SUMMARY REPORT | SEPTEMBER 2023

ENERGY & SPACE

A comparative analysis of spatial requirements of different decarbonisation scenarios

Renewables Grid Initiative

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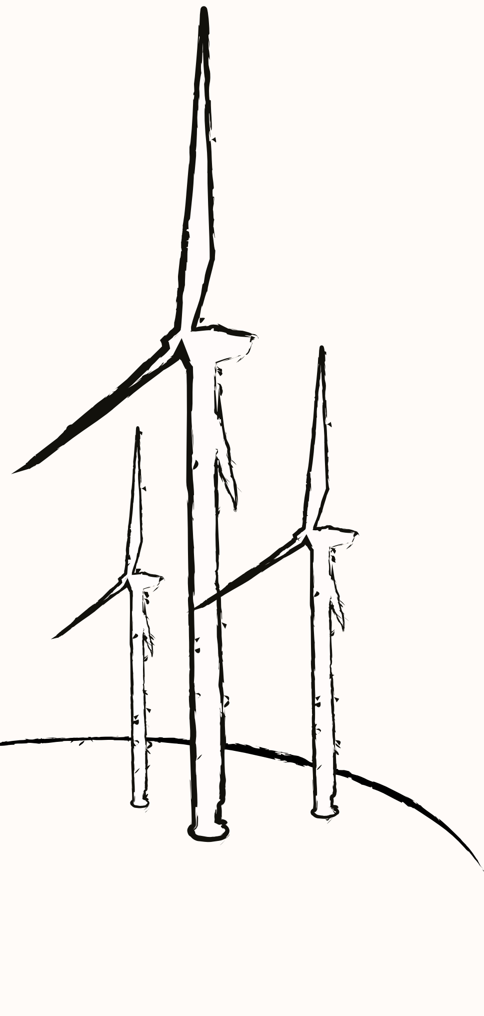


01 Introduction

In response to the climate crisis and in alignment with the 2015 Paris Agreement goals, the European Union has committed to achieving carbon neutrality by 2050. This ambitious target requires a profound transformation of the entire energy system, transitioning from centralised and national energy systems to decentralised, yet interconnected ones.

A central element of this transition is the increasing role of renewable energy sources, considered a linchpin for achieving decarbonisation as well as electricity grids that enable the integration of renewables into the energy system. While renewables can reduce and eliminate greenhouse gas emissions, the deployment of wind, solar, electricity grids assets and other energy transition infrastructure requires a considerable amount of space and water.

This context poses a challenge, considering that available space on land and at sea is finite and, as a result, subject to various and conflicting uses, for example, urban development, agriculture, biodiversity protection and restoration, and the deployment of energy transition infrastructure. Balancing the need for a rapid and extensive deployment of renewables, electricity grids and other infrastructure, while considering the importance of other human activities and nature protection, presents a significant challenge.

At the same time, a lack of sufficient data and information on the space required to achieve decarbonisation prevents an understanding of where energy transition infrastructure shall be located in order to aid decisions about how to optimally use available resources, reduce potential conflicts, and contribute to the system planning.

To address this gap, the Renewables Grid Initiative (RGI) commissioned the Reiner Lemoine Institute (RLI) to develop a comprehensive analysis of spatial and water requirements to achieve the implementation of four distinct decarbonisation scenarios in Europe. This process included interactions with a broad array of stakeholders and energy experts from diverse sectors, whose input contributed to generating modelling results, which are also visualised in an online interactive tool. This brochure provides an overview of the findings and implications of the analysis.

02 ANALYSED SCENARIOS

This analysis compared four of the available decarbonisation scenarios for Europe, which strategically outline pathways for how to eliminate greenhouse gases (GHG) emissions in order to combat climate change and transition to a climate-neutral Europe by 2050.

These scenarios provide guidance on how to achieve specific emissions reduction targets for specific years. They are valuable tools for understanding the challenges and opportunities associated with reducing carbon emissions and, in turn, to be able to make informed decisions about climate action.

Four distinctive decarbonisation scenarios for Europe have been selected, based on exchanges with energy system planning and modelling experts. While all these scenarios represent pathways to achieve carbon neutrality in Europe by 2050, they have been developed by different actors and differ in terms of targets and drivers behind the transition.

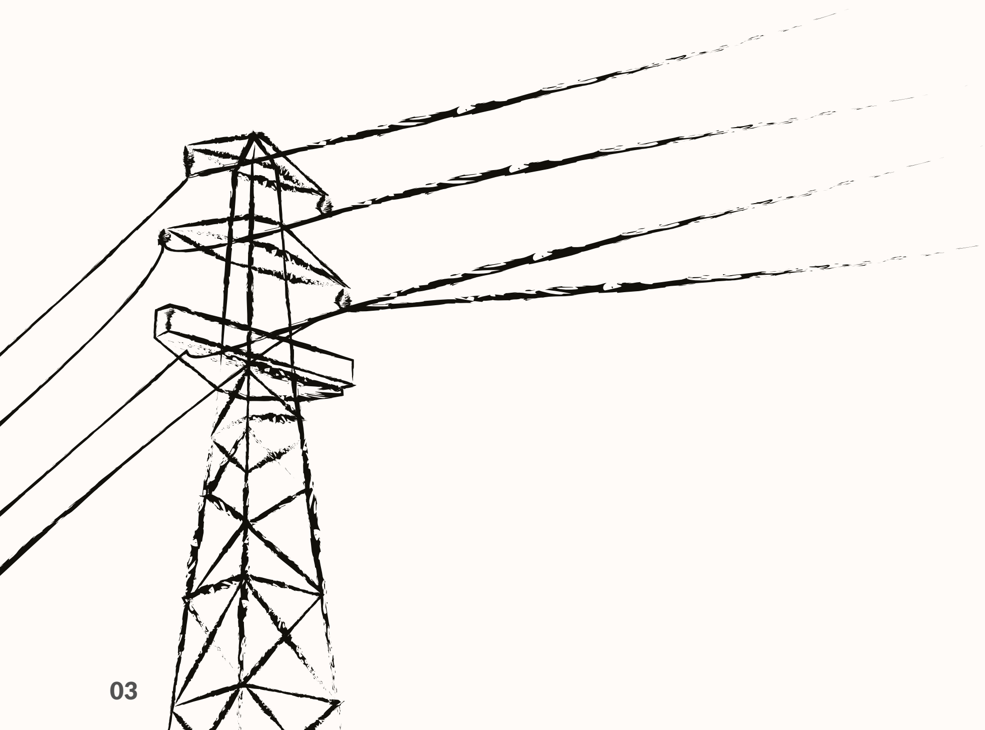
The following sections briefly describe each of the scenarios used in this analysis.

CLEVER SCENARIO

The CLEVER (a Collaborative Low Energy Vision for the European Region) scenario assumes carbon neutrality in Europe by 2050 at the very latest. It was developed by the négaWatt Association through a bottom-up, collaborative approach involving experts from academia and civil society from 26 European countries. The CLEVER scenario presents a trajectory that balances the imperative of achieving long-term climate and sustainability objectives with the immediate challenges of ensuring energy security and the practical feasibility of such a transformation.

The three key principles behind this scenario are:

- *Enhancing energy sufficiency*
- *Improving energy efficiency, leading to energy demand reduction*
- *Renewable energy development to achieve 100% renewable energy mix in Europe*



THE CONCEPT OF SUFFICIENCY

played a central role for the CLEVER scenario development.

Sufficiency in the energy transition context addresses the environmental challenges associated with energy consumption by reducing demand and the use of resource-intense services while promoting sustainable practices, lifestyles, and systems.

PAC SCENARIO

The Paris Agreement Compatible (PAC) Scenario was developed by Climate Action Network (CAN) Europe and the European Environmental Bureau (EEB) under the banner of the PAC project. At its core, PAC constructs a European-wide energy scenario which is aligned with the Paris Agreement's objective to limit global warming to 1.5°C and which embodies policy demands of civil society for this purpose. The PAC scenario will guide European energy infrastructure planning and help to ensure that only the infrastructure necessary for a future low carbon, renewables-based energy system is planned and built.

The PAC Scenario is guided by three main objectives:

- *65% reduction in greenhouse gas emissions by 2030*
- *Net-zero greenhouse gas emissions by 2040*
- *100% renewables in Europe by 2040 in all sectors*

TYNDP SCENARIOS

Two remaining scenarios used for this analysis – Distributed Energy (DE) and Global Ambition (GA) – have been developed jointly by the European Network of Transmission System Operators for Electricity (ENTSO-E) and the European Network of Transmission System Operators for Gas (ENTSOG).

These scenarios serve as a base for the official **Ten-Year Network Development Plan (TYNDP)**, which is a key tool for the coordinated planning and development of energy infrastructure within the European Union and determining the EU funding for electricity and gas infrastructure.

While both TYNDP scenarios used for this analysis: DE and GA are in line with the EU legislation and aim for at least 55% GHG emission reductions by 2030 and climate neutrality by 2050, they are based on different storylines and different visions of the future European energy system.

Distributed Energy

The Distributed Energy scenario is driven from the bottom-up by the local and national levels to achieve energy autonomy based on distributed renewable energy sources. It is supported by citizens initiatives, communities, and businesses, and with the support of local authorities to maximise local renewable energy production and reduce energy imports.

It also supports circularity, renovation and insulation of residential and commercial buildings, and behavioural changes to reduce energy demand. It focuses on the application of decentralised and distributed technologies, such as: solar PV, batteries (behind the meter), smart charging or demand side response based on smart metering.

Global Ambition

The Global Ambition scenario is driven by a global effort to address the climate crisis. The transition is initiated at the international level and global energy trading helps to achieve decarbonisation. While in the Global Ambition scenario the energy demand decreases, the priority is given to decarbonisation of energy supply. This is done by developing a wide range of large scale and centralised technologies, as for example offshore wind, large scale energy storage facilities and concentrated solar power. This scenario assumes, moreover, integration of low-carbon technologies, such as nuclear and carbon capture and storage (CCS).

03 ASSUMPTIONS AND METHODOLOGY

The methodology applied to determine energy-related land and water requirements in Europe for four different decarbonisation scenarios in three distinct timeframes (2030, 2040, 2050) has been structured into three steps:

FIRST STEP

Input data preparation

Crucial input data for modelling the European energy system has been collected and integrated into the open-source optimisation model for the European energy system: PyPSA-Eur.

This step involved the utilisation of scenario datasets that provided information about energy demands, installed capacity, energy generation targets by technology or carrier, and emission budgets. In situations where data was not specified in the scenario datasets, PyPSA-Eur's assumptions have been used to fill the gaps.

SECOND STEP

Modelling of the European Energy System

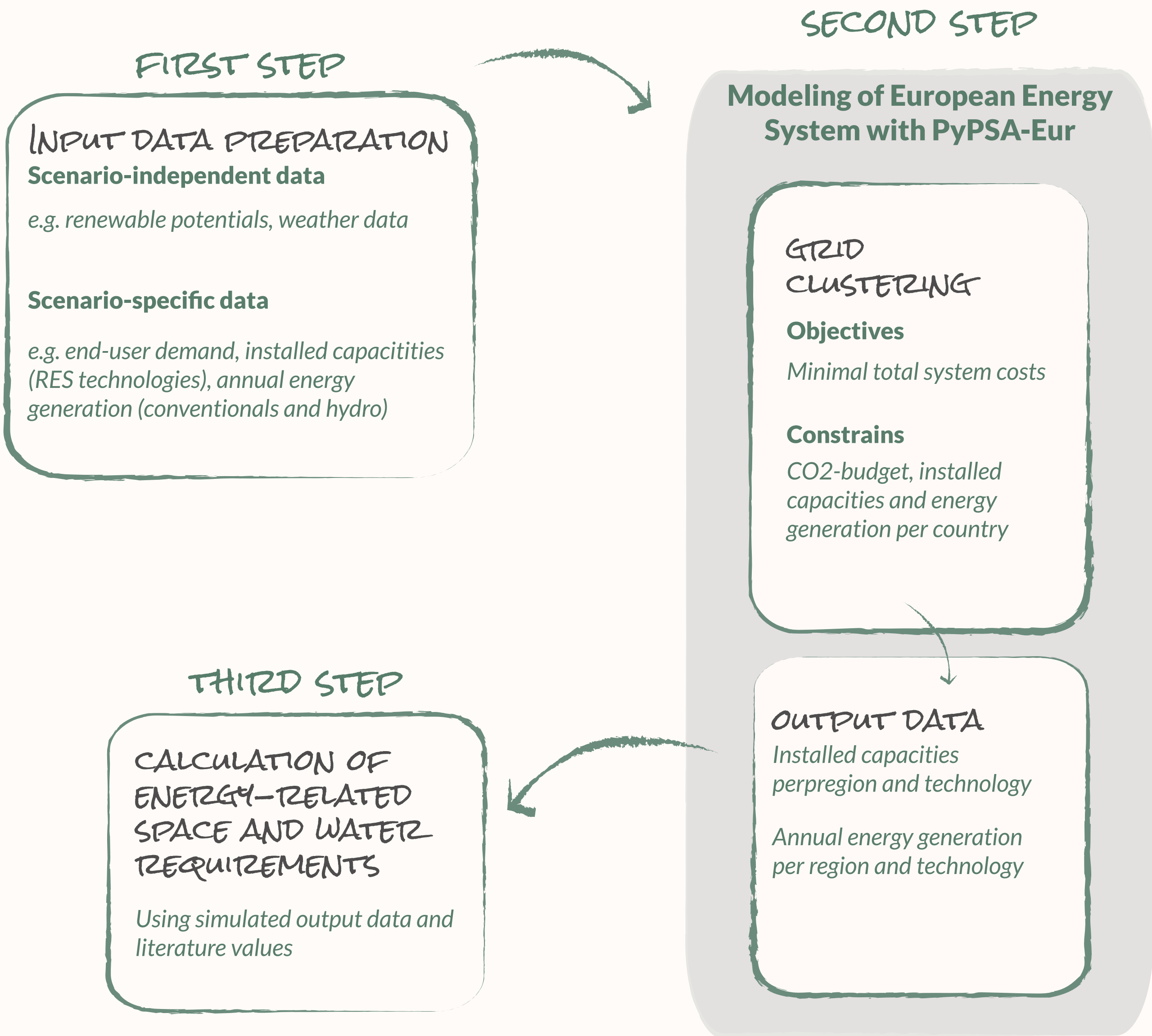
A modified version of PyPSA-Eur has been employed with an overarching optimisation approach towards the European energy system. The main objectives behind the modelling were the minimisation of system costs while ensuring that energy demands are met, CO2 budgets are adhered to, and various other constraints (such as the geographical potential for renewable energy sources or land-use restrictions) are satisfied. To simplify the modelling process, the model has been streamlined by grouping the network into 50 regions.

THIRD STEP

Calculation of Space and Water Requirements

The space required for solar and wind generators has been determined by considering their installed capacity and referring to values available in the literature. Space requirements for the electricity transmission grid have been estimated by taking expansion factors into account. The analysis also included computation of space prerequisites for electrolyser facilities and hydrogen storage. The assessment of land-use areas has been conducted based on land-use datasets, as well as the water needs of thermal power plants, hydropower installations, and hydrogen production facilities, which have been gauged based on values available in literature.

The conducted analysis has certain limitations stemming from the model capabilities and available data. For example, social and political factors (such as social acceptance) have not been incorporated into the model. Because of the same reason, certain energy technologies (such as geothermal power or marine power) have also been excluded from the analysis. The modelled scenarios use different climate years than PyPSA-Eur, and in case of certain efficiency and cost assumptions, PyPSA-Eur values have been used, whereas those from the selected scenarios have been neglected. In case of water use, only the requirements of energy production have been included, whereas cleaning water demand (e.g., for solar PV) has not been accounted for, and some technologies (e.g., lignite and hard coal or run-of-river and water reservoir hydropower plants) are grouped together when estimating water usage.



04 RESULTS

Comparison of four different decarbonisation scenarios: CLEVER, PAC, Distributed Energy (DE), and Global Ambition (GA), through the prism of space needed for the energy transition infrastructure shows that in the years to come, Europe will need to designate substantial parts of available area on land and at sea for this infrastructure. These values differ depending on the scenario analysed, resulting from the specific technological choices driving the transition. Since Europe aims to become a climate neutral continent by the middle of the current century, for each decade analysed (2030, 2040, 2050), the overall values of the needed land and water increase.

In 2030, the modelling of the CLEVER scenario shows that 60,851 km² of space in the EU will be required for the deployment of renewables and the related infrastructure. This corresponds to an area smaller in size than Latvia. The calculations based on the PAC scenario follow, with 59,094 km² of required space. The TYNDP Scenarios (DE and GA) occupy 58,584 km2 and 54,647 km2 of space respectively. This means that the entire space (on- and offshore) needed for the energy transition infrastructure under the two latter scenarios would be approximately aligned with an area the size of Croatia.

In 2040, according to the modelling results based on the CLEVER scenario, space required for renewables, electricity grid deployment and other infrastructure, expands to 98,625 km². This includes the integration of infrastructure for green hydrogen production (electrolysers) needed for delivering flexibility into the system, which results in 36.8 km² of land. Modelling of the PAC scenario shows that space requirements reaching 97,992 km² with substantial grid expansion (8,178 km²). Modelling of the TYNDP scenarios delivers the following values: for GA the space requirement grows to 85,186 km², whereas calculations based on the DE scenario predict 105,592 km² of needed space, the latter being equal to slightly more than the area of Iceland.

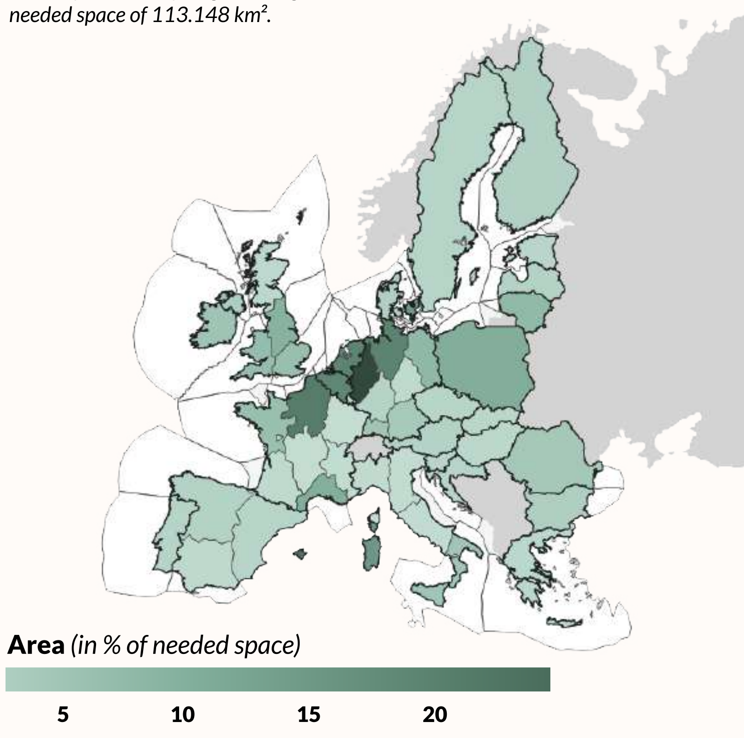
In 2050, the highest values are presented by the modelling of the two TYNDP scenarios: while DE reaches 147,398 km², under the GA scenario 115,371 km² of space would be needed for the energy transition infrastructure. Moreover, modelling of the CLEVER scenario shows 113,148 km² of required space, whereas the spatial requirements based on modelling of the PAC scenario amount to 131,927 km².

In the broader context, wind energy (combined onshore and offshore) takes centre stage, averaging 80% of spatial requirements across scenarios and timeframes. Solar technologies, excluding rooftop photovoltaic (PV), follow at 7-8% of total space needs (with a notable exception of the PAC scenario, in which solar power technologies reach 18% of total space required by 2050).

CLEVER Scenario

spatial requirements on land and at sea until 2050

including Wind (onshore and offshore), PV (excluding rooftop), grids, electrolysers and hydrogen storage until 2050. This translates to a needed space of 113.148 km².



A significant deployment of renewables, mostly wind and solar, requires an adequate electricity grid expansion to integrate renewable electricity into the system. The modelling results of the four decarbonisation scenarios show that within the analysed timeframes, the overall land requirements for electricity grid would amount to around 10% of total space only in case of the PAC scenario and only in 2030. Otherwise, the land needed for electricity grids to reach carbon neutrality in 2050 would amount to between 5-7% of the total space required (depending on the scenario).

The area needed for green hydrogen infrastructure is a marginal part of the total space required for energy transition infrastructure: in 2050, according to the PAC scenario electrolysers needed for green hydrogen production would amount with 34.7 km² land footprint, which is around three times less than the results from the DE scenario modelling show (122.95 km²).

Overview by regions

When considering spatial requirements by different European regions and focussing on the last timeframe of the analysis (2050) where Europe has reached climate neutrality, all results confirm that wind power will be the main protagonist of the energy transition and the decarbonisation processes.

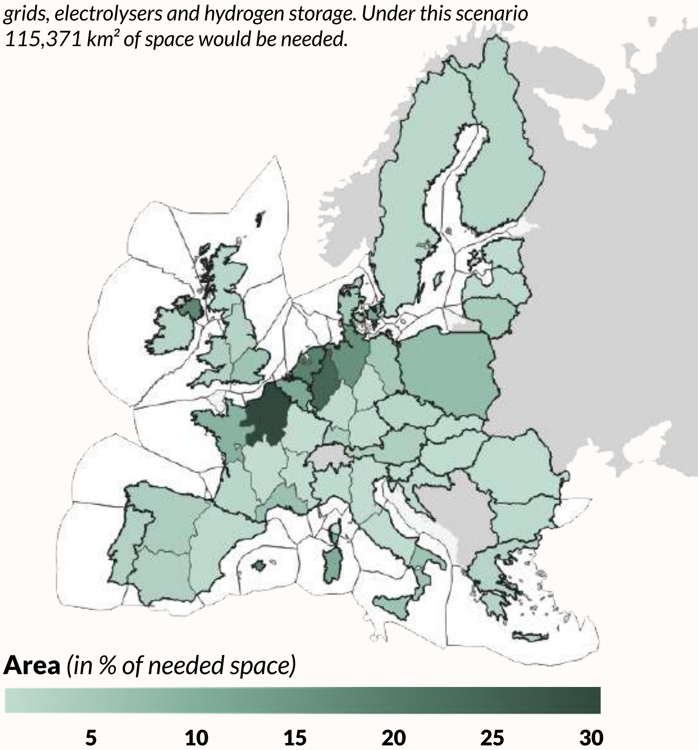
In the analysed Nordic countries (Denmark, Sweden, and Finland), wind energy dominates, comprising 89% (on average) of the space that the energy transition infrastructure should occupy. In particular, the GA scenario pushes this further to 95%. On average, solar energy makes up a modest 2% of space allocation. Grid expansion occupies 8% of total space, reflecting a commitment to balanced infrastructure deployment.

In 2050, Italy's energy landscape stands out, with wind technologies occupying on average 61% of the space to be dedicated to energy transition infrastructure deployment. Solar energy takes up a significant 18%, diverging from the European trend. Italy invests heavily in grid expansion, using about 20% of overall space used to strategically enhance the electricity transmission grid.

Global Ambition Scenario

spatial requirements on land and at sea until 2050

including Wind (onshore and offshore), PV (excluding rooftop), grids, electrolysers and hydrogen storage. Under this scenario 115,371 km² of space would be needed.



Germany aligns closely with the Nordic countries in its reliance on wind energy, standing at 88% of space use in all scenarios by the middle of the current century. Solar energy infrastructure in Germany occupies 9% of space needed, similar to the European average. Germany's relatively small grid expansion (less than 2% of available space dedicated to the energy system), highlights a strategic focus on optimising existing electricity grid infrastructure.

Spain and France exhibit some energy landscape parallels. Both countries dedicate on average 12% of space use to solar PV and 82% to wind energy, whereas France has a much larger share of offshore wind than Spain.

Additionally, in the case of wind energy, there are some differences between scenarios' estimations, with CLEVER emphasising wind at 90% in Spain and 79% in France, while the DE scenario highlights 87% wind in France and 83% in Spain.

Under the three scenarios (CLEVER, DE and GA), grid expansion in both countries is similar, at 5% of total space, reflecting a shared approach to infrastructure and renewables integration. A larger difference between the land required for grid expansion comes with the results of the PAC scenario modelling, which show that Spain needs amount to 5.2% of the required space, whereas in France this value amounts 1.2%.

Overview by regions / continued

In case of the Balkan countries included in this analysis (Romania, Croatia, Greece, and Slovenia), also wind energy is prioritised, which results in approximately 92% of space dedicated to the energy transition infrastructure. A notable example among these countries is Slovenia, which has a larger share of solar energy than other countries, reaching the highest value of 50% under the DE scenario. Electricity grid expansion in the Balkan countries is relatively modest, with Croatia and Slovenia representing relatively larger spatial needs for this infrastructure.

Similar to the Balkan countries, the Central-Eastern European countries analysed (Poland, Czech Republic, Slovakia and Hungary) will need to dedicate less space for solar energy infrastructure (on average 3%, except for the pathway outlined by the PAC scenario that forecasts 6% of space).

These countries will rely heavily on wind energy – on average 86% of the overall space needed for the energy transition infrastructure, whereas in case of Poland around 40% of space will be covered by the offshore wind (with a notable exception of the DE scenario's predictions of 18% of the overall space needed). Grid expansion is substantial in these countries, requiring around 10% of dedicated space, particularly in scenarios other than PAC, which estimates these needs at around 14%. These results underscore the need for robust electricity transmission infrastructure to facilitate the energy transition in the Central and Eastern European countries.

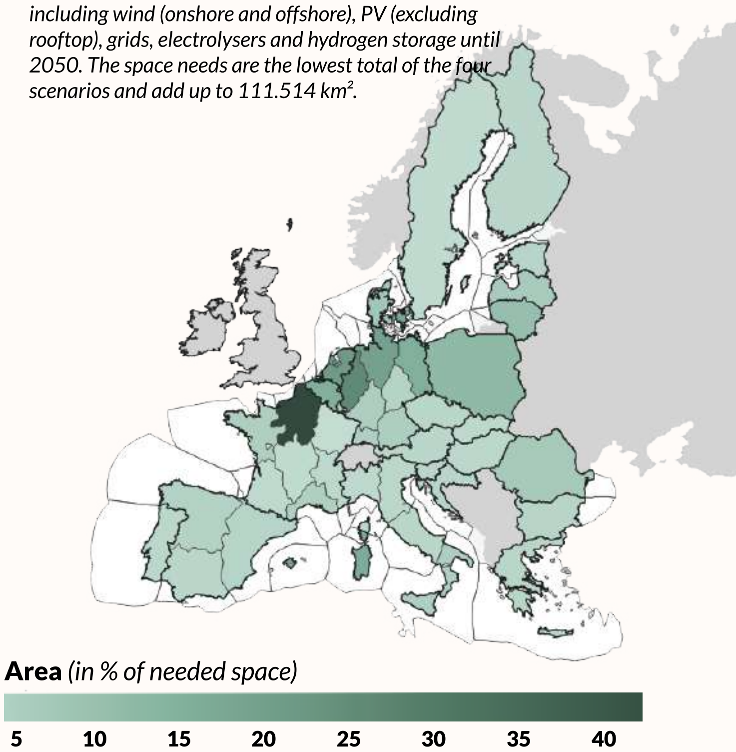
Baltic countries (Estonia, Lithuania, and Latvia), differently from Central-Eastern European countries, rely less on solar (1% of the total space occupied by the energy system by 2050 according to each scenario), focussing more on wind energy (91-94%, with a highest value for CLEVER with 97%).

Offshore and onshore wind will need a similar amount of space, according to each scenario, apart from PAC, which forecasts a higher reliance on offshore wind. On average, grid expansion in all Baltic countries occupies around 5-7% of total space dedicated to deployment of the energy transition infrastructure.

PAC Scenario (2.0)

spatial requirements on land and at sea until 2050

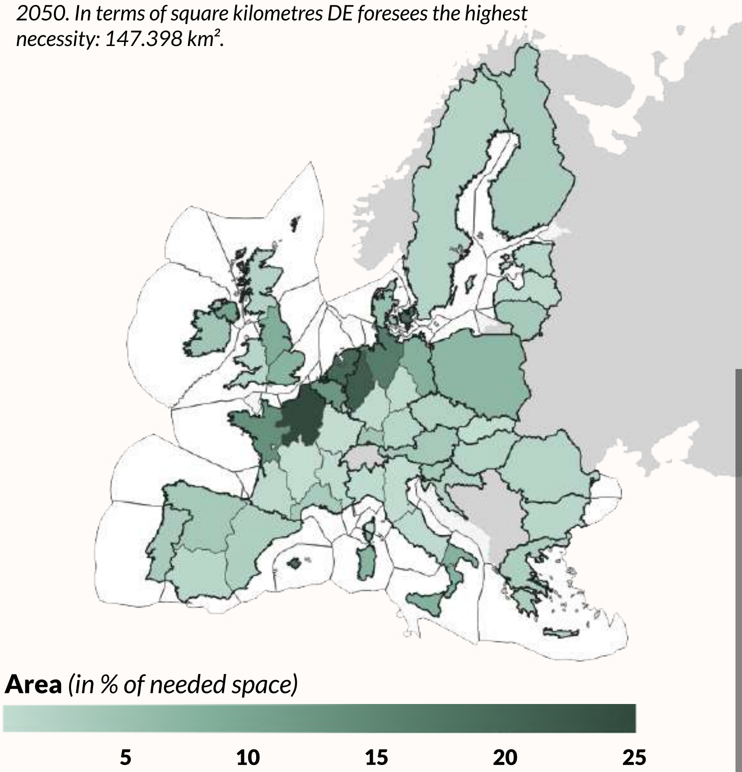
including wind (onshore and offshore), PV (excluding rooftop), grids, electrolysers and hydrogen storage until 2050. The space needs are the lowest total of the four scenarios and add up to 111.514 km².



Distributed Energy Scenario

spatial requirements on land and at sea until 2050

including wind (onshore and offshore), PV (excluding rooftop), grids, electrolysers and hydrogen storage until 2050. In terms of square kilometres DE foresees the highest necessity: 147.398 km².



WATER REQUIREMENTS

Regarding the comparison of water requirements, the analysis primarily focuses on the amount of water needed for energy purposes by various energy technologies, including nuclear, hydrogen electrolysis, steam methane reforming (SMRs), coal, lignite, oil, gas, biomass, and hydro, for the years 2030, 2040, and 2050. The results are reported in millions of cubic meters (miom^3) of water.

Across the three timeframes (2030, 2040, and 2050), the CLEVER scenario forecasts substantial shifts in water requirements in Europe. Nuclear energy experiences a remarkable reduction in water demand due to reactor shutdowns, plummeting from 840 miom^3 in 2030 to nearly zero by 2050. In parallel, all fossil fuels except gas relinquish their dependence on water by 2050. Meanwhile, hydrogen electrolysis registers an upward trajectory in water needs, rising from less than 2 miom^3 in 2030 to 14 miom^3 by 2050.

Water requirements associated with gas diminish from 262 miom^3 to 40 miom^3. Remarkably, the water requirement for hydro energy stays consistent, averaging around 6300 miom^3, making it the most water-intensive component.

In the PAC scenario, nuclear energy also reaches a complete shutdown by 2050, thus necessitating minimal water resources. Unlike the CLEVER scenario, green hydrogen production through electrolysis, while experiencing an increase in water demands over the analysed decades, remains below 10 miom^3 by 2050, starting from the level of less than 4 miom^3 in 2030. Fossil fuels, in alignment with all analysed scenarios, are progressively phased out, requiring nearly zero miom^3 by 2050. In contrast to the CLEVER scenario, gas is also phased out. Notably, the results of the PAC scenario modelling indicate an increased water requirements related to hydropower, rising from 6111 miom^3 in 2030 to 6893 miom^3 in 2050.

In both the DE and GA scenarios, nuclear energy remains operational, with nuanced variations. In DE, its water requirement gradually decreases from 1016 miom^3 in 2030 to 236 miom^3 by 2050, while in GA, it maintains a consistent water demand of approximately 1070 miom^3.

Notably, hydrogen production experiences slightly faster growth in water requirements, reaching 25 miom^3 by 2050 for DE and 39 miom^3 for GA, surpassing the modelling results based on the CLEVER scenario. In the DE and GA scenarios, most of fossil fuels are phased out by 2050, except for gas, which, according to the modelling results based on the DE scenario, retains a role in the 2050 energy landscape and requires 220 miom^3 of water. Under both TYNDP scenarios, the water requirements for hydropower initially rise from 2030, reaching 7804 miom^3 in 2040 for DE and 7660 miom^3 for GA, to subsequently decrease by 2050, accounting for 7424 miom^3 and 7273 miom^3, respectively.

TABLE | *Spatial requirements - EU level*

		CLEVER	PAC	DE	GA
GRID	2030	2.93%	10.66%	0.80%	1.10%
		1,781 km^2	6,302 km^2	466 km^2	604 km^2
	2040	4.19%	8.34%	2.19%	1.76%
		4,140 km^2	8,178 km^2	2,313 km^2	1,496 km^2
	2050	5.57%	6.2%	4.91%	5.78%
		6,312 km^2	8,178 km^2	7,244 km^2	6,670 km^2
HYDROGEN	2030	0.007%	0.002%	0.020%	0.021%
		4.5 km^2	1.17 km^2	11.84 km^2	11.49 km^2
	2040	0.037%	0.013%	0.056%	0.035%
		36.4 km^2	13.03 km^2	58.74 km^2	29.61 km^2
	2050	0.041%	0.026%	0.083%	0.088%
		46.1 km^2	34.7 km^2	122 km^2	101 km^2
SOLAR	2030	9.11%	16.27%	9.61%	7.79%
		5,543 km^2	9,616 km^2	5,629 km^2	4,261 km^2
	2040	9.26%	16.98%	9.50%	7.11%
		9,142 km^2	16,643 km^2	10,041 km^2	6,060 km^2
	2050	8.03%	15.59%	8.52%	7.10%
		9,099 km^2	20,565 km^2	12,569 km^2	8,200 km^2
ONSHORE WIND	2030	61.50%	48.92%	68.76%	61.55%
		37,428 km^2	28,911 km^2	40,293 km^2	33,664 km^2
	2040	54.25%	46.54%	64.48%	54.45%
		53,570 km^2	45,614 km^2	68,122 km^2	46,400 km^2
	2050	51.68%	47.247%	59.78%	50.95%
		58,545 km^2	62,324 km^2	88,235 km^2	58,800 km^2
OFFSHORE WIND	2030	26.45%	24.14%	20.79%	29.52%
		16,094 km^2	14,264 km^2	12,184.5 km^2	16,147 km^2
	2040	32.14%	28.10%	23.72%	36.61%
		31,737 km^2	27,544 km^2	25,057 km^2	31,200 km^2
	2050	34.56%	30.95%	26.58%	36.04%
		39,145.5 km^2	40,825 km^2	39,227.5 km^2	41,600 km^2

05 CONCLUSIONS

Following any of the decarbonisation pathways towards a climate neutral Europe will require a considerable amount of resources for the deployment and operation of the energy transition's infrastructure. The comparative analysis of spatial requirements of different decarbonisation scenarios has illuminated the intricate interplay between the European energy transition and utilisation of available space and water. Our exploration on the needs of these resources based on modelling of four distinct decarbonisation scenarios – CLEVER, PAC, Distributed Energy (DE), and Global Ambition (GA) – has revealed relevant insights that demand attention when it comes to implementing these pathways.

Europe's journey towards carbon neutrality by 2050 relies heavily on renewable energy technologies, particularly wind (onshore & offshore) and solar, with an enabling role of the electricity grids. These technologies will inevitably require space and water. However, the quantities needed differs when looking more closely at different countries and regions, which exhibit varying preferences for renewable energy sources, reflecting their unique geographical and socio-economic conditions:

NORDIC COUNTRIES

The majority of the required space in Denmark, Sweden, and Finland will be dedicated to wind energy, with remarkable unity across scenarios. Space needed for solar energy infrastructure remains relatively modest in these countries. Electricity grid expansion reflects a commitment to balanced infrastructure development.

ITALY

Stands out with a significant space requirement for both wind and solar energy, coupled with substantial grid expansion to strategically optimise the electricity transmission infrastructure.

GERMANY

Aligns closely with the Nordic countries in wind energy reliance and the corresponding spatial needs, while at the same time developing solar energy to reach a European average. Minimal grid expansion highlights a focus on existing infrastructure optimisation.

CENTRAL AND EASTERN EUROPEAN COUNTRIES

Poland, Czech Republic, Slovakia, and Hungary follow a similar pattern of wind dominance and modest solar energy, but with a substantial electricity grid expansion.

SPAIN AND FRANCE

These countries share a balanced mix of wind and solar energy, which results in a similar need for space for both technologies, with more sea space dedicated to offshore wind in France.

BALKAN COUNTRIES

Romania, Croatia, Greece, and Slovenia prioritize wind energy and moderate solar energy, with a strategic focus on efficient land use.

BALTIC COUNTRIES

Latvia, Lithuania, and Estonia's reliance on solar is low, while they rely heavily on wind, which will require substantial amount of space. A modest grid expansion reflects a focus on decentralisation.

Water is further a precious resource that plays a pivotal role in energy generation, especially in cooling processes for the conventional power plants, but also in case of hydropower and hydrogen production. At the same time, water becomes an increasingly scarce resource, because of advancing climate change and an increasing need for different uses, such as agriculture. Thus, as the modelling results of different decarbonisation scenarios lead to diverse water consumption patterns, the relevance of these findings lies in the need of careful consideration of sustainable use of water alongside energy transition goals, targets, and related interdependencies.

The ongoing decarbonisation and decentralisation of the European energy system, as outlined by the analysed scenarios, can lead to increasing competition over scarce space and water. Thus, the pathway to carbon neutrality necessitates a cautious balancing act between sustainable energy generation, transmission and consumption and an optimised use of available resources. For that reason, energy modelling and energy system planning efforts must consider the scarcity of resources and take steps to maximise system optimisation. This will enable a more efficient and effective usage of available space, water, and other resources, which, in turn, will be essential for enhanced collaboration between European countries, while minimising impacts of the needed infrastructure on nature and society.

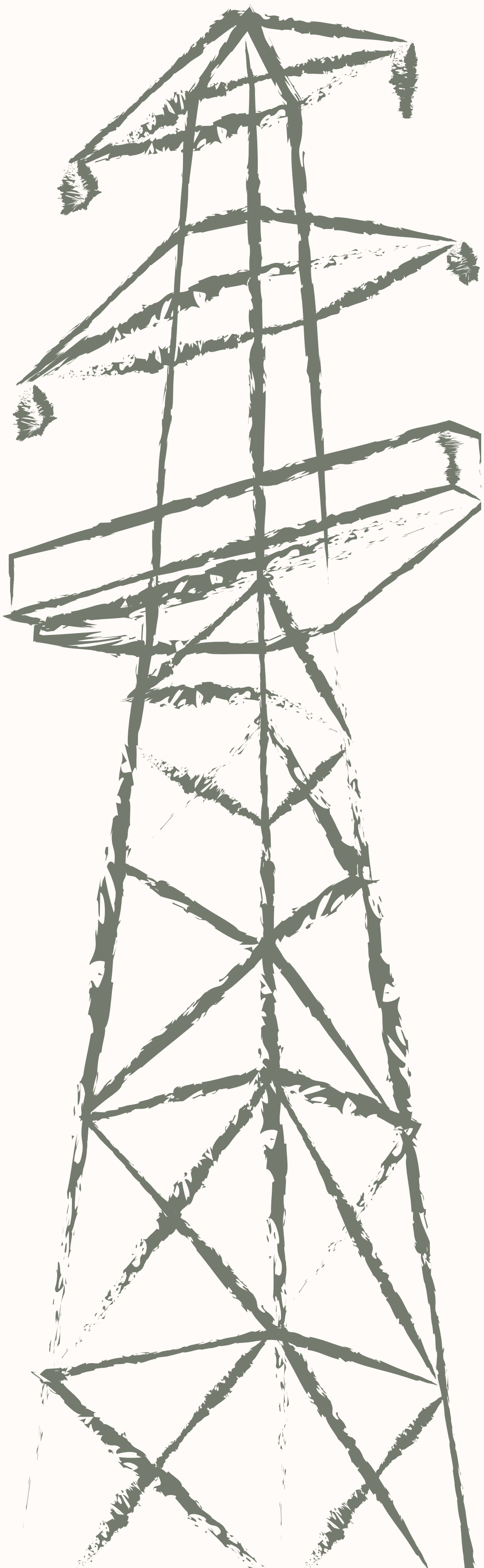
As the EU navigates the complex terrain of decarbonisation, informed decision-making becomes paramount. This analysis and the corresponding online visualisation tool provide insights for policymakers, energy system planners, and other stakeholders, helping to understand the trade-offs and opportunities associated with the implementation of each of the analysed decarbonisation scenarios. This analysis was driven by trust that its findings and outputs will facilitate collaborative dialogues among different actors, leading to the development of ideas and solutions, which would address challenges stemming from the implications of energy transition infrastructure on space use, water resources, and sustainability at large.

In recent years, a wealth of good practices has emerged, offering valuable insights into the efficient deployment of the energy transition infrastructure from a spatial perspective, including the planning, siting, and implementation stages. These approaches encompass a wide spectrum of strategies and tools, such as geographic information systems, space-optimised pylons, or the ingenious use of smart energy islands for concentrating renewable energy generation. Some of the practices extend beyond the technical field. They delve into the field of stakeholder engagement and community involvement and rightly recognise the pivotal role of citizens and society in shaping the spatial dimension of the future energy systems. A better understanding of spatial and water requirements related to the implementation of different decarbonisation pathways can contribute to improvement of the current, or development of new practices, offering guidance on how to navigate the complex landscape of infrastructure enlargement while fostering cooperation and minimising tensions within nature, communities, and regions.

By acknowledging the complexities of spatial and water requirements and their dynamic nature, Europe can chart a sustainable path toward carbon neutrality while preserving the integrity of its land, water resources, and the environment. The results of this analysis serve as a foundation for informed decision-making as Europe should progress toward a decarbonised and optimised energy future.

Read more about RGI's Workstream

ENERGY &SPACE



IMPRINT

Energy&Space: A Comparative Analysis of Spatial Requirements of Different Decarbonisation Scenarios

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ABOUT RGI

The Renewables Grid Initiative is a unique group of transmission system operators (TSOs) and environmental and climate NGOs collaborating on a nature-friendly renewables grid for the energy transition. Our aim is to speed up the transition towards a renewables-based energy system.

We promote grid development in harmony with people and nature. To do this, we share and develop best practices for: energy scenario building; nature protection and restoration; and a fair and inclusive public engagement.

RGI gratefully acknowledges the EU LIFE funding support:

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