Nature-Positive Renewables

EEB European Environmental Bureau

EEB Policy Brief: Measures towards nature-friendly renewables building on the Paris Agreement Compatible (PAC) energy scenario

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Paris Agreement Compatible Scenarios for Energy Infrastructure

EEB Policy Brief: Policy measures towards Nature-Positive Renewable Energy in the EU using PAC scenario results

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About this report

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Disclaimer

The opinions expressed within this Policy Brief are solely the EEB's and should not be taken to reflect the views of the funder or partners.

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EEB Policy Brief: Policy measures towards Nature-Positive Renewable Energy in the EU using PAC scenario results[1]

1. Introduction

Addressing the climate and biodiversity crisis has never been more urgent. The latest IPCC climate change report on climate impacts and adaptation adds yet another alarm to the ones already raised: half of the population lives in especially vulnerable areas to climate change. The impacts of an increased global warming caused by global Greenhouse Gas (GHG) emissions will go beyond economic damage on key infrastructures – they will severely disrupt ecosystems, biodiversity, food systems and will entail significant risks for mental health and malnutrition all around the globe[2].

According to a joint IPCC and IPBES report, the mutual reinforcing of climate change and biodiversity loss requires tackling both in a joint, synergic manner to effectively resolve either issue. Climate change and biodiversity loss are closely interconnected and share common drivers through human activities. In turn, both have major negative impacts on human well-being and quality of life.

The energy sector is key to address climate change and Europe is not doing enough. Tackling GHG and pollution emissions from the energy sector, which account for approximately three quarters of global emissions according to the International Energy Agency (IEA) data, is fundamental to overcome the climate and environmental emergency. In Europe, the scale of the problem is very similar: in the European Union (EU), as outlined by the European Environmental Agency, energy accounts for 71% of total GHG emissions.[3]

In the EU, the revision proposal for the Renewable Energy Directive, as outlined in the EEB's PAC 2.0 Policy Brief on RED III published in February 2022, falls short on what is needed to achieve a complete and successful transition to a climate-neutral energy system. According to PAC scenario results[4], Europe can stop relying on fossil fuels as an energy source for the green transition, and if we significantly decrease our final demand of energy through sufficiency and efficiency measures, a direct switch towards an energy system fully based on renewable energy sources (RES) would already be technically possible by 2040.

Europe is at a crucial point in time to define the future of its energy supply. The war in Ukraine has brought to the front Europe's massive energy dependence on Russian fossil fuels imports. According to the latest figures provided by the European Commission in the REPowerEU Communication of 8 March 2022, imports from Russia account for 40% of gas, 46% of coal and 27% of oil used in the EU. While many countries are focusing on diversifying their gas supply, the answer lies in a massive investment in renewables such as wind and solar that are now the cheapest sources[5] and constitute Europe's no regret

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[2] We refer to Figure SPM.2 in the IPCC report, summary for policymakers, available here.

[3] The figure is taken from EEA Sectoral shares in EU-27 in 2019 when combining the figures for energy supply, domestic transport and industry.

[4] We refer to the Paris Agreement Compatible (PAC) scenario – a modelling exercise done in a consortium with environmental NGOs including EEB and CAN Europe, as well as renewable energy industry, published in 2021. The summary of the results is available here.

[5] In a complementary report on renewable energy costs, the International Renewable Energy Agency (IRENA) already identifies renewables as the lowest cost technology in most locations globally, as their costs have fallen sharply (i.e. a cost reduction of 85% for utility-scale solar photovoltaics between 2010 and 2020).

investment towards energy independence. The new IPCC report confirms wind and solar are the cheapest sources of energy and require less time for project development. Downstream industrial manufacturing also needs to divert away from fossil-based feedstocks, requiring increased demand for electricity from non-combustion-based renewables. Similarly, the EEB's Reference Environmental Standards for Energy Techniques (RESET) guidance [6], published in 2021, compares renewable energy sources and fossil fuels over their entire lifetime on a series of Key Environmental Indicators. The main findings of that report show that the **environmental benefits of renewables outweigh their environmental costs, with the latter being remarkably lower than fossil fuels'.**

Scaling-up renewable energy capacity comes with broad, cross-cutting benefits:

- **Renewable energy emits no or low greenhouse gases**, even when considering the full life cycle of RES technologies. In turn, the combustion of fossil fuels for energy purposes results in significant greenhouse gas emissions that contribute to global warming and reinforce both the climate and the biodiversity crises.
- **Renewable energy emits no or low air pollutants**, while fossil fuel-based road transport, industrial activity, and power generation contribute to high levels of air pollution. According to the World Health Organisation, the concentration of particles and other pollutants from fossil fuels are responsible for millions of premature deaths worldwide.
- **Renewable energy is less affected than fossil fuels by geopolitical crises**, armed conflicts, sudden disruptions to the supply chain and consequent spikes in energy prices. As renewable energy is produced locally, it offers a unique opportunity for the EU to reduce energy dependence and reliance on fossil fuels, as also enshrined in the European Commission's REPowerEU Communication of 8 March 2022.
- **Renewable energy can significantly benefit local communities**. As renewable energy largely relies on decentralised infrastructure, it paves the way for community-led approaches to energy projects that can improve socio-economic benefits for local communities by creating local job opportunities, reducing energy bills, and helping money being re-invested in local services.

The energy transition must be carried out at the least environmental cost. The massive and quick deployment of renewables must take place at a minimum environmental cost. Non-combustion-based renewables are the most cost-effective solution to get to a net-zero energy system, but they entail environmental impacts that need to be prevented and mitigated. The biodiversity crisis is a twin and equal crisis to climate change and must be tackled in parallel if we are to avoid catastrophic mass extinction events. With rapidly dwindling biodiversity, we cannot afford to pitch climate and nature protection against each other. Healthy and resilient ecosystems are crucial to tackle the climate crisis, as they can be a major factor for climate mitigation and adaptation. This is also recognised in the EU's Biodiversity Strategy for 2030, and the Nature Restoration Law proposal provides a major opportunity to bring back and improve ecosystems to help us tackle the twin-crises. Similarly, we cannot afford to undermine the existing well-established nature protection obligations that also very recently were found to be fit for purpose. The upscale of renewables must go hand-in-hand with the implementation of the existing legislation and the

[6] The full report is available here. The messages on air pollution and water use have been taken from page 24 onwards of the RESET Guidance report.

Biodiversity Strategy. Existing and new obligations and targets for nature protection and restoration must thus form the basis of spatial planning for renewables, instead of merely being an afterthought. Therefore, to maximise climate and nature benefits, renewables should be prioritised in already developed areas where these projects will have the least impacts, rather than turning to the few areas where nature is not completely degraded yet. Roofs, motorways, and parking lots, for instance, are priority, easy wins for renewables upscale.

Energy sufficiency and energy efficiency remain priority policies to implement: according to the figures of the PAC scenario, the precondition to achieve climate neutrality by 2040 is to **reduce the EU's gross final demand of energy by around 40% between 2020 and 2040**[7]. Significant energy savings can be achieved primarily by reducing energy consumption through sufficiency policies. For instance, transport-related energy needs can be reduced via measures such as car-free Sundays, promoting teleworking, and broader urban planning to curb commuting. Applying the energy efficiency first principle is also of utmost importance, whereby measures such as promoting insulation and refurbishment of inefficient buildings and banning the sale of inefficient heating and fossil fuel-based technologies and combustion cars are key to reduce the EU's energy needs, as well as strongly increasing the EU's aim for energy savings beyond the target proposed in the REPowerEU plan.

A Circular Economy approach must guide the expansion of the renewable energy sector. As the current linear economic paradigm of 'produce-consume-dispose' depletes resources and increases waste and greenhouse gas emissions, Circular Economy (CE) measures can help reducing the amount of energy and materials needed, especially with respect to mining green tech metals as this too can pose a threat to ecosystems. Hence, reducing resource inputs, waste, and emissions along the supply chain through enhanced reuse, repurposing and recycling would deliver not only on decarbonisation targets, but also on other objectives of the European Green Deal such as the biodiversity strategy and zero-pollution goal.

Nature-Positive Renewable Energy is the way to go. This Policy Brief outlines recommendations on how to achieve a nature-positive energy transition in the EU by shaping the concept of Nature-Positive Renewable Energy and suggesting corresponding policy inputs. For the energy transition to be successful, energy supply in the EU should not only be renewable, but it should also have an overall positive impact on nature and communities. In fact, renewables roll-out should seek not only to mitigate climate change, but also to produce regenerative effects, encouraging greater resilience and continued protection. This could be achieved by preventing, mitigating, and rectifying potential environmental and social effects. On top of promoting circularity, energy sufficiency, and energy efficiency first, this can be achieved by drawing clear environmental boundaries to be used *ex-ante* in renewable energy spatial planning and permitting processes. Section 2 constitutes the main body of this brief and outlines the challenges and solutions for different potential impacts of renewables. It is followed by a set of policy recommendations, provided in section 3, that focus on current and upcoming EU policy files and initiatives. A schematic representation for strategic spatial planning of renewable energy deployment is provided in section 4, while conclusions are included in section 5 of this paper.

[7] This estimate is based on real-world data for 2020 in the EU-27 (10884 TWh) and UK (1483 TWh) for gross final energy consumption, plus the modelled figure for 2040 from the PAC scenario at EU-28 level. Sources: Eurostat for EU-27; UK National Statistics for UK. Original figures expressed in Ktoe.

2. The challenge – Wide-scale deployment of renewable energy is the key to a zero-pollution energy sector, but needs to be carried out in a nature-positive way

According to the PAC scenario results produced by EEB and CAN Europe, **for the EU to reach climate neutrality, renewable energy supply needs to be scaled up by a factor of 2.5 from the current level to 2050[8]**. It is worth noting that, without due investment in energy efficiency and sufficiency in the coming decades that 2.5 factor would be considerably higher[9], thereby highlighting the importance of matching energy supply and demand through a mix of both supply and demand-side measures. In other words, the success of the energy transition will ultimately rely on scaling up renewable energy capacity while at the same time reducing energy and material consumption through increased energy efficiency and sufficiency, and also by means of enhanced circularity in the use of resources and products.

In the PAC scenario, a **minimum share of 50% of total primary energy should be coming from renewables in the EU by 2030**, with wind and solar as the two leading technologies. Other modelling results such as those used in the EU Reference Scenario 2020 fall short of such figures, but still project large increases in renewable energy installed capacity[10], especially with respect to wind and solar energy. Scaling the installed capacity of renewables (mainly wind and solar) to the levels projected in the PAC scenario results will require **large deployment efforts in all EU Member States**. Among other measures, as detailed in the EEB's PAC 2.0 Policy Brief on RED III published in February 2022, increasing the **EU renewable energy target up to 50% of gross final energy consumption by 2030** is of utmost importance. Achieving this will entail **changes in land use** as well as an **increased need of materials** to manufacture the turbines, solar panels and all other assets needed for the transition. Moreover, the deployment of renewable energy generation must go hand in hand with **grid development**. As the realisation of new grid infrastructure will take up space and could have an impact on both nature and people, it is crucial to adopt a comprehensive approach when planning renewable energy generation, transmission, and distribution infrastructure.

This section outlines potential environmental impacts of the large-scale deployment of renewables, together with possible solutions, while the following section includes a proposed schematic zoning map to ease planning and a series of policy suggestions to mitigate impact and speed up permitting. In any case, detailing the potentially adverse impacts of renewable energy does not put into question the fact that **renewable energy technologies show the largest potential for decarbonising the energy sector and that the benefits of deploying them far outweigh their environmental costs** (as pointed out in EEB's RESET guidance and in academic literature)[11] and, under certain circumstances, can have positive effects on biodiversity.[12] In this context, it is also important to stress that the question of how to distribute land for renewable energy is also linked to broader questions of land use, global equity considerations

[8] This estimate is based on real-world data for 2020 in the EU-27 (2437 TWh) and UK (283 TWh) for RES contribution to gross final energy consumption, and on the modelled figure for 2050 from the PAC scenario for RES contribution to gross final energy consumption at EU-28 level (100% share). When considering transmission and distribution losses along the supply chain, the PAC scenario projects primary energy supply for renewables at 7840 TWh in 2050. Sources: Eurostat for EU-27; UK National Statistics for UK. Original figures expressed in Ktoe.

[9] i.e. most likely in the region of 4.5 when assuming no significant reduction in gross final energy consumption by 2050 compared to 2020 levels

[10] We refer in particular to Figures 44 and 45 of the full report, available here.

[11] We refer to the paper by Gasparatos et al. (2017), published in Renewable and Sustainable Energy Reviews and available here, that summarises the state of the art of academic literature on the interactions between renewable energy and biodiversity.

[12] See e.g. https://www.bne-online.de/fileadmin/bne/Dokumente/Englisch/Publications/201911_bne_study_biodiversity_profits_from_pv.pdf

and to reducing land use pressures through, *inter alia,* shifting to more sustainable diets and cutting food waste.[13]

2.1 Biodiversity & land use change impacts

According to a LOCOMOTION project study published in Nature,[14] **between 0.5% and 2.8% of the EU's total land area will be needed for solar energy by 2050 to achieve climate neutrality**, depending on the final rate of penetration of solar in the total energy mix. The middle range would relate to roughly 5% of anticipated crop area in 2050. In another study focusing on Germany and onshore wind energy, the Climate Neutrality Foundation estimated that an average of 2% of state and municipal land would be needed for onshore wind energy to reach climate neutrality.[15] Both figures indicate that, while agricultural production occupies a much higher share of land (nearly 50% of land in the EU), the needed deployment of renewables will nevertheless entail taking up a small but non-negligible share of land to achieve the EU Green Deal and geopolitical objectives.

Such deployment of renewable energy and occupation of land could result in adverse biodiversity impacts and could compete with food and feed production if proper safeguards are not in place. As portrayed in a landmark study by the International Union for Conservation of Nature (IUCN) in 2021[16] and in academic literature,[17] these impacts are mainly due to the interventions needed in the locations of the projects which often lead to the modification or removal of natural or agro-ecosystems, as well as the disruption of migratory patterns and habitats of vulnerable species by additional transmission lines or by the installation of different components of solar panels and wind turbines (e.g. noise levels when installing foundations of wind turbines, seabed damage and underwater noise through the installation and maintenance of offshore wind parks and cable trays). While efforts are already being put into place to mitigate these impacts, the latter can be significant and further effort is needed to make sure renewable energy developments are also sustainable from a wider environmental standpoint and fully compliant with existing nature protection legislation.

The use of biomass can result in negative effects on climate and biodiversity. As pointed out in the EEB's PAC 2.0 Policy Brief on the revision of the Renewable Energy Directive (RED III) [18] and PAC scenario results [19], bioenergy should play a rather marginal role in the future of the energy mix in the EU in a Paris Agreement-compatible scenario. According to PAC scenario results, the contribution of bioenergy is expected to represent no more than 230TWh by 2050[20], which amounts to a maximum 7% of the total projected EU primary energy supply by 2050. This is based on clear sustainability-related assumptions: even if bioenergy is derived from sustainable feedstock that complies with circular economy principles, burning biomass in power plants still entails the quick release of very high levels of CO_2. This rapidly released CO_2 is then reabsorbed in decades, thus contributing to exacerbating the climate crisis. Intensive

[13] See e.g. https://www.birdlife.org/wp-content/uploads/2021/12/birdlife-europe-report-burn-restore-forests-land-use-bioenergy-may2021.pdf

[14] The full paper is available here. For the total estimated land use for solar energy use the figures from Table 1 "Land occupation characteristics at different solar penetration levels by 2050"

[15] The full study is available here.

[16] The full study is available here.

[17] Gasparatos, A., Doll, C. N., Esteban, M., Ahmed, A., & Olang, T. A. (2017). Renewable energy and biodiversity: Implications for transitioning to a Green Economy. Renewable and Sustainable Energy Reviews, 70, 161-184.

[18] The full report is available here.

[19] The summary of the results is available here.

[20] This is a modelled figure for bioenergy use in gross final energy consumption in 2050 at EU-28 level.

monoculture plantations for biomass, as well as clear-cut logging, are also harmful for biodiversity, soil health and ecosystem dynamics. Additionally, if the cascading principle of biomass is not properly enforced, Member States might rely excessively on bioenergy to fulfil their targets under the Renewable Energy Directive, thereby negatively affecting forests and biodiversity. It is also worth stressing that the solar energy produced in a given territory is always much higher than the one yielded through biomass plantations considering the comparatively higher energy density of PV panels. Similarly, BirdLife calculated that for the same production capacity, bioenergy would take up 1300 times more land than wind energy.

The use of **biogas**, on the other hand, is contemplated in district heating and direct heating, to a small extent. Only the production of biogas from waste streams such as sewage, manure or food residues is taken into consideration, to prevent the competition between energy crops and food/feed. However, the use of biogas from manure must not create lock-ins, for example by disincentivising action to prevent food waste or by hindering the necessary transition of the EU's livestock sector away from industrial farming, which is a major contributor to biodiversity loss, climate change, and air and water pollution[21]. Additionally, small- to medium-scale and decentralised biogas production is preferable in order to facilitate the disposal of digestate, which should be returned to the soil (on the condition that it is not contaminated with pollutants) to close the nutrient cycle[22].

In the PAC scenario, primary energy supply of **geothermal** energy increases more than ten-fold from 21 TWh in 2015 to 247 TWh in 2050. However, it will be key to identify the correct areas and operational characteristics of geothermal energy facilities so to address any risk of environmental impact, as geothermal resources are often located in pristine areas of high endemic biodiversity, and often intersect with protected areas[23]. Typical geothermal power plants that use hot water and steam to generate electricity emit CO2, air pollutants (NH3, H2S) and other gases (H2, O2, N2) and elements (Rn, He, As, Hg, B) whose levels vary between geothermal areas[24]. While CO2 emissions from geothermal are negligible if compared to conventional electricity generation, the emission of toxic pollutants such as hydrogen sulfide (H2S) and boric acid can have a more substantial effect on surrounding ecosystems. For example, small to moderate biodiversity impacts caused by H2S releases have been reported in two different geothermal locations in Italy[25].

The PAC scenario assigns a very limited role to **hydropower** in the mid-term and foresees no new hydropower in and beyond the EU. The largest share of the hydropower capacity in the EU has already been harnessed and the remaining capacity is located mostly in pristine areas where the impact on biodiversity and landscape would largely outweigh the climate benefits derived from the hydropower.

Hydropower plants in all their forms disrupt the flow of water and sediment downstream by creating segregated river fragments. Just like all other in-stream structures, they alter or impede the natural seasonal flow of a river and change its hydrological characteristics. The blockage that they create also keeps biota, most commonly migratory fish, from moving freely along the river. The uneven and sudden release from the dams – which is becoming more and more intermittent since production is now linked to

[21] Styles, D., Yesufu, J., Bowman, M., Williams, A. P., Duffy, C., & Luyckx, K. (2022). Climate mitigation efficacy of anaerobic digestion in a decarbonising economy. Journal of Cleaner Production, 130441.

[22] Risberg, K., Cederlund, H., Pell, M., Arthurson, V., & Schnürer, A. (2017). Comparative characterization of digestate versus pig slurry and cow manure–Chemical composition and effects on soil microbial activity. Waste management, 61, 529-538

[23] Gasparatos, A., Doll, C. N., Esteban, M., Ahmed, A., & Olang, T. A. (2017). Renewable energy and biodiversity: Implications for transitioning to a Green Economy. Renewable and Sustainable Energy Reviews, 70, 161-184.

[24] Bravi, M., & Basosi, R. (2014). Environmental impact of electricity from selected geothermal power plants in Italy. Journal of cleaner production, 66, 301-308.

[25] Manzo, C., Salvini, R., Guastaldi, E., Nicolardi, V., & Protano, G. (2013). Reflectance spectral analyses for the assessment of environmental pollution in the geothermal site of Mt. Amiata (Italy). Atmospheric environment, 79, 650-665.

the spot market price – creates confusion for the aquatic wildlife whose vital cycle is extremely sensitive to water temperature changes[26]. The frequent changes in depths and width of the rivers also strongly affect both the flora and fauna of the biome of river shores. Lastly, the release of pure water captured in high mountain environment in the flow downstream creates a chemical shock in terms of PH that can strongly affect aquatic life.

Hydropower causes more pressures on ecosystems compared to other renewable energy technologies such as solar or wind. According to the European Environment Agency's recent State of Nature in the EU report, hydropower is the largest energy-related pressure factor for habitats and species (excluding extractive energy sources)[27]. Additionally, more frequent drought risk to limit the hydropower capacity in coming years. According to the PAC scenario, the generation from hydropower is expected to remain largely linked to the power plants existing in 2020 and is expected to decrease by around 10% between 2020 and 2050 primarily due to climate change and minimum flow requirements.

2.1.1 Suggested solutions / Policy recommendations

For solar and wind parks

Put energy sufficiency & efficiency first. Before planning the total renewable energy deployment needed in a Member State, public authorities at all administrative levels should apply the Energy Efficiency First principle and promote energy sufficiency measures. This means considering all available measures to reduce energy demand and consumption in the EU Member States, and therefore reduce the needed renewable energy deployment to the minimum necessary to ensure security of supply. Furthermore, as the reduced energy demand is expected to make already installed renewable power plants (especially utility-scale solar and wind) able to satisfy a larger share of the reduced electricity requirements, this could also determine a wider role for utility-scale solar and wind power plants in controlling and stabilising energy prices[28].

Fully implement existing EU nature protection legislation. Ensuring the full compliance with existing obligations provides plannability, is in line with the Commission's own conclusions that the Nature Directives are fit for purpose but must be implemented better, and is the baseline for reaching the EU's biodiversity and climate commitments.

Establish clear "go-to" areas in strategic spatial planning. In order to speed up the deployment of renewable energies in the safest and most environmentally-sound way possible, areas with very limited environmental impact should be preferred and permitting should be facilitated in these areas. These areas could include, *inter alia*, industrial areas, commercial areas (roofs), motorways, parking lots and irrigation canals. According to the EEA, already in 1996, 1.2% of land was covered by transport infrastructure. This has likely significantly increased, providing ample opportunities for solar energy coverage. By designating these areas as go-to areas, the planning authorities would direct the development of these technologies in areas characterised by limited conflicts with biodiversity. The identification of 'go-to' areas should be done with proper public participation procedures, thereby ensuring that citizens and civil society are involved in the process of site designation and preparation and implementation of the necessary

[26] On this see for instance, inter alia, Bretschko G, Moog O, 1990. Downstream effects of intermittent power generation. Water Science and Technology, Vol 22, 5, 127-135

[27] European Environment Agency, State of Nature in the EU, (October 2020)

[28] Chiesa V. & Al, 2022. Renewable Energy report 2022. Politecnico di Milano – Energy & Strategy Group. Available at energystrategy.it (IT only)

conservation measures, including site management plans. Following this streamlined process, the subsequent need for further Environmental Impact Assessments (EIAs) will be reduced as an EIA will likely be deemed unnecessary in the screening process after a good Strategic Environmental Assessment.

Establish clear "no-go" areas in strategic spatial planning. In order to ensure swift permitting procedures for renewable energy projects without harming ecosystems and biodiversity, clear "no-go" areas should be established by permitting authorities. These should include all strictly protected areas[29] (10% of the EU's land and sea area by 2030) as well as areas subject to nature restoration measures and Natura 2000 sites. In total, protected areas will only be 30% of the EU's land and sea area by 2030, leaving 70% of land and sea unprotected and open for developments. While there is no blanket ban on renewables in Natura 2000 areas under the Birds and Habitats Directives, an appropriate assessment needs to be carried out to ensure that a planned project does not adversely affect the integrity of the site. As the result of the assessment will most likely be negative, to strengthen the efficiency, plannability and speed of the renewables upscale, these areas should be considered as no-go areas in spatial planning.

Streamline renewables permitting procedures by focusing on the actual bottlenecks. Aside from careful mapping and rigorous spatial planning, permitting procedures for new renewable energy installations must be streamlined not by weakening nature protection mechanisms, but rather by tackling the real obstacles that currently hinder the speedy development of renewable energy projects. The length of the administrative procedures and their non-uniform application among different Member States are creating important barriers and must be addressed by fostering digitalisation in permitting procedures, establishing one-stop-shop contact points for the entire permit-granting process, and improving staffing and administrative capacity in permitting authorities.

Reward low-disruption renewable energy projects and promote Best Available Techniques (BAT). Permitting processes should foresee measures to minimise disruption from solar (e.g. reducing soil compaction by minimising vehicle movements during construction[30]) and wind plants (e.g. noise reduction techniques when placing offshore wind turbines foundations[31]). Furthermore, permitting processes should seek synergies that can benefit biodiversity, such as on agricultural land (e.g. by using adjacent or intervening land between rows of photovoltaics to plant native vegetation and increase pollination services[32]). In fact, intensively farmed land could benefit from Agri-PV installations which could increase biodiversity when combined with other activities (such as organic agriculture or animal husbandry). For instance, some studies have recorded positive effects of solar PV parks on the populations of butterflies, grasshoppers, lizards and breeding birds.

Promote innovation in grid planning and development. Optimising and upgrading the existing grid, improving energy efficiency, reducing demand at busy periods and electricity storage can all help in reducing the need for new grids, but not eliminate it entirely. When planning and deploying additional grid infrastructure it is therefore key to minimise ecological risks (e.g. by making use of integrated mapping tools[33]) and seek synergies to make power lines support greater biodiversity and improve ecosystem

[29] In line with the European Commission's guidelines for protected areas designations, accessible here

[30] Biodiversity, B. R. E. (2014). Guidance for solar developments. St. Blazey: BRE National Solar Centre.

[31] Gasparatos, A., Doll, C. N., Esteban, M., Ahmed, A., & Olang, T. A. (2017). Renewable energy and biodiversity: Implications for transitioning to a Green Economy. Renewable and Sustainable Energy Reviews, 70, 161-184.

[32] Walston, L.J. et al., 2018. Examining the potential for agricultural benefits from pollinator habitat at solar facilities in the United States. Environ. Sci. Technol. 52, 7566–7576.

[33] As demonstrated by the LIFE ELIA project, integrated mapping tools can provide crucial information to correctly plan the upgrade or realization of electricity grid infrastructure. For instance, information on natural habitats and vegetation present beneath high voltage lines, identification of existing forest edges or those needing to be constructed, presence of invasive plant species, etc.

services. In that respect, the realization of green electricity corridors has the potential to enhance local biodiversity through site-specific Integrated Vegetation Management (IVM) techniques such as selective tree cutting to create forest edges, restoring natural grasslands, and eliminating invasive plants.

Ensure meaningful consultation and participation from local communities. Early-stage, transparent, and meaningful local consultation processes must be established for local communities affected by renewable energy projects with measures for local communities to withhold consent if costs are too high and benefits too little. Proper and transparent public participation helps speeding up the planning processes as it ensures that potential environmental concerns, including possible related legal issues, are addressed early on in the process. Furthermore, involving local communities can prove highly beneficial in raising awareness on the local benefits of renewable energy as well as identifying and mitigating potential risks and misperceptions. Finally, ensuring that local communities can benefit from earnings of renewable energy projects, for instance through reinvesting project earnings in energy efficiency and local social services can foster the buy-in from the population.

Ensure adequate monitoring and reporting, as already required under nature legislation, to ensure that adequate information about the environmental value of a site is in place from the start. This provides a baseline for a focus on cutting double checks and syncing the evaluation processes and providing one-stop-shop authorisation solutions and implementing institutional coordination, rather than aiming at watering down citizens' participation or skipping environmental and social checks.

For Biomass and Biogas

Ensure full compliance with the cascading principle of biomass. Only biomass sourced from post-consumption and post-production waste that has no alternative use or value should be considered as a sustainable source of renewable energy. In all other cases, extending the lifetime of biomass resources (i.e. by means of reusing and recycling) should be prioritised over burning them to generate energy.

Do not offer public support to bioenergy plants using primary forest biomass. The use of biomass directly sourced from forests should not be allowed as it violates the cascading principle of biomass, results in harmful effects to vulnerable ecosystems and biodiversity, and incentivises monoculture plantations that are harmful for biodiversity. Most importantly, biomass combustion plants should not be considered eligible for simplified or faster permitting processes and should always be subject to Environmental Impact Assessments (EIAs).

Ensure proper accounting of emissions associated to burning of biomass. As raised in a recent study, emissions associated with the use of bioenergy for power generation in bioenergy combustion plants are often underreported. This could be enshrined in the foreseen European Commission's Delegated Act on biomass following the revision of the Renewable Energy Directive, which shall include a mandate for biomass combustion plants to be included under the scope of the EU Emission Trading Scheme (EU ETS).

Move from the risk-based approach to the precautionary approach so that the risk assessment can focus on forest holdings instead of the much broader sourcing area such as at State level. Mitigation measures, such as voluntary and national certification schemes, should always be required.

Phase out solid biomass for residential and tertiary heating by 2045. As shown in the PAC scenario results[34], for the EU to be in line with the Paris Agreement solid biomass should no longer be used for heating in the residential and tertiary sectors by 2045, while the non-energy share of biomass should be

[34] The summary of the results is available here. We refer to the figure titled "Bioenergy: Primary energy supply and non-energy feedstock EU28 [TWh]".

expanded, most notably as raw material in the chemicals industry to allow for substitution of fossil oil products in a circular economy approach. With respect to solid biomass use for heating purposes in rural and mountainous areas, alternatives such as small-scale district heating systems running on secondary biomass (i.e. wood residues) should be explored, along with broader efficiency measures to reduce the energy needs of buildings.

Do not use negative emission technologies (Carbon Capture Storage and Use) which do not make bioenergy sustainable. Loopholes in EU and Member States legislations in the form of exemption through the use of CCS/CCU shall not be allowed. Negative emissions technologies do not contribute to the overall aim of increasing material efficiency and circularity of resources, as they allow to further rely on fossil fuels without actually making the necessary changes in energy supply. Such technologies might also lead to an excessive reliance of Member States on bioenergy to fulfil their targets under the Renewable Energy Directive, with potential negative effects on forestry and biodiversity. Should such technologies still be considered, they should be evaluated on the same basis as other carbon removal options such as nature-based solutions, and related investment and permitting should be subordinated to at least the same investment made towards reducing demand for energy first.

Limit the production of biogas to sustainable waste streams only such as sewage, waste from food industry, landfills, and manure, following the cascading principle. If biogas is derived from waste whose disposal constitutes an issue of economic, environmental or social nature, this can give way to win-win situations such as biogas production from the anaerobic digestion (AD) of urban residual waters, urban biowastes, and industrial biowastes. Small-scale biogas production from manure may also be beneficial in some cases. However, biogas production must not create further lock-ins for intensive livestock farming, as this would prevent the necessary transition away from industrial animal farming and towards extensive animal rearing in mixed farming systems, which will unavoidably require reducing overall farmed animal numbers in the EU. Biogas production via AD might have some role to play in a sustainable future, but it must be kept within a sustainable niche.

For Geothermal

Focus on technologies that prevent emissions of aquatic and ambient air pollutants. For instance, binary plants that are closed-loop systems do not emit gases, while dry steam and flashed steam plants emit water vapor that contains non-condensable gases, as geothermal fluids are re-injected into the geothermal reservoir[35]. Furthermore, minimising openings and directional drilling could help reducing the overall land requirement of geothermal facilities. Lastly, adopting BAT can play a role in preventing geothermal pits connecting different water beds: this would avoid the accidental leak of pollutants to deeper underground water layers.

For Hydropower

Do not grant support to new hydropower plants[36]. More than 150 NGOs have called on the EU to stop supporting the construction of new hydropower plants in a Manifesto[37] including stopping public finance for new hydropower facilities and redirecting it towards ecological refurbishments of the existing plants in and beyond the EU. Thus, the permitting should focus on improving ecological performance of existing

[35] Arnórsson, S. (2004). Environmental impact of geothermal energy utilization. Geological Society, London, Special Publications, 236(1), 297-336.
[36] With the only exception of small-scale hydropower facilities located on artificial waterways.
[37] No more new hydropower in Europe: a Manifesto (October 2020)

plants and removal of obsolete dams to make rivers free-flowing and bring the permits in line with the EU water and nature protection legislation.

Improve ecological performance of existing hydropower plants by means of on-site mitigation measures (e.g. up and downstream fishways such as fish ladders or fish-friendly turbines[38], introducing requirements for minimum ecological flows[39]). This can provide win-win solutions - an increased installed capacity, reduced environmental impacts and could also be the occasion to fit those installations with the latest BAT to abate the above-mentioned negative impacts[40]

Remove obsolete dams and restore the rivers' natural functions, in particular continuity and habitat. It can also be necessary to holistically address the impact of the plant at the catchment level, which means going beyond environmental refurbishment of the plant itself, and engaging in larger-scale river restoration measures, such as natural fishways, restoration of habitats to complement the mitigation measures on-site.

2.2 Material demand and extraction impacts

As reported in IRENA's 2021 "Critical Materials for The Energy Transition" report, **keeping the world in a 1.5°C pathway in compliance with the Paris Agreement will inevitably increase the need for critical materials** needed to build solar photovoltaic plants and wind farms. The complete list of these materials differs from source to source as there is no globally agreed definition of criticality, but some main points are clear. As outlined by the IEA's 2022 "The Role of Critical Minerals in Clean Energy Transitions" report [41], **renewable energy sources (especially wind and solar) are particularly dependent on critical materials, but demand is not static.** These materials include especially copper, zinc, silicon, lithium and neodymium but also lithium, nickel, and cobalt for battery storage. If no significant energy and critical material reduction and efficiency measures are put in place, any scenario relying on a large share of renewables for the decarbonisation of power generation in the EU will inevitably result in larger needs of critical materials that will come with social and environmental costs.

The size of the demand increase will differ across materials, but in some cases such as copper, nickel, lithium, cobalt and neodymium, the demand increase for all uses (not only the energy transition) will be on average more than two-fold by 2050, as estimated by IRENA[42]. Nevertheless, IRENA[43] also points out that increasing **recycling rates and innovation will partially offset such need for newly sourced critical materials** in the energy sector. High recycling rates (85%) require standardisation of secondary raw materials and the possibility to integrate them in the production, which underlines the need for more R&D, especially for lithium.

In the case of wind and solar technologies, **poor design measures could lead to high levels of waste** at their end of life. Today, a single 3.1 MW wind turbine creates 7.3 tons of e-waste per unit. A recent study

[38] Pander J, Mueller M, Geist J, 2011. Ecological functions of fish bypass channels in streams: migration corridor and habitat for rheophilic species. River Research and Applications

[39] EC: Guidance Document n 31 – Ecological flows in the implementation of the EU Water Framework Directive (2015)

[40] On this see, for instance, SHARE, Sustainable Hydropower in Alpine Rivers Ecosystems, 2012. Handbook: a problem solving approach for sustainable management of hydropower and river ecosystems in the Alps. Available here

[41] The full report is available here. For the comparison on mineral use we refer to the figure titled "Minerals used in clean energy technologies compared to other power generation sources".

[42] The figure is taken from Table 1 of IRENA's 2021 "Critical Materials for The Energy Transition" report, available here.

[43] The full report is available here.

suggests that for Europe to install 100,000 new wind turbines by 2050, would result in another 730,000 tons of e-waste[44] if no action is taken. Extended Producer Responsibility obligations exist for PVs at EU level, but this is not yet the case for wind turbines. Reinforcing the obligations with related binding waste prevention and reuse targets, recycled contents requirements on top of stringent collection and recycling performances could be an essential leverage to decrease waste generation and unleash urban mining potentials.

The increased demand for critical raw materials for the Renewable Energy transition can pose great challenges for environmental protection and local communities, particularly Indigenous peoples around the globe. **Metal extraction and processing is associated with serious and significant environmental impacts**. Mining produces an extraordinary amount of waste due to the mining of ever finer-grained low-grade orebodies. The world's 3,500 large-scale mining operations produce over 100 billion tonnes of solid waste per year, making mining waste the largest global waste stream[45].

Downstream heavy metals pollution caused by mining operations related to the above-mentioned materials needed for the realisation of RES technologies can cause long term effects such as poor waste rock disposal leading to acid mine drainage, contamination of groundwater, wetlands, coral reefs, and other aquatic systems. Deep seabed mining, currently under exploration with commercial licences potentially issued as early as 2023, can have massive, yet largely unknown effects on marine biodiversity, and an international moratorium must halt the deployment of this new industrial activity.

2.2.1 Suggested Solutions

Make rational use of resources. Sufficiency and efficiency policies for both energy and material use are of utmost importance to tackle the aforementioned risks and impacts and limit the demand for raw materials needed for RES expansion. For example, 60% of energy transition metals demand by 2050 is foreseen to be driven by the transportation sector, and at the same time, a substantial amount of low-carbon technologies requiring critical raw materials will be deployed to provide for this sector. Therefore, it is fundamental to tackle energy-intensive applications pertaining to the transport sector's value chain in order to reduce the latter's energy demand. Furthermore, sustainable urban mobility plans that promote car-free cities as well as 15- and 20-minute city initiatives have the potential to heavily reduce cars demand and hence related energy and raw materials demand. Conversely, ensuring that the remaining primary materials needed are sourced according to the most rigorous environmental and social standards is also of pivotal importance. Indeed, the renewable energy transition must be become an opportunity to transition to a post-extractivist model based on reduction of energy and material needs, reuse, and recycling.

Move towards circular economy. Adopting a circular economy (CE) approach is of utmost importance when it comes to manufacturing renewable energy technologies. CE strategies aiming at enhancing resource efficiency should prioritise design measures for repairability, refurbishment, repurposing and recycling of materials and products, thereby ensuring that the burden of emission reduction – achievable through more RES penetration – does not come at the expense of new environmental and social problems. Covering wind turbines under Ecodesign, as for PVs, may be an option worth exploring.

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[44] Enevoldsen, P., Permien, F. H., Bakhtaoui, I., von Krauland, A. K., Jacobson, M. Z., Xydis, G., ... & Oxley, G. (2019). How much wind power potential does europe have? Examining european wind power potential with an enhanced socio-technical atlas. Energy Policy, 132, 1092-1100.

[45] Re-Thinking Mining Waste Through an Integrative Approach Led by Circular Economy Aspirations. You can access the study here.

Promote material footprint targets. Considering the close link between material use and carbon emissions, connecting material footprint reduction targets – such as 65% reduction by 2050 as suggested by the EEB – to those targets to reduce carbon emissions as exemplified by the fit-55 is needed to make the best use of available materials. These two complementary targets would uptick eco-design measures, right to repair, extended producer responsibility, substitutability for more environmentally costly materials, etc. They would also incentivise large investments in urban mining to recuperate secondary raw materials which is generally less energy intense and tend to become more economically competitive[46] than primary material extraction.

Make use of Green Public Procurement, as it can increase material sustainability and material efficiency of solar and wind power plants. Green Public Procurement can be a powerful tool for permitting authorities to influence the energy market and accelerate the deployment of nature-positive renewable energy[47] Permitting processes must include provisions to ensure that only sustainably sourced materials are used in the construction of power plants and reward projects that incorporate recycled materials or best end of life practices to improve material efficiency.

2.3 Social impacts

Social impacts of renewable energy projects in the communities where they are installed are often overlooked. However, **considering those impacts is fundamental to make way for a just and equitable energy transition and to deliver on different dimensions of justice while tackling rising energy prices**. As pointed out in a 2021 report by the Institute for European Environmental Policy, renewable energy developments can lead to direct local and regional benefits. This is especially true in regions with high renewable energy potential, which can become net exporters of energy and thus be able to benefit from the income generated. RES expansion also appears to be generally associated with positive effects on local employment, especially when a local renewables supply chain is developed[48]. Local community-ownership models were also found to enhance regional socio-economic benefits. In addition, when taking into consideration the overall context of the current climate crisis and its social impacts, renewables have a net positive societal impact.

However, if no measures are put in place, **large renewable energy projects can also have negative impacts on the communities residing next to them**, albeit of a different scale and magnitude than e.g. coal power plants. For instance, siting utility scale solar plants on agricultural, fertile land might bring about competition between different land uses and this might prove critical for the surrounding communities if the process is not adequately managed. Proper planning and site management will be key in that respect to ensure that the relationship between different land uses becomes complementary rather than competitive. Moreover, landscape changes due to renewable energy deployment can be a major driver of socio-political unacceptance of RES projects. For example, wind power expansion has frequently triggered significant opposition by local communities, motivated primarily by the perceived impact on 'natural' landscapes[49]. **Meaningful public participation and benefit-sharing are therefore key** to assess local

[46] Comparing the costs and benefits of virgin and urban mining. You can access the study here.

[47] More information on sustainable procurement can be found in EEB's "Policy brief on unleashing the potential of sustainable procurement". The full report is available here.

[48] Allan, G., Eromenko, I., Gilmartin, M., Kockar, I., & McGregor, P. (2015). The economics of distributed energy generation: A literature review. Renewable and Sustainable Energy Reviews, 42, 543-556.

[49] Warren, C. R., & McFadyen, M. (2010). Does community ownership affect public attitudes to wind energy? A case study from south-west Scotland. Land use policy, 27(2), 204-213.

communities' preferences for renewable energy infrastructure development and, ultimately, enhance social acceptance of RES projects.

Mining for lithium, cobalt, manganese, platinum, aluminium and copper has also been associated with high or very high social risks. Globally, mining includes 495 human rights abuse allegations with 1/3 of cases involving human rights defenders. The Responsible Mining Index in 2022 found that the performances of even the best-scoring companies fall considerably short of societal expectations in all areas, including community wellbeing, working conditions and environmental responsibility, and that many companies show limited signs of translating corporate commitments and standards into successful business practices.

2.3.1 Suggested Solutions

Engage and consult with local communities at the early stage of renewable energy development, as it increases greatly the degree of public acceptance of such projects, hence it improves the chances of success and speeds up the process by mitigating the risk of potential legal suits and other impediments[50]. In fact, a balance needs to be struck between the need for public acceptance, especially in rural vulnerable communities, and the needed rapid increase in renewable energy capacity to ensure climate neutrality. Fostering early inclusion and participation in renewable energy projects is crucial to achieve this, for example as part of broader neighbourhood/district level planning, as this could help identify area-based strategies to align RES projects with community needs and expected social vulnerabilities.

Give priority, as for both subsidies and permitting processes, to distributed, community-owned projects that not only can prevent major social and environmental impacts to the larger extent, but also can trigger socio-economic restoration effects in certain areas[51] (e.g. when earnings from renewable projects are reinvested in local social services). Particular focus should be placed on encouraging the realization of clusters to improve complementarity between different community energy projects, thereby minimizing costs and maximizing benefits of renewable energy integration into the grid.

Make sure that local communities retain a fair share of the added value generated by RES projects in a way that is tailored to the local needs and specificities. As the most substantial local impacts are associated with indirect project outcomes and investment of project revenues in the local community, renewable energy projects shall ensure that the local communities retain a tangible share of the added value generated through those projects (i.e. via rebates in the electricity bill, shares in the projects- given to the affected local community). Furthermore, ad-hoc financial schemes should be promoted in order to enable easier fundraising in the communities for earmarked renewables projects, and especially to lower the need for placing upfront capital costs on community members[52].

[50] Goedkoop, F., & Devine-Wright, P. (2016). Partnership or placation? The role of trust and justice in the shared ownership of renewable energy projects. Energy Research & Social Science, 17, 135-146.

[51] Berka, A. L., & Creamer, E. (2018). Taking stock of the local impacts of community owned renewable energy: A review and research agenda. Renewable and Sustainable Energy Reviews, 82, 3400-3419.

[52] For instance, in the UK the Brighton and Hove Energy Services Co-operative have started utilising "pay-as-you-save" financing models to recuperate costs from end users gradually over time.

3. The policies

Building on the recommendations identified in sections 2.1.1, 2.2.1, and 2.3.1, the table below summarises the main proposed changes and upgrades in relevant EU legislation and initiatives:

	Key environmental risks	Relevant EU legislation/communications	What needs to be enshrined in the relevant EU legislation to achieve a nature-positive RES deployment
SOLAR (all types)	- For utility-scale solar installations, need for large areas of unused land, with consequent habitat loss and fragmentation - Even if this varies across different technologies and might change in the future, dependence on critical materials - Land use changes in rural areas (conflict with agriculture soil) can be significant if no mitigation is put in place	- Renewable Energy Directive review (RED III) - Further review of RED (RES permitting), EPBD (solar installations) EED (EU 2030 EE target) under REPowerEU plan - EU Solar Energy Strategy (REPowerEU) - Recommendation on Renewable Energy Permitting (REPowerEU)	- **Enhance** the Energy Efficiency targets beyond those proposed under the REPowerEU plan to keep the needed RE deployment to the minimum necessary to ensure security of supply and minimise any potential environmental impact - **Establish** clear "go-to" and "no-go" areas in strategic spatial planning of renewable energy projects to balance environmental protection and RE deployment needs - **Exclude** marine and terrestrial protected areas from 'go-to areas' for large renewables projects - **Focus** on mapping and spatial planning, tackling administrative bottlenecks, enhancing digitalisation, establishing one-stop-shops - **Promote** the Positive Administrative Silence rule (also referred to as "consent by silence") in permitting processes for installing solar technologies on roofs, except for heritage and protected buildings - **Reward** BAT in renewable energy projects to minimise disruption when installing solar plants and proactively restore nature rather than compensating impacts - **Require** management plans detailing the use of land for pasture or sustainable agriculture when installing PV panels in arable lands - **Establish** strong Ecodesign requirements with respect to disassembly, repairability, recyclability of materials, while not hampering the uptake of PVs. - **Make use** of Green Public Procurement to ensure only sustainably sourced raw materials are used in solar plants, and reward projects that rely on enhanced recycling/reusing of key components - **Facilitate** local communities' consultation and direct involvement in RES projects to foster acceptance while not compromising deployment
WIND (offshore & onshore)	- Wind facilities require less land than solar, but nevertheless entail habitat fragmentation effect - Risk of birds being killed by wind turbines, especially if along migratory routes - Even if this varies across different technologies and might change in the future, dependence on critical materials - In offshore, risk of seabed disruption (e.g. when installing foundations)	- Renewable Energy Directive review (RED III) - Further review of RED (RES permitting) and EED (EU 2030 EE target) under REPowerEU plan - Recommendation on Renewable Energy Permitting (REPowerEU)	- **Enhance** the Energy Efficiency targets beyond those proposed under the REPowerEU plan to keep the needed RE deployment to the minimum necessary to ensure security of supply and minimise any potential environmental impact - **Establish** clear "go-to" and "no-go" areas in strategic spatial planning of renewable energy projects to balance environmental protection and RE deployment needs - **Exclude** marine and terrestrial protected areas from 'go-to areas' for large renewables projects. For instance, marine protected areas should be "no-go" for offshore wind installations. - **Focus** on mapping and spatial planning, tackling administrative bottlenecks, enhancing digitalisation, establishing one-stop-shops - **Reward** BAT in renewable energy projects to minimise disruption when installing wind turbines and proactively restore nature rather than compensating impacts

	Key environmental risks	Relevant EU legislation/communications	What needs to be enshrined in the relevant EU legislation to achieve a nature-positive RES deployment
		- Offshore Renewable Energy communication	- **Support** the development of innovative financial and operational schemes to allow for citizens participation in offshore wind power projects - **Consider Ecodesign requirements** for wind turbines to ensure disassembly, repairability, reusability of key components and recyclability of associated materials - **Consider EU wide Extended Producer Responsibility schemes** for wind turbines to boost waste prevention, reuse and recycling. - **Make use** of Green Public Procurement to ensure only sustainably sourced raw materials are used in wind plants, and reward projects that rely on enhanced recycling/reusing of key components - **Facilitate** local communities' consultation and direct involvement in RES projects to foster acceptance while not compromising deployment
BIOENERGY (including biogas)	- Risk of exploiting forest resources in and beyond the EU to produce energy, with biodiversity and ecosystem losses - Risk of bioenergy being overused by Member States reluctant on deploying wind and solar to comply with RED III - Air pollution and water use from bioenergy combustion plants. In the case of solid biomass, dust and Nox are particularly relevant pollutants. In biogas, Nox is also relevant - Biogas can only be considered when it comes from waste that cannot be used in any other non-energy-related way	- Renewable Energy Directive review (RED III) - Delegated Act on Sustainability Principles in Bioenergy – *two years after adoption of RED III (tbc)*	- **Ensure full compliance** with the cascading principle in the use of biomass: only biomass from waste with no other alternative use. RED III needs to be fit for purpose on this – *see EEB PAC 2.0 Policy Brief on RED III for more details* - **Phase out** solid biomass for residential and tertiary heating by 2045; no incentives for bioenergy plants using forest biomass - **Not accepting** Carbon Capture technologies to make bioenergy sustainable; the only sustainable bioenergy is the one complying with cascading principle - **Exclude** energy production with forest biomass from public support measures and incentives - **Condition** the production of biogas to the use of sustainable waste streams only (e.g. sewage, food waste, landfills, manure)
GEOTHERMAL	- Emission of toxic pollutants such as hydrogen sulfide and boric acid, with potential adverse effects on associated aquatic and terrestrial ecosystems - Risk of geothermal pits connecting different water beds	- Renewable Energy Directive review (RED III) - Review of Groundwater Directive (GWD) – *October 2022 (tbc)*	- **Facilitate** only the deployment of geothermal energy with low environmental impact such as closed-loop systems, dry steam and flashed steam plants - **Reinforce** provisions to prevent the entry of pollutants into groundwater
HYDROPOWER	- Habitat fragmentation and changes to water flow regime and water quality - Disruption of fish migration and reproduction, and risk of fish species extinction	- Renewable Energy Directive review (RED III) - Further review of RED (RES permitting) under REPowerEU plan	- **Stop** support to new hydropower plants across the EU - **Focus** on refurbishment of existing hydropower stations, including upgrades to BAT to reduce their ecological impact - **Address** the impact of the hydropower plants at the catchment level and engage in larger-scale river restoration measures - **Limit** faster permitting procedures only to repowering of existing/historical hydropower plants and bring them in line with EU water and nature protection legislation

4. Strategic RES spatial planning

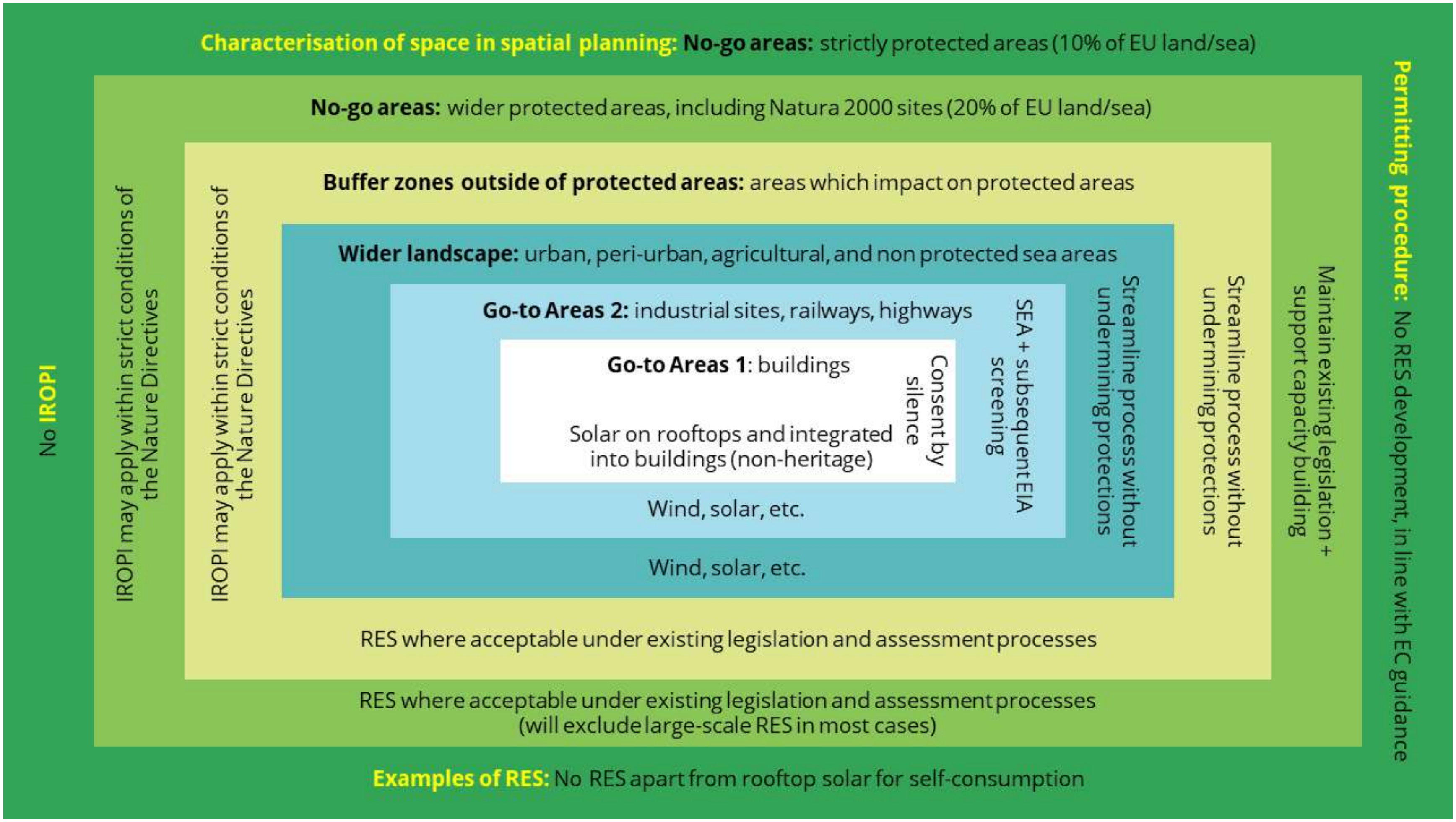

Figure 1 – Strategic RES spatial planning

As represented in figure 1, we suggest a possible zoning strategy to guide renewable energy planning and definition of permitting rules in the EU Member States. For the sake of clarity, the same zoning strategy is further explained in the following tabular format.

	Characterisation of Space in spatial planning	Permitting procedure	IROPI (Imperative Reasons of Overriding Public Interest)	Examples of RES
Go-to areas 1	Rooftops and buildings (non-heritage)	Very limited permitting requirements following a transparent and participatory process to identify those areas. Positive administrative silence rule applies		Solar on rooftops and integrated into buildings (non-heritage)
Go-to areas 2	Industrial sites, railways, highways	Very limited permitting requirements following a transparent and participatory process to identify those areas. With appropriate SEA, likely no EIA needed following screening		PV, solar thermal, wind
Wider landscape	Urban, peri-urban and agricultural areas + non protected sea areas	Streamline permitting process without undermining protections, i.e. normal impact assessment obligations apply + consultation + support capacity building in permitting authorities		PV, solar thermal, wind
Buffer zones outside of PAs	Areas which impact on protected areas	Streamline permitting process without undermining protections, i.e. assessment to ensure that the development does not harm the adjacent protected area + consultation + support capacity building in permitting authorities	No IROPI presumption. IROPI may apply under strict conditions of Nature Directives, i.e. Art. 6(4) Habitats Directive, Art. 4(7) WFD, Art. 9 Birds Directive	RES where acceptable under existing legislation & assessment processes – possible to have large scale RES under right conditions
No-go areas 1	Wider protected areas including Natura 2000 sites (20% of EU land/sea)	Maintain existing legislation and support capacity building to ensure institutional implementation	No IROPI presumption. IROPI may apply under strict conditions of Nature Directives, i.e. Art. 6(4) Habitats Directive, Art. 4(7) WFD, Art. 9 Birds Directive. Conditions should not be met given alternatives in go-to areas	RES where acceptable under existing legislation and assessment processes - will exclude large-scale RES in most cases
No-go areas 2	Strictly protected areas (10% of EU land/sea)	No RES development, in line with EC's guidance	No IROPI	No RES apart from rooftop solar for self-consumption

5. Conclusions

The main biodiversity and wider environmental impacts of a large deployment of renewable energy, which is needed for the EU to become climate neutral and pollution-free by 2050, have been summarised in this paper. Overall, **the benefits of renewables far outweigh their impacts by providing clean, affordable, and reliable electricity**. The presented impacts of renewables are in any case significantly lower than those associated with fossil fuels, as the latter's GHG emissions in the energy sector still account for one of the highest shares of the total GHG emissions in Europe and for three quarters of GHG emissions globally. Furthermore, the needed scale of renewable energy deployment will ultimately depend on Europe's ability to reduce its energy and material consumption through increased energy sufficiency, technological efficiency, and enhanced circularity.

The current Russia-Ukraine war makes the transition to renewable energy more crucial than ever before. The REPowerEU plan puts natural gas, and sometimes even domestic coal burning, at the core of the EU's strategy to tackle the short term consequences of cutting off dependence from Russian fossil fuels. This is, however, no long-term fix and will entail even higher environmental and economic costs than accelerating renewable energy deployment.

Three sources of renewable energy have received particular attention in this Policy Brief, namely wind, solar, and bioenergy, as according to the PAC scenario results[53] those will be the ones providing most of the energy in the EU by 2050. The potential environmental impacts of solar and wind are mainly related to their location, which, if not planned accordingly, might result in adverse effects on biodiversity and land use change. Thus, careful mapping and spatial planning are key to identify suitable and unsuitable areas and direct the deployment of renewables installations accordingly. Furthermore, critical materials used in some of the components must be sustainably sourced, reused and recycled where possible. The impacts of bioenergy can be significant as they are primarily linked to the risk of over-exploitation of forests resources. Hence, it is proposed to limit the biomass sourcing exclusively to woody waste with no other alternative use.

There is a particularly crucial issue where an equilibrium between broad environmental protection and renewable energy deployment needs to be found: permitting. Building on the concept of **Nature-positive Renewable Energy**, the issue is addressed by outlining a series of recommendations to mitigate the potential environmental impacts of solar, wind, and bioenergy. By identifying such mitigation pathways *ex-ante* in permitting processes, a fast, yet sustainable rollout of renewable energy in the EU can be achieved. Nothing could be more important in a context where the EU needs to boost its energy sovereignty and reduce its dependency from unsafe, climate harming sources.

If the solutions recommended in this paper are heeded, integrated into political commitment, and implemented, then the **EU's policy initiatives will be able to catalyse a nature-positive renewables transition** that is so essential to jointly step-up climate change mitigation, nature protection, and energy security. Such a transition will also help strengthening household and business resilience to energy prices volatility and ensure that the EU as a whole is better equipped to effectively pursue its climate neutrality and nature protection ambitions despite geopolitical conflicts.

[53] The summary of the results is available here.

Next steps and further information

This document constitutes an assessment of the environmental impacts of deploying the needed RES capacity to achieve a successful energy transition in the European Union while respecting environmental boundaries. For its development, the results from the Paris Agreement Compatible (PAC) scenario have been used as a starting point and source for the main figures on RES deployment in the European Union.

This policy brief constitutes an EEB deliverable under the PAC 2.0 project, being implemented by the partnership comprising RGI, REN-21, EEB, and CAN Europe which looks at ways to implement the PAC scenario in relevant policy files and modelling activities. The opinions expressed within this Policy Brief are solely the EEB's and should not be taken to reflect the views of the funder or partners.

Other policy briefs released and foreseen under the PAC 2.0 project include:

"Taking the Paris Agreement Compatible (PAC) energy scenario to the next level: the revision of the Renewable Energy Directive (RED III) as a key milestone towards a 100% renewable grid" (published in February 2022, available here)

"Green Hydrogen solutions for a renewable grid" *(upcoming EEB policy brief)*

"Sustainability criteria for biomass and PAC Scenario" *(upcoming EEB policy brief)*

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