

Land cover in Romania is characterised by roughly 58% of agricultural areas. Around 23% of the country's territory is located inside Natura 2000 sites, including around 12% of agricultural land and 40% of forest areas. Based on data from the Nature Restoration Law's Impact Assessment, an additional 14.6% of the country's land will be needed for nature restoration purposes, making it important to plan for renewables and restoration efforts jointly. The JRC has estimated that 9.08% of Romania's land is suitable for onshore wind installations, followed by 7.68% suitable for ground-mounted PV capacity and 0.15% for rooftop PV systems. For both technologies, around 85% of suitable land is located in rural areas.

Based on the PAC scenario capacity results, we estimate that by 2040, Romania will need 0.35% of its land to install the necessary ground-mounted PV capacity (37 GW). Even when considering only the suitable siting options that match the JRC's suitability estimates (21 times more land than is needed by solar), Romania finds itself in an extremely advantageous position to develop significant solar capacity in rural areas without impeding upon agricultural production or nature conservation efforts. By comparison, Romania currently uses almost double the land to for vineyards (0.67%) than it would need to host all the ground-mounted solar PV it needs by 2040, and eight times more land is currently used to produce crops destined for fodder production. Rooftop solar systems as modelled in PAC will require just 0.09% of total land, while the JRC's estimated suitable surface stands at 0.15%. Therefore, the needed share of rooftop solar could be easily accommodated in Romania if all relevant permitting barriers are removed and access to financing schemes for self-consumption is improved.

In addition, the 'solar mandate' dictated by the revised EU Energy Performance of Buildings Directive should be further expanded and swiftly implemented on all technically feasible buildings, while providing low-income households and small businesses to access financing schemes to install buildings-integrated and rooftop PV assets.

With respect to onshore wind, Romania's land characteristics are even more favourable. When excluding ex-ante all nature-protected areas and valuable agricultural land, 37 times more land would be available for development in suitable sites than needed under PAC assumptions.

In order to achieve strategic and effective renewable energy spatial planning in Romania, it is crucial to develop clear rules that allow for the co-location of renewable energy with other land uses, and to ensure inclusive decision-making processes involving municipalities and local actors in comprehensive spatial mapping and planning.

# CONCLUSION

Europe's pathway towards 100% renewables relies on a decisive acceleration of solar and wind energy development, which could finally be unlocked by EU countries through careful spatial planning in line with the requirements of the revised EU RED. Key findings from our analysis highlight that only 2.2% of the EU's total land area is needed to accommodate the current and future solar and wind projects required.

With the right land-use planning and environmental safeguards in place in EU countries, the required solar and wind installations can therefore be deployed with a minimal land footprint and without compromising biodiversity protection, food production and wider agricultural activities, or future nature restoration needs. Research carried out by the JRC on areas with sufficient solar or wind potential and low agricultural and environmental sensitivity shows that there is sufficient suitable land available for renewable energy deployment away from Europe's most environmentally sensitive areas.

While the availability of suitable land varies widely across EU countries, a common trend is that most suitable sites are located in rural areas, particularly on degraded agricultural land with low productivity and at high risk of abandonment. This provides an opportunity not only to revitalise these areas, but also to support the local economy and create jobs. It is essential that renewable energy projects in rural areas are designed and implemented with local needs and conditions in mind. Tailored approaches that take into account the specific geographical, economic and social context of rural areas will increase the effectiveness and acceptance of renewable energy projects.

In terms of suitable land available for solar and wind energy development, most EU countries do not face significant land constraints. Based on the results of the PAC scenario, countries such as France, Romania and Spain have significant 'spare' land, even excluding protected areas and agricultural land that is not degraded or of low value. Some countries, such as Germany and Italy, are expected to have limited space for onshore wind, so development areas will need to be identified either near natural sites or in combination with other uses of agricultural land.

Compared to other current land uses, particularly in the agricultural sector, the amount of land required for renewable energy is often dwarfed by some current high impact land uses. In France and Italy, 2 to 3 times more land is currently used to grow crops for animal feed than would be needed to accommodate all solar and wind installations. Changes in diet and progress towards the adoption of agro-ecological practices could free up much more agricultural land than is needed for renewable energy.

Interconnectivity and solidarity between EU countries is crucial. Countries such as Germany and Italy face relative land limitations, while countries such as Spain and Romania have a surplus of suitable land. A European interconnected supergrid is essential to compensate for these inequalities, allowing energy to be shared and reducing curtailment of renewables. This collaborative approach will be key to ensuring energy security and efficiency across the continent.

Europe has sufficient land resources to host all the renewables needed to achieve climate neutrality without compromising food production or natural ecosystems. With careful spatial planning, fair and transparent permitting, and a commitment to benefit-sharing, EU countries can realise their full renewable potential to build a sustainable, resilient, and interconnected energy union powered by 100% renewables.

# ANNEX

## EU27

| Land use categories | km2 | % of total land | Source |
|---|---|---|---|
| Artificial and built-up areas | 227,288 | **5.5%** | Eurostat |
| Land use with heavy environmental impact | 161,968 | **3.9%** | Eurostat |
| Agricultural areas and natural grassland - of which | 1,976,048 | **47.9%** | Eurostat |
| *facing high or very high degradation (LMI index)* | 187,922 | **4.6%** | Nature |
| Cropland - of which | 998,508 | **24.2%** | Eurostat |
| *Industrial (incl. bioenergy) crops* | 113,262 | **2.7%** | Eurostat |
| *Fodder crops* | 103,259 | **2.5%** | Eurostat |
| *Potatoes* | 12,775 | **0.3%** | Eurostat |
| *Vineyards* | 28,079 | **0.7%** | Eurostat |
| Protected areas (Natura 2000) | 767,877 | **18.6%** | EEA |
| Additional restoration needs (Nature Restoration Law Impact Assessment average projection) | 687,478 | **16.7%** | European Commission |

| Suitable land for renewables | km2 | % of total land | Source |
|---|---|---|---|
| Onshore wind | 114,046 | **2.8%** | JRC |
| Solar PV ground-mounted | 92,767 | **2.2%** | JRC |
| Solar PV rooftop | 7,151 | **0.2%** | JRC |
| Total suitable land | 213,964 | **5.2%** | JRC |

| Share of suitable land by degree of urbanisation | Cities (%) | Towns & Suburbs (%) | Rural (%) | Source |
|---|---|---|---|---|
| Onshore wind | **0.043%** | **0.429%** | **2.293%** | JRC |
| Solar (all) | **0.087%** | **0.433%** | **1.902%** | JRC |
| Total | **0.130%** | **0.861%** | **4.196%** | |

| Suitable land by degree of urbanisation (%) | Cities (km2) | Towns & Suburbs (km2) | Rural (km2) | Source |
|---|---|---|---|---|
| Onshore wind | **1.5%** | **15.5%** | **82.9%** | JRC |
| Solar PV (all) | **3.6%** | **17.9%** | **78.5%** | JRC |

| Land requirements by 2040 based on PAC capacities | Capacity (GW) | km2 | % of total land | Source |
|---|---|---|---|---|
| Onshore wind | 672 | 64,491 | **1.6%** | Own calculations by EEB based on PAC results, available literature, and JRC Urban Observatory data |
| Solar PV ground-mounted | 553 | 10,986 | **0.3%** | |
| Solar PV rooftop | 1,396 | 9,157 | **0.2%** | |
| Grids | N/A | 8,178 | **0.2%** | Energy and Space Summary Report (RGI, 2023) |
| Total | 2,621 | 92,812 | **2.2%** | |

## GERMANY

| Land use categories | km2 | % of total land | Source |
|---|---|---|---|
| Artificial and built-up areas | 35,830 | **10.02%** | Eurostat |
| Land use with heavy environmental impact | 23,826 | **6.66%** | Eurostat |
| Agricultural areas and natural grassland - of which | 213,179 | **59.62%** | Eurostat |
| *facing high or very high degradation (LMI index)* | 1,364 | **0.38%** | Nature |
| Cropland - of which | 115,399 | **32.27%** | Eurostat |
| *Industrial (incl. bioenergy) crops* | 14,417 | **4.03%** | Eurostat |
| *Fodder crops* | 8,677 | **2.43%** | Eurostat |
| *Potatoes* | 2,549 | **0.71%** | Eurostat |
| *Vineyards* | 1,176 | **0.33%** | Eurostat |
| Protected areas (Natura 2000) | 55,221 | **15.44%** | EEA |
| Additional restoration needs (Nature Restoration Law Impact Assessment | 7,078 | **1.98%** | European Commission |

| Suitable land | km2 | % of total land | Source |
|---|---|---|---|
| Onshore wind | 2,346 | **0.66%** | JRC |
| Solar PV ground-mounted | 2,211 | **0.62%** | JRC |
| Solar PV rooftop | 1,521 | **0.43%** | JRC |
| Total suitable land | 6,078 | **1.70%** | |

| Share of suitable land by degree of urbanisation | Cities (%) | Towns & Suburbs (%) | Rural (%) | Source |
|---|---|---|---|---|
| Onshore wind | **0.005%** | **0.092%** | **0.559%** | JRC |
| Solar (all) | **0.113%** | **0.281%** | **0.650%** | JRC |
| Total | **0.118%** | **0.373%** | **1.209%** | |

| Suitable land by degree of urbanisation (%) | Cities (km2) | Towns & Suburbs (km2) | Rural (km2) | Source |
|---|---|---|---|---|
| Onshore wind | **0.8%** | **14.0%** | **85.2%** | JRC |
| Solar PV (all) | **10.8%** | **26.9%** | **62.3%** | JRC |

| Land requirements by 2040 based on PAC capacities | Capacity (GW) | km2 | % of total land | Source |
|---|---|---|---|---|
| Onshore wind | 114 | 11,966 | **3.35%** | Own calculations by EEB based on PAC results, available literature, and JRC Urban Observatory data |
| Solar PV ground-mounted | 82 | 1,174 | **0.33%** | |
| Solar PV rooftop | 264 | 1,945 | **0.54%** | |
| Grids | N/A | 719 | **0.20%** | Energy and Space Summary Report (RGI, 2023) |
| Total | 460 | 15,804 | **4.42%** | |

## SPAIN

| Land use categories | km2 | % of total land | Source |
|---|---|---|---|
| Artificial and built-up areas | 22,901 | **4.59%** | Eurostat |
| Land use with heavy environmental | 17,932 | **3.60%** | Eurostat |

| | | | |
|---|---|---|---|
| Agricultural areas and natural grassland - of which | 276,855 | **55.54%** | Eurostat |
| *facing high or very high degradation (LMI index)* | 82,447 | **16.54%** | Nature |
| Cropland - of which | 136,476 | **27.38%** | Eurostat |
| *Industrial (incl. bioenergy) crops* | 7,344 | **1.47%** | Eurostat |
| *Fodder crops* | 8,194 | **1.64%** | Eurostat |
| *Potatoes* | 583 | **0.12%** | Eurostat |
| *Vineyards* | 7,624 | **1.53%** | Eurostat |
| Protected areas (Natura 2000) | 138,301 | **27.74%** | EEA |
| Additional restoration needs (Nature Restoration Law Impact Assessment average projection) | 69,947 | **14.03%** | European Commission |

| **Suitable land** | **km2** | **% of total land** | **Source** |
|---|---|---|---|
| Onshore wind | 11,719 | **2.35%** | JRC |
| Solar PV ground-mounted | 16,359 | **3.28%** | JRC |
| Solar PV rooftop | 461 | **0.09%** | JRC |
| Total suitable land | 28,539 | **5.72%** | |

| **Share of suitable land by degree of urbanisation** | **Cities (%)** | **Towns & Suburbs (%)** | **Rural (%)** | **Source** |
|---|---|---|---|---|
| Onshore wind | **0.119%** | **0.560%** | **1.672%** | JRC |
| Solar (all) | **0.160%** | **0.780%** | **2.433%** | JRC |
| Total | **0.279%** | **1.340%** | **4.105%** | |

| **Suitable land by degree of urbanisation (%)** | **Cities (km2)** | **Towns & Suburbs (km2)** | **Rural (km2)** | **Source** |
|---|---|---|---|---|
| Onshore wind | **5.1%** | **23.8%** | **71.1%** | JRC |
| Solar PV (all) | **4.8%** | **23.1%** | **72.1%** | JRC |

| **Land requirements by 2040 based on PAC capacities** | **Capacity (GW)** | **km2** | **% of total land** | **Source** |
|---|---|---|---|---|
| Onshore wind | 99 | 8,092 | **1.62%** | Own calculations by EEB based on PAC results, |
| Solar PV ground-mounted | 155 | 2,421 | **0.49%** | |

| | | | | |
|---|---|---|---|---|
| | | | | JRC Urban Observatory data |
| Grids | N/A | 897 | **0.18%** | Energy and Space Summary Report (RGI, 2023) |
| Total | 361 | 13,067 | **2.62%** | |

## FRANCE

| Land use categories | km2 | % of total land | Source |
|---|---|---|---|
| Artificial and built-up areas | 39,651 | **7.22%** | Eurostat |
| Land use with heavy environmental impact | 23,007 | **4.19%** | Eurostat |
| Agricultural areas and natural grassland - of which | 339,301 | **61.80%** | Eurostat |
| *facing high or very high degradation (LMI index)* | 21,410 | **3.90%** | Nature |
| Cropland - of which | 164,349 | **29.93%** | Eurostat |
| *Industrial (incl. bioenergy) crops* | 23,705 | **4.32%** | Eurostat |
| *Fodder crops* | 18,824 | **3.43%** | Eurostat |
| *Potatoes* | 1,930 | **0.35%** | Eurostat |
| *Vineyards* | 5,067 | **0.92%** | Eurostat |
| Protected areas (Natura 2000) | 71,238 | **12.97%** | EEA |
| Additional restoration needs (Nature Restoration Law Impact Assessment average projection) | 83,864 | **15.27%** | European Commission |

| Suitable land | km2 | % of total land | Source |
|---|---|---|---|
| Onshore wind | 14,911 | **2.72%** | JRC |
| Solar PV ground-mounted | 12,185 | **2.22%** | JRC |
| Solar PV rooftop | 1,344 | **0.24%** | JRC |
| Total suitable land | 28,440 | **5.18%** | |

| Share of suitable land by degree of urbanisation | Cities (%) | Towns & Suburbs (%) | Rural (%) | Source |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Solar (all) | **0.097%** | **0.108%** | **2.260%** | JRC |
| Total | **0.119%** | **0.168%** | **4.893%** | |

| **Suitable land by degree of urbanisation (%)** | **Cities (km2)** | **Towns & Suburbs (km2)** | **Rural (km2)** | **Source** |
|---|---|---|---|---|
| Onshore wind | **0.8%** | **2.2%** | **97.0%** | JRC |
| Solar PV (all) | **3.9%** | **4.4%** | **91.7%** | JRC |

| **Land requirements by 2040 based on PAC capacities** | **Capacity (GW)** | **km2** | **% of total land** | **Source** |
|---|---|---|---|---|
| Onshore wind | 83 | 8,019 | **1.46%** | Own calculations by EEB based on PAC results, available literature, and JRC Urban Observatory data |
| Solar PV ground-mounted | 101 | 1,704 | **0.31%** | |
| Solar PV rooftop | 159 | 942 | **0.17%** | |
| Grids | N/A | 307 | **0.06%** | Energy and Space Summary Report (RGI, 2023) |
| Total | 342 | 10,971 | **2.00%** | |

## ITALY

| **Land use categories** | **km2** | **% of total land** | **Source** |
|---|---|---|---|
| Artificial and built-up areas | 26,541 | **8.79%** | Eurostat |
| Land use with heavy environmental impact | 14,311 | **4.74%** | Eurostat |
| Agricultural areas and natural grassland - of which | 170,376 | **56.40%** | Eurostat |
| *facing high or very high degradation (LMI index)* | 39,698 | **13.14%** | Nature |
| Cropland - of which | 95,612 | **31.65%** | Eurostat |
| *Industrial (incl. bioenergy) crops* | 3,766 | **1.25%** | Eurostat |
| *Fodder crops* | 20,340 | **6.73%** | Eurostat |
| *Potatoes* | 330 | **0.11%** | Eurostat |

| | | | |
|---|---|---|---|
| Protected areas (Natura 2000) | 57,365 | **18.99%** | EEA |
| Additional restoration needs (Nature Restoration Law Impact Assessment average projection) | 36,292 | **12.01%** | European Commission |

| **Suitable land** | **km2** | **% of total land** | **Source** |
|---|---|---|---|
| Onshore wind | 1,399 | **0.46%** | JRC |
| Solar PV ground-mounted | 2,757 | **0.91%** | JRC |
| Solar PV rooftop | 752 | **0.25%** | JRC |
| Total suitable land | 4,908 | **1.62%** | |

| **Share of suitable land by degree of urbanisation** | **Cities (%)** | **Towns & Suburbs (%)** | **Rural (%)** | **Source** |
|---|---|---|---|---|
| Onshore wind | **0.043%** | **0.217%** | **0.203%** | JRC |
| Solar (all) | **0.099%** | **0.497%** | **0.565%** | JRC |
| Total | **0.142%** | **0.714%** | **0.769%** | |

| **Suitable land by degree of urbanisation (%)** | **Cities (km2)** | **Towns & Suburbs (km2)** | **Rural (km2)** | **Source** |
|---|---|---|---|---|
| Onshore wind | **9.4%** | **46.8%** | **43.8%** | JRC |
| Solar PV (all) | **8.5%** | **42.8%** | **48.7%** | JRC |

| **Land requirements by 2040 based on PAC capacities** | **Capacity (GW)** | **km2** | **% of total land** | **Source** |
|---|---|---|---|---|
| Onshore wind | 39 | 3,980 | **1.32%** | Own calculations by EEB based on PAC results, available literature, and JRC Urban Observatory data |
| Solar PV ground-mounted | 78 | 1,415 | **0.47%** | |
| Solar PV rooftop | 150 | 769 | **0.25%** | |
| Grids | N/A | 2,058 | **0.68%** | Energy and Space Summary Report (RGI, 2023) |
| Total | 267 | 8,222 | **2.72%** | |

## POLAND

| Land use categories | km2 | % of total land | Source |
|---|---|---|---|
| Artificial and built-up areas | 14,799 | **4.74%** | Eurostat |
| Land use with heavy environmental impact | 10,799 | **3.46%** | Eurostat |
| Agricultural areas and natural grassland - of which | 195,224 | **62.59%** | Eurostat |
| *facing high or very high degradation (LMI index)* | 2,616 | **0.84%** | Nature |
| Cropland - of which | 108,212 | **34.69%** | Eurostat |
| *Industrial (incl. bioenergy) crops* | 11,261 | **3.61%** | Eurostat |
| *Fodder crops* | 5,467 | **1.75%** | Eurostat |
| *Potatoes* | 2,084 | **0.67%** | Eurostat |
| *Vineyards* | 0 | **0.00%** | Eurostat |
| Protected areas (Natura 2000) | 61,257 | **19.64%** | EEA |
| Additional restoration needs (Nature Restoration Law Impact Assessment average projection) | 14,275 | **4.58%** | European Commission |

| Suitable land | km2 | % of total land | Source |
|---|---|---|---|
| Onshore wind | 7,599 | **2.44%** | JRC |
| Solar PV ground-mounted | 5,092 | **1.63%** | JRC |
| Solar PV rooftop | 468 | **0.15%** | JRC |
| Total suitable land | 13,159 | **4.22%** | |

| Share of suitable land by degree of urbanisation | Cities (%) | Towns & Suburbs (%) | Rural (%) | Source |
|---|---|---|---|---|
| Onshore wind | **0.007%** | **0.300%** | **2.129%** | JRC |
| Solar (all) | **0.045%** | **0.252%** | **1.486%** | JRC |
| Total | **0.052%** | **0.552%** | **3.615%** | |

| Suitable land by degree of urbanisation (%) | Cities (km2) | Towns & Suburbs (km2) | Rural (km2) | Source |
|---|---|---|---|---|
| Onshore wind | **0.3%** | **12.3%** | **87.4%** | JRC |
| Solar PV (all) | **2.5%** | **14.1%** | **83.4%** | JRC |

| Land requirements by 2040 based on PAC capacities | Capacity (GW) | km2 | % of total land | Source |
|---|---|---|---|---|
| Onshore wind | 51 | 3,858 | **1.24%** | Own calculations by EEB based on PAC results, available literature, and JRC Urban Observatory data |
| Solar PV ground-mounted | 23 | 512 | **0.16%** | |
| Solar PV rooftop | 62 | 452 | **0.15%** | |
| Grids | N/A | 1,049 | **0.34%** | Energy and Space Summary Report (RGI, 2023) |
| Total | 136 | 5,871 | **1.88%** | |

## ROMANIA

| Land use categories | km2 | % of total land | Source |
|---|---|---|---|
| Artificial and built-up areas | 9,017 | **3.78%** | Eurostat |
| Land use with heavy environmental impact | 6,408 | **2.69%** | Eurostat |
| Agricultural areas and natural grassland - of which | 138,219 | **57.98%** | Eurostat |
| *facing high or very high degradation (LMI index)* | 9,122 | **3.83%** | Nature |
| Cropland - of which | 77,664 | **32.58%** | Eurostat |
| *Industrial (incl. bioenergy) crops* | 11,502 | **4.82%** | Eurostat |
| *Fodder crops* | 7,024 | **2.95%** | Eurostat |
| *Potatoes* | 467 | **0.20%** | Eurostat |
| *Vineyards* | 1,603 | **0.67%** | Eurostat |
| Protected areas (Natura 2000) | 54,214 | **22.74%** | EEA |
| Additional restoration needs (Nature Restoration Law Impact Assessment average projection) | 34,833 | **14.61%** | European Commission |

| Suitable land | km2 | % of total land | Source |
|---|---|---|---|
| Onshore wind | 21,641 | **9.08%** | JRC |
| Solar PV ground-mounted | 18,304 | **7.68%** | JRC |

| | | | |
|---|---|---|---|
| Total suitable land | 40,299 | **16.90%** | |

| **Share of suitable land by degree of urbanisation** | **Cities (% of total land)** | **Towns & Suburbs (% of total land)** | **Rural (% of total land)** | **Source** |
|---|---|---|---|---|
| Onshore wind | **0.030%** | **1.262%** | **7.785%** | JRC |
| Solar (all) | **0.050%** | **1.105%** | **6.671%** | JRC |
| Total | **0.080%** | **2.368%** | **14.456%** | |

| **Suitable land by degree of urbanisation (%)** | **Cities (km2)** | **Towns & Suburbs (km2)** | **Rural (km2)** | **Source** |
|---|---|---|---|---|
| Onshore wind | **0.3%** | **13.9%** | **85.8%** | JRC |
| Solar PV (all) | **0.6%** | **14.1%** | **85.2%** | JRC |

| **Land requirements by 2040 based on PAC capacities** | **Capacity (GW)** | **km2** | **% of total land** | **Source** |
|---|---|---|---|---|
| Onshore wind | 7 | 572 | **0.24%** | Own calculations by EEB based on PAC results, available literature, and JRC Urban Observatory data |
| Solar PV ground-mounted | 37 | 833 | **0.35%** | |
| Solar PV rooftop | 37 | 207 | **0.09%** | |
| Grids | N/A | 36 | **0.02%** | Energy and Space Summary Report (RGI, 2023) |
| Total | 81 | 1,649 | **0.69%** | |

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