WORKING PAPER | ISSUE 11/2025 | 3 JUN 2025

# IMPLEMENTING THE EU NATURE RESTORATION LAW: EXPLORING PATHWAYS FOR MEMBER STATES

HEATHER GRABBE, CAMILLE MEHLBAUM, BAS HEERMA VAN VOSS AND SJOERD VAN DER ZWAAG

The European Union Nature Restoration Law (NRL) entered into force in 2024. The NRL sets quantitative restoration targets aimed at improving natural habitats that are currently in poor condition, with substantial leeway for countries to choose implementation pathways that fit their priorities.

This Working Paper examines three pathways: (1) evenly spreading restoration efforts across all ecosystems; (2) prioritising cost-efficiency; and (3) maximising carbon sequestration. Each approach yields vastly different outcomes. This paper provides insights into the trade-offs.

For countries seeking to minimise costs in the short run, an 81 percent reduction in costs over the period 2025-2030 is possible compared to a baseline scenario of an even restoration of all ecosystems. Countries that aim to maximise carbon sequestration benefits can achieve a 54 percent increase in climate impact over the same period. However, the different pathways converge after 2040. Prioritising cost minimisation in the early years could lead to higher costs later if delays in investment in the more costly restoration projects allow habitats to continue to degrade.

Maximising *cost-efficient* carbon sequestration is possible, allowing relatively low investment costs and high sequestration. Countries should adopt a holistic approach to pathway selection, considering the full spectrum of ecological and societal gains alongside climate mitigation.

Land ownership is an important factor that shapes feasible and effective pathways. In countries such as Spain and Germany, where private entities own substantial shares of agricultural and forest lands, policies should incentivise private investment, including through norms, subsidies or pricing mechanisms. Countries with substantial public landholdings, such as the Netherlands, may find it easier to implement direct restoration projects. These structural differences will influence the cost and pace of restoration and also the design of policies and governance mechanisms to ensure compliance with NRL targets.

Heather Grabbe (heather.grabbe@bruegel.org) is a Senior Fellow at Bruegel.
Camille Mehlbaum is an Economist at De Nederlandsche Bank.
Bas Heerma van Voss is an Economist at De Nederlandsche Bank.
Sjoerd van der Zwaag is a Sustainable Finance Policy Officer at De Nederlandsche Bank.

*The opinions expressed in this paper are those of the authors and not of the institutions they are affiliated with.*

**Recommended citation:**
Grabbe, H., C. Mehlbaum, B. Heerma van Voss and S. van der Zwaag (2025) 'Implementing the EU Nature Restoration Law: exploring pathways for member states', *Working Paper* 11/2025, Bruegel

bruegel

## 1 Introduction

In 2024, the European Union's Nature Restoration Law (NRL, Regulation (EU) 2024/1991) entered into force – the first comprehensive, continent-wide legislation to restore degraded ecosystems, which is central to the EU's Biodiversity Strategy. Ecosystem services are what nature provides to human economic activity, such as water and air filtration, soil fertility and pollination for food production, genetic diversity that allows the development of medicines, as well as carbon sequestration and storage. The economy is heavily reliant on these ecosystem services, but they are not accounted for on either public or private balance-sheets.

In Europe, over 80 percent of natural habitats are in poor condition (EEA, 2020), reducing their capacity to absorb and hold carbon and provide other eco-system services. The NRL sets ambitious goals for the sustained recovery of biodiversity, climate change mitigation and adaptation and enhanced food security.

### Policy context of the Nature Restoration Law

The annual cost of nature restoration across the 27 countries is estimated at €8.2 billion[1]. The available biodiversity funding under the EU's current budget would at best only cover part of this sum (see Darvas and Sekut, 2025). National funding will be needed if EU members are to reach the targets set under the NRL.

National governments are having to make difficult choices between funding priorities. Among those on climate and environment, they are investing in the transition to renewable energy and decarbonisation of many sectors, including industry, transport and buildings. The rationale for spending scarce fiscal resources on nature restoration is simple in principle, but hard to quantify because the services provided by nature are largely unaccounted for in measures such as GDP. The environmental and economic rationales for the NRL are interconnected. Economic stability and growth are inextricably linked to the resilience of the natural systems that underpin them[2]. The economy cannot function efficiently without clean water, fertile soils and stable climate patterns. More broadly across societies, ecosystem degradation, including biodiversity loss, imposes significant costs through – among other things – reduced agricultural productivity, increased vulnerability to natural disasters and diminished availability of ecosystem services such as pollination and water purification. Healthy ecosystems also play a critical role in mitigating and adapting to climate change by sequestering carbon and reducing the impacts of extreme weather events. Many eco-system services are very expensive to replace with human technology, and some are irreplaceable.

[1] Average annual costs over 2022-2030 according to European Commission (2022).
[2] See NGFS statement of 24 March 2022 'Statement on Nature-Related Financial Risks' https://www.ngfs.net/system/files/import/ngfs/medias/documents/statement_on_nature_related_financial_risks_-_final.pdf, ECB (2024), Dasgupta (2021).

The NRL prioritises efforts within specific areas which are considered most valuable, most notably the Natura 2000 sites – a network of protected areas at the heart of EU conservation policy. These zones are critical to efficient resource allocation to increase ecological benefits. The Natura 2000 sites and other habitats prioritised in Annex I of the NRL cover 24 percent of EU land area but provide habitats for enormous biodiversity that is central to provision of eco-system services[3].

The NRL sets clear and binding targets, but allows member states a degree of flexibility in implementing restoration measures, recognising the diverse ecological, social and economic contexts across the EU. This balance between prescription and discretion empowers member states to tailor their actions while aligning with overarching European objectives.

By 2030, member states are required to implement restoration measures covering at least 30 percent of the degraded habitats set out in Annex I of the NRL. This target increases to 60 percent by 2040 and 90 percent by 2050. To achieve these goals, each country must develop and submit comprehensive restoration plans to the European Commission, outlining pathways to meet the specified benchmarks.

To aid consideration of the choices and trade-offs to make at national level, this policy brief quantifies the effects of different restoration pathways on costs and carbon sequestration over time. We analyse three different pathways to reach the milestones for restoration of degraded Annex I habitats in 2030, 2040 and 2050. On the first pathway, countries aim for an even spread of restoration measures across different ecosystems while prioritising Natura 2000 sites. On the second, countries prioritise cost-efficiency in reaching the EU targets. On the third pathway, countries prioritise the benefits that nature restoration brings to climate change mitigation, focusing first on ecosystems that sequester more carbon.

National conditions, including patterns of land ownership, will determine which pathways are preferable for different member states. Bringing together land ownership data from across the EU, we find that most of nature in the EU is owned privately, suggesting that policy instruments involving private finance in nature restoration could be valuable in reaching the NRL targets. However, there are vast differences in land ownership patterns across EU countries. In some, such as France, nature is mostly owned by corporations that hold larger plots of land; while in others, individuals own small plots of the land where nature is most valuable.

*A caveat on data: The available data on the spread of project costs, sequestration rates, ecosystem characteristics and restoration potential are imperfect. In recent years, data availability on the ecological and economic characteristics of nature restoration has increased substantially, allowing us to calculate different country-specific pathways and their consequences in some detail. To the best of our knowledge, we are the first to provide such calculations. However, while our results highlight interesting trade-offs, processes and orders of magnitude, they should not be considered precise*

[3] Authors' calculations using data from the EEA on Article 17, Habitats Directive 92/43/EEC. Of the 24 percent, almost 450,000 km$^2$ (44 percent) is considered to be in need of restoration, with one third classified as Natura 2000.

*point estimates. Nature restoration requires highly local interventions, which are only alike across the continent to a limited extent, and any modelling effort comes with unavoidable simplifications. Furthermore, the available data are based on a limited set of sources, and some rely on countries' self-reporting, which may result in biased estimates. For a full description of our methodology and data of our calculations, please see the annex to this paper.*

## 2 Nature restoration pathways: treat all ecosystems as equal, minimise costs, or maximise climate benefits?

In this section, we will look at the effects of three pathways that allow member states to achieve the NRL targets for the restoration of degraded Annex I habitats. First, we will define the pathways in more detail. Second, we will quantify the effects of each pathway on the costs for restoration and maintenance across the EU. Third, we will look at effects on carbon sequestration and the contribution of each pathway to climate targets. Fourth, we will look at the impact on the type of ecosystems that are restored.

### 2.1 Defining nature restoration pathways

#### 2.1.1 Pathway 1: all ecosystems are equal

On our first pathway, member states implement the NRL by distributing restoration efforts evenly across all ecosystem groups. Restoration efforts are made proportionally to the size of each ecosystem within a member state that requires restoration. Priority is given to Natura 2000 areas within each group, in line with NRL guidance. For otherwise equal projects within the same ecosystem, low-cost projects are given priority. This approach ensures that all ecosystems receive attention but may not fully optimise cost or any specific co-benefit nature restoration may bring.

#### 2.1.2 Pathway 2: minimising costs

On this second pathway, member states aim to meet the NRL's restoration targets by prioritising areas with the lowest restoration costs. Restoration efforts are guided by discounted restoration costs per hectare, ensuring that investments deliver most hectares of restored nature for each euro spent. Projects with the lowest costs are prioritised. An example of a lower cost project would be a habitat which is not as heavily degraded as other habitats or habitat for which a passive restoration method is preferred[4].

Costs include a combination of one-off initial investment and annual maintenance estimates. The rationale for cost-efficiency as a guiding principle is rooted in the significant financial investments required for large-scale habitat restoration. By focusing on low-cost areas first, this pathway minimises the overall economic burden on member states with constrained budgets. However, this approach may

[4] Regardless of their ecosystem type or Natura 2000 classification.

lead to unequal restoration progress across ecosystem types, potentially leaving higher cost but ecologically and economically valuable habitats under-prioritised in the early stages.

### 2.1.3 Pathway 3: maximising climate benefits

On this third pathway, member states prioritise restoration projects based on their potential to sequester carbon and contribute to climate change mitigation targets. By selecting restoration projects with high carbon sequestration potential from restoration, this approach brings earlier reductions in atmospheric $CO_2$-concentrations. Capturing carbon sooner rather than later mitigates climate change, reducing the long-term costs and risks associated with delayed climate action and contributing to EU and national climate goals.

This approach involves identifying habitats with the highest carbon sequestration potential from restoration. Just as with the first scenario, when projects are equal otherwise, low-cost projects are given preference. The rationale for this pathway lies in the potential of nature restoration as a cost-effective mechanism to achieve climate objectives, thereby achieving the dual objectives of biodiversity restoration and climate mitigation. This pathway allows member states to align their nature restoration efforts with broader climate strategies, while providing co-benefits that extend beyond climate mitigation. While this approach is highly strategic in terms of climate outcomes, it may deprioritise habitats that have lower carbon capture potential but have significant biodiversity or ecosystem service value, necessitating careful consideration of the trade-offs. This pathway also disregards considerations of cost-efficiency.

### 2.1.4 Why only climate mitigation, and no other co-benefits?

While our pathways do not look at co-benefits other than climate change mitigation, this does not mean these other benefits are not meaningful and sizeable. These pathways are intended to illustrate how such strategies might affect outcomes. The restoration of habitats offers a wide array of ecosystem services beyond carbon sequestration, including improved biodiversity, enhanced ecosystem services and greater resilience to climate change. Carbon sequestration, however, provides a directly measurable outcome that can illustrate the implications of different restoration pathways. In this policy brief, we focus on the carbon sequestration potential of restoration efforts to evaluate the trade-offs and synergies across three pathways. Nonetheless, it is important to stress that the broader ecological and social benefits of restoration are equally significant and should not be overshadowed by a singular focus on carbon outcomes.

## 2.2 Calculating costs of restoration

In this section, we quantify the cost of each pathway over time using data on the initial investment and maintenance costs of nature restoration in Europe[5]. We allow the project size for each individual

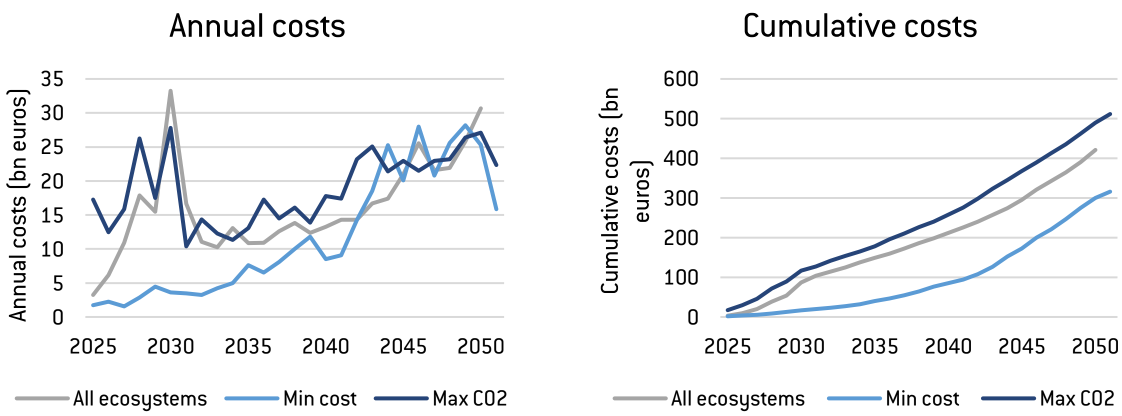
---

[5] The data is taken from Tucker *et al* (2013) and corrected for inflation, and we follow the impact assessment of the NRL from the European Commission (European Commission, 2022).

restoration project to vary in line with the distribution found for restoration projects in European ecosystems (EIB, 2023). Restoration costs vary per country, reflecting varying costs of material, labour and capital[6]. See the annex for a full description of calculations and data used.

The cost minimisation pathway leads to a significant reduction in annual costs of implementation up to 2040 (see Figure 1). If countries choose to spread their restoration efforts evenly across each ecosystem, this leads to a total cost of €86.9 billion across the EU in the period 2025-2030. By selecting the most cost-efficient projects countries can save 81 percent of those costs collectively, spending €16.5 billion collectively in that period. However, over time, the annual costs of the different pathways converge, because the NRL requires restoration to start before 2050 on 90 percent of the area of all degraded ecosystems, so there are few areas left for cost-optimisation towards the end. This means that the annual cost reduction in following the cost-minimisation pathway versus that the even-spread pathway is greatest around 2030 and diminishes towards 2040. Still, the cumulative costs of the cost-minimisation pathway in the period 2025-2040 are 60 percent lower than those of a pathway with even spread across ecosystems. After 2040, the annual costs of these two pathways are largely similar.

**Figure 1: Costs from NRL in three scenarios (2025-2050)**




Source: Bruegel, see the annex for a full description of calculations and data used.

The spread in project costs per hectare explains the large potential for cost minimisation. These differences are large between ecosystems, but also between projects for the same ecosystems. There is a relatively simple explanation for these differences. The targets under the NRL are defined by the area of nature that is currently degraded. What it means for a habitat to be in poor condition is hard to define objectively. This means that implementation of the criteria can vary significantly between member states, leading to wide differences in restoration and maintenance costs. The severity of degradation heavily affects restoration costs.

[6] This is reflected in our calculation by applying a factor that is dependent on the GDP of the member state in which restoration takes place, in line with Verhoeven *et al* (2024).

The NRL provides member states with some flexibility in setting their level of ambition for nature restoration while still complying with the area-based targets of the NRL. This flexibility is particularly relevant in the early stages of the implementation, when none of the degraded habitats is being restored yet. However, prioritising lower-cost projects often results in less intensive restoration efforts. For example, fully restoring a severely degraded forest provides far greater benefits overall than making minor improvements to a slightly degraded one. Since the societal benefits of nature restoration generally far outweigh the costs (European Commission, 2022), governments that focus solely on minimising expenses are not making the best long-term investment decisions for their societies.

The pathway that maximises the climate benefits of nature restoration, by contrast, is more expensive than a pathway with an even spread across ecosystems until 2040. The total costs of nature restoration that optimises for carbon sequestration lie 35 percent above those of the even-spread pathway in the period 2025-2030. After 2030 costs converge, for much the same reason as outlined above: as the pool of projects from which to select diminishes towards attaining 90 percent restoration in 2050, so do the cost differences between pathways. Again, there is a straightforward reason for these cost differences. More complex ecosystems are likely to sequester more carbon per unit of area over the long run (Gouch *et al*, 2019), but these more complex ecosystems generally cost more to restore and maintain. Therefore, a pathway that maximises $CO_2$-sequestration is more expensive than one with an even spread across all ecosystems. It is important to remember that costs here are only defined in the narrow sense. Higher carbon sequestration by nature means better attainment of climate goals, which can lead to lower costs of the impact of climate change or lower expenditure on climate policy in other domains.

### 2.3 Climate mitigation

In this section, we quantify the climate benefits of the different pathways. To do so, we use data on the additional sequestration of each ecosystem that is being restored from He *et al* (2024). Once a habitat has been restored, it will continue to sequester additional carbon until its maximum carbon stock is reached. This requires using data on the stock of carbon of an ecosystem in a degraded state and in a good state, as well as the time required for an ecosystem to fully restore[7]. In our analysis we assume a linear recovery trend. In the literature this is considered appropriate for restoration goals focusing on ecosystem services, such as carbon sequestration (Meli *et al*, 2019).

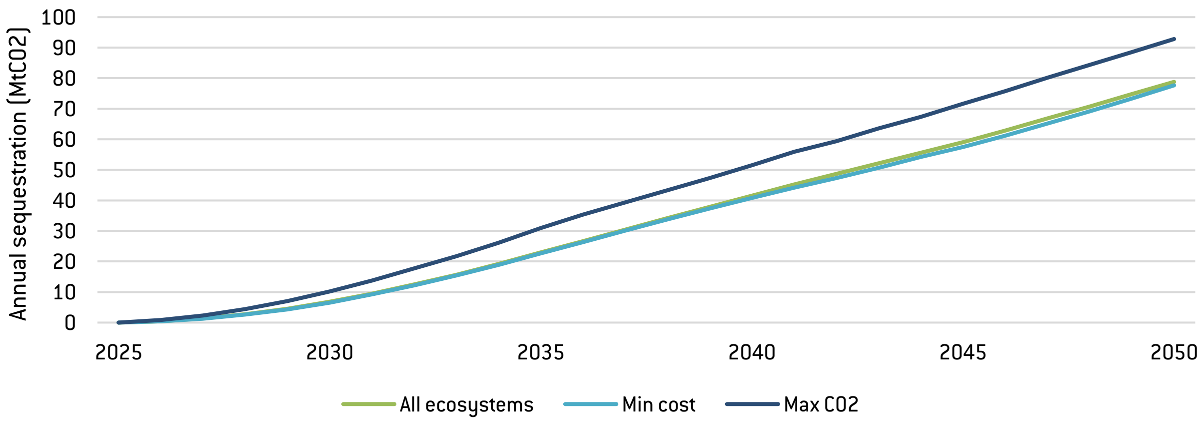
The pathway that maximises $CO_2$ sequestration yields significantly higher climate benefits throughout the period 2025-2050 (see Figure 2). Under this pathway, the total additional amount of carbon sequestered until 2050 is 1,091 Mton of $CO_2$. To show the order of magnitude, this is nine times the total 2023 emissions from the Netherlands, a mid-sized European economy with a large industrial

[7] We take the data required from the impact assessment of the NRL from the European Commission (JRC, 2023). We combine this with Erb *et al* (2018) to determine the initial carbon stock of an ecosystem in a degraded state. Furthermore, we use data on the recovery times of ecosystems from Jones and Schmitz (2009).

sector. This is also 23 percent more carbon than is sequestered on than the pathway with an even spread between ecosystems. The carbon maximisation pathway contributes 55 percent more to reaching the EU's target of absorbing 310 $MtCO_2e$ through land use, land-use change and forestry annually by 2030[8]. The relative climate benefits of the pathway maximising $CO_2$ sequestration are higher in earlier periods: 54 percent until 2030, and 32 percent until 2040. Because ecosystems generally take decades from the moment restoration takes place until the carbon stock is reached, climate mitigation benefits continue after 2050 against only the costs necessary to maintain the restored areas. In all scenarios the $CO_2$ sequestered between 2050 and 2070 is roughly twice the amount of that sequestered between 2025 and 2050.

The cost minimisation pathway yields slightly lower climate benefits than the scenario with an even spread. This difference is relatively small: 4 percentage points in 2030, 2 percentage points in 2040 and 1 percentage point in 2050. For context, in absolute terms the differences are similar to the electricity usage of 40,000, 105,000 and 150,000 households, respectively. Our estimates of this difference are likely a lower bound, as we do allow for full variation in project costs for each ecosystem, but lack the data to match this with the according project-to-project variation in the sequestration rate. In other words, it is intuitive that cheaper projects generally yield lower effective restoration for each hectare restored, which in turn is likely to imply lower sequestration rates, but we lack data to reflect this in our calculations. Cost minimisation is therefore likely to imply sequestration rates that are lower compared to the other pathways.

**Figure 2: Annual sequestration of $CO_2$ from NRL in three scenarios, 2025-2050**




Source: Bruegel, see the annex for a full description of calculations and data used.

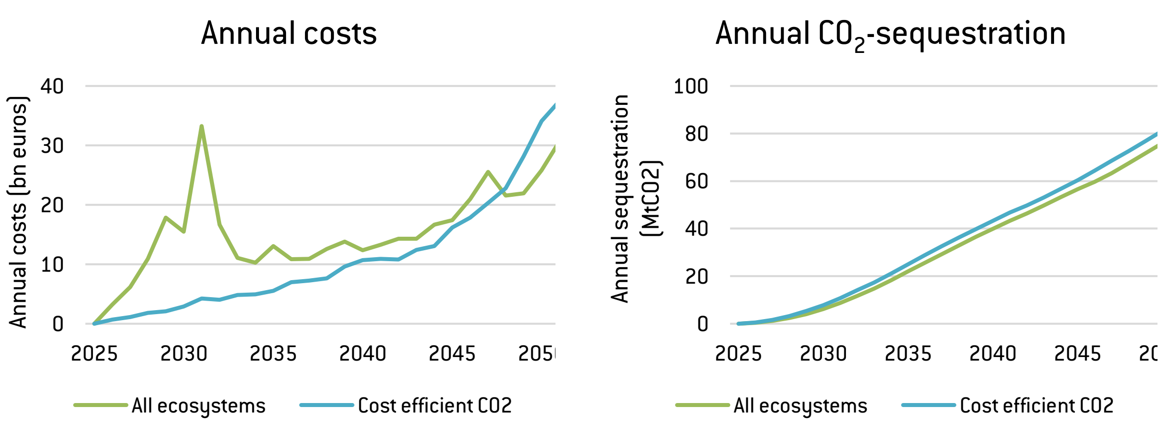
The pathway that maximises $CO_2$ leads to the most carbon sequestration, but with relatively high costs. On balance, at an average of €301 per ton of $CO_2$ across the period 2025-2070 (both costs and benefits in non-discounted 2023 euro), restoration of nature at this scale in Europe would be fairly

[8] However, none of the pathways are sufficient to bridge the land use, land-use change and forestry absorption gap (236 in 2022 to 310 in 2030, $MtCO_2e$) by themselves.

expensive climate policy. In the pathway with an even spread across all ecosystems, costs are lower at €282 per ton of $CO_2$. For comparison, the social cost of carbon in 2025 is €181 according to the US Environmental Protection Agency[9]. This is an incomplete benchmark against which to evaluate the costs of nature restoration, as it ignores all other benefits, but it does show the limitations of extra nature restoration as just climate policy. While the Commission's impact assessment for the Nature Restoration Law has shown there is lots of cost-efficient potential (European Commission, 2022), this does not scale indefinitely and to all ecosystems.

Countries can also opt for a pathway that maximises *cost-efficient* sequestration of $CO_2$, yielding higher climate benefits whilst lowering costs compared to other pathways. On this pathway, member states prioritise projects that have the lowest cost per ton of carbon sequestered[10]. This can be seen as a combination of our second and third pathway. The benefits of such an approach are obvious: as shown in Figure 3, this pathway allows for both lower annual costs and higher climate mitigation benefits than a pathway with an even spread across ecosystems. On this pathway, the difference is larger in terms of the resulting costs than it is in terms of carbon sequestered. Overall costs over the period 2025-2050 are 29 percent lower, while the cumulative carbon sequestered over the same period is only 4 percent higher.

**Figure 3: Annual costs and $CO_2$-sequestration from NRL in two scenarios, 2025-2050[11]**




Source: Bruegel, see the annex for a full description of calculations and data used.

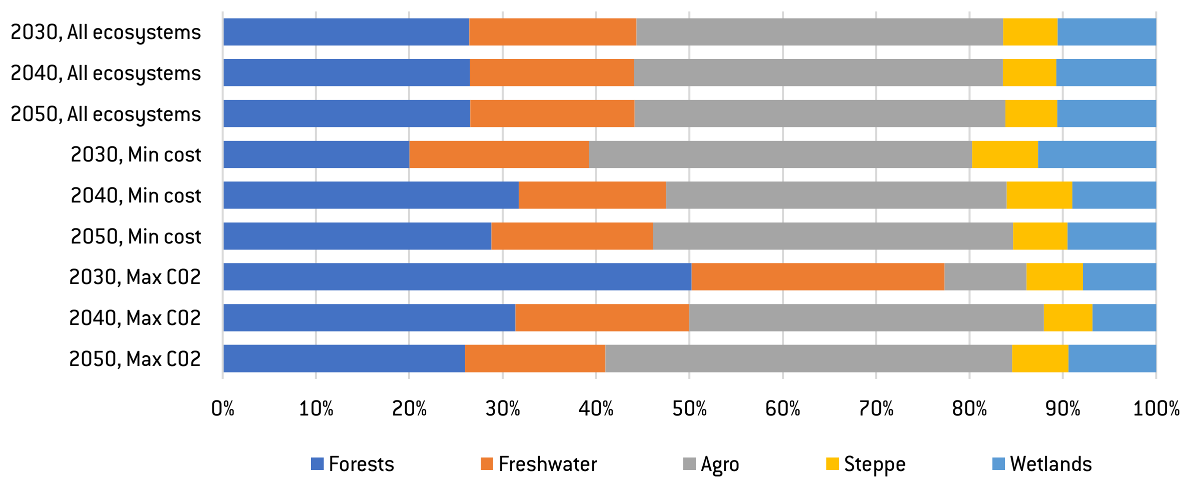
[9] EPA (2023). The EU does not issue its own official estimates.
[10] Calculated for the carbon sequestered in the first five years of a project.
[11] Authors' calculations, see the annex for a full description of calculations and data used

### 2.4 Which ecosystems are restored?

In this section, we show how our three main pathways differ in terms of the ecosystems that are restored. Figure 4 shows for each of the pathways what the contribution of each ecosystem is to the targets[12].

With an even spread across ecosystems, restoration of agro-ecosystems and forests contributes two-thirds to the total area restored in each of the target years. The even-spread pathway yields restoration in proportion to the degraded area of each ecosystem. As agro-ecosystems (40 percent) and forests (26 percent) make up two-thirds of the initial degraded area of nature, they contribute roughly the same shares to reaching the targets. Freshwater (18 percent), wetlands (11 percent) and steppe, heath and scrubs (6 percent) make up the rest.

**Figure 4: Contribution of each ecosystem to the total area restored for three scenarios; 2030, 2040 and 2050**




Source: Bruegel, see the annex for a full description of calculations and data used.

If countries minimise costs, they will restore more agro-ecosystems and fewer forests early on because there are more agro-ecosystem restoration projects available with relatively low cost for restoration and maintenance per hectare, including larger areas of grassland. The relative lack of low-cost forest restoration projects is because restoring a forest is relatively complex, involving much more than planting some trees (Holl and Brancalion, 2020). These differences notwithstanding, all ecosystems still contribute fairly evenly to target attainment in this pathway. This is because the spread of costs *within* each ecosystem is larger than the spread *between* ecosystems, as explained in Section 2.2. In other words, while there are differences in costs between an average wetland and an

[12] Note that we only show results on the *ecosystem-group* level. The underlying data are more specific, for example on the type of habitat ('Sarmatic steppe pine forest') in an ecosystem ('temperate forest') and its location, which matter to its characteristics in terms of costs and $CO_2$-sequestration.

average steppe restoration project, these are generally smaller than the differences between two randomly chosen wetland restoration projects.

With the cost minimisation pathway, the relative contributions of each ecosystem changes from 2030 onwards. Forests, for example, contribute *less* than their proportionate share in 2030 (20 percent), but *more* in 2040 (32 percent) and 2050 (29 percent). While there may be relatively few low-cost projects for forest ecosystems in our data, there are more forest projects with average costs than with very high costs. In other words, the spread of the costs of forest projects is low compared to that of other ecosystems.

If countries maximise carbon sequestration, they will restore mostly forests and freshwater ecosystems early on. Forest (50 percent) and freshwater ecosystems (27 percent)[13] together make up more than three quarters of the total area restored up until 2030. Agro-ecosystems only make up 9 percent of the restored area, despite its large share in the total degraded ecosystem area. Although the relative contribution of each ecosystem varies over time, the overall pattern remains consistent: forests and freshwater ecosystems contribute more than their proportional share, while agro-ecosystems contribute less.

The pathways converge towards 2050. As seen with the costs and $CO_2$ sequestration in Sections 2.2 and 2.3, there are differences between pathways in terms of the relative contributions of ecosystems diminish towards the end of the period. Again, this reflects the smaller pool of available projects towards the end of the period, resulting from the 90 percent restoration target for 2050.

**3 National conditions impacting NRL implementation: the case of land ownership**

Countries not only have varying policy preferences in implementing the NRL, but also face different national constraints. These include, amongst others, the availability of ecosystems for restoration and fiscal and regulatory constraints on the repurposing of land. In this section, we will look in detail at one such constraint that may be considered among the most important: the ownership of land on which nature restoration must take place.

The widely differing land ownership patterns across Europe create different challenges for governments. For example, land that is in public ownership implies direct governmental control over its use, which may facilitate its (re)purposing for nature restoration, as that could be more cumbersome in the case of privately owned land. On the other hand, land that is in private ownership may be easier to target with policy instruments aimed at generating private investment in nature restoration. Private investment can alleviate budget constraints in meeting the NRL targets. Policy instruments aimed at generating private investment could include norms, pricing and subsidies. The extent to which each policy may be deemed appropriate by governments not only depends on the distinction between publicly and privately owned land. It will also depend on the *type* of government and private owner of

[13] This is mostly the result of alluvial forests.

the land. Subnational governments may face different incentives from national ones. Likewise, smallholders may require very different incentives from large landowning corporation to invest in nature restoration.

Looking at the available data on European landownership, we find that European nature is mostly in the hands of private owners with relatively large estates. In all of Europe, most Natura 2000 sites are privately owned[14]. A majority of private landowners hold larger estates, with 75 percent owning more than 51 hectares and 50 percent owning more than 251 hectares (Land is Forever 2019, Land is Forever 2021). Most European forests (60 percent) are under private ownership[15]. When looking at private landownership of nature, we find that both individuals and companies play a significant role, with large variations between member states. Below we look at the available data on landownership patterns in individual member states. To do so, we combine data from various sources that collectively covers roughly 40 percent of all EU land area. This includes the ecosystems covered by Annex I of the Nature Restoration Law, but also other land that those sources define as nature or forest.

### 3.1 Ownership of nature in EU member states

Data on the ownership of European land is not collected centrally, and publicly available data is patchy and not harmonised between member states. Below we will discuss the data we were able to acquire from different member states.

#### 3.1.1 Germany

Roughly two thirds of German land is in private hands[16]. The largest groups of private owners are farmers and foresters (34 percent of total land ownership) and private individuals (22 percent)[17]. A little less than a third of all land belongs to the federal government, states and municipalities and the rest is shared by churches, housing companies, banks and other companies. About 30 percent of Germany is forest, half of which is owned by around two million private individuals[18]. The five largest owners are aristocrats. A third of the German forest is owned by the state. Furthermore, almost half of Germany is agricultural land, which is mostly privately owned.

---

[14] See https://www.natura2000branding.eu/about-natura-2000/, Kamphorst *et al* (2017), ELO (2019).

[15] Around 60 percent of the EU's forests are in private ownership, with about 16 million private forest owners. Around 40 percent of the forest area in the EU is publicly owned. Across the EU there are major variations in ownership of forests (European Commission, 2022).

[16] The best available data covers 65 percent of the area.

[17] The last comprehensive scientific study was published in 1974, but according to experts, the situation has not fundamentally changed. Hardly more than a tenth of a percent of land changes ownership every year. It is not uncommon for forests, fields and meadows to have been in the hands of a family for generations.

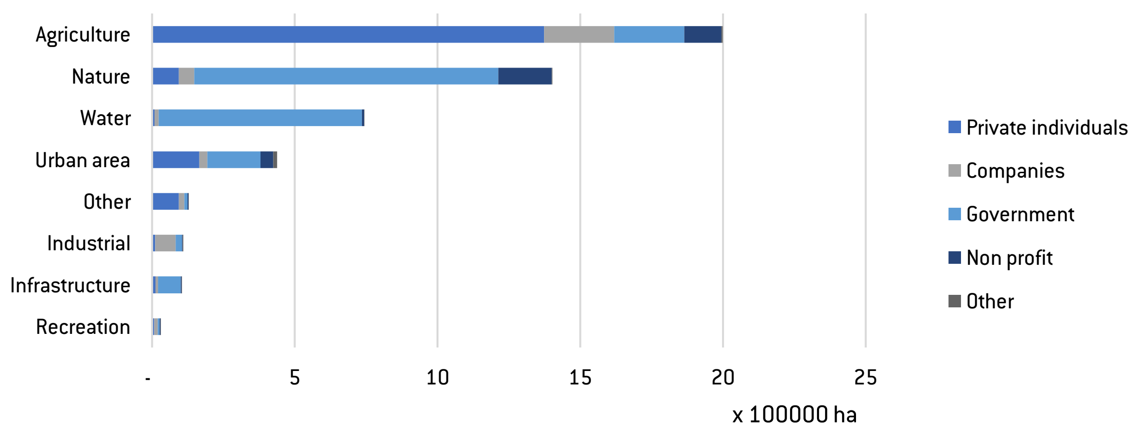
[18] Federal Statistical Office Germany, via Mark Fehr, 'Wem gehört Deutschland?', *Frankfurter Allgemeine*, 19 October 2020, https://www.faz.net/aktuell/wirtschaft/schneller-schlau/grund-und-boden-unternehmen-wald-wem-gehoert-deutschland-17005863.html.

### 3.1.2 The Netherlands

In the Netherlands, nature is mostly owned by large public landowners. When including the North Sea, almost one third of the total area of the Netherlands is nature[19]. The share of public ownership is high in the Netherlands compared to other European countries. The 100 largest owners in the Netherlands collectively own 85 percent of all nature, with 79 percent in public hands and 6 percent under private ownership. Almost all water is owned by the 100 largest owners (93 percent), with 92 percent owned by public entities.

**Figure 5: Land by type and owner in the Netherlands**

Area including the North Sea




Source: Bruegel based on data from Kadaster Nederland.

### 3.1.3 France

In France most of the forests and agricultural land are owned by private individuals. Three quarters of French forests are owned by about 3.5 million individuals[20]. Caisse des Dépôts is the largest owner of French forests, managing 150 thousand hectares. Other large owners are Société Générale (30 thousand ha), Axa (22 thousand ha) and Crédit Agricole (12 thousand ha).

### 3.1.4 Data from other member states

In most other countries for which data is available, the majority of the land is owned by private individuals. In Sweden, private entities own over 75 percent of the total land. Almost 50 percent of Swedish land (18 million ha) is in the hands of households. In Estonia, almost 60 percent of nature is

[19] The following is classified as nature: nature reserve, national park, forests, heath, dune, sand, forests. Nature also includes a share of the North Sea (173,000 ha).
[20] *Le Nouvel Obs*, 'A qui appartient la France?', 1 July 2011, https://www.nouvelobs.com/le-dossier-de-l-obs/20110630.OBS6191/a-qui-appartient-la-france.html.

in the hands of private individuals. In Czechia, private individuals own over 75 percent of the total land area.

### 3.2 The policy implications of land ownership patterns

Private ownership of nature increases the need for the mobilisation of private investment in nature restoration. In section 3.1 we saw that although land ownership patterns vary widely between EU member states, most of nature is privately owned in the majority of member states. To achieve the targets of the NRL, private landowners will either have to allow investments on their land or make such investments themselves[21]. Governments will therefore have to take private landowners into account when drafting their restoration plans and the accompanying policies.

The policy instruments available to governments to incentivise private investment in nature restoration can broadly be categorised into norms, subsidies and pricing instruments. Norms are used to ensure all products or activities of a specific type meet public goals. They include standards (eg, for consumers to only use wood that was sourced in a sustainable manner) and obligations (eg, for owners of large land areas to achieve targets for nature restoration). Subsidies are given by governments to stimulate pre-defined types of investment, for example through tax credits, loans or direct grants to restoration project developers. Pricing instruments are used to price externalities, such as environmental damages or benefits, into economic activities. They include levies, taxes and market-based solutions. Market-based solutions include a regulatory component that restricts or prohibits certain outcomes, and a reward component allowing relevant entities to trade. See Figure 6 for an overview.

We can find examples of norms, subsidies and pricing policies for stimulating nature restoration around the globe, but they generally lack scale. A biodiversity cap-and-trade scheme was introduced in the UK in 2024. The scheme, called 'Biodiversity Net Gain', aims to restrict additional biodiversity loss from economic activity. It allows offsetting, ie the ability to purchase an additional biodiversity improvement or creation from other suppliers to compensate for biodiversity loss that follows from new project development activities[22]. A similar instrument exists in the UK to counter water pollution. Any developments that increase pollution loads to the water must produce or otherwise purchase an equivalent reduction of pollution loads[23]. At the EU level there are examples of subsidies for nature restoration, such as the financing of nature-based solutions through targeted green payments under the Common Agricultural Policy and agri-environment-climate measures (AECMs)[24].

[21] If the control of the land lies in different hands, for example, because it is leased out, this should also be considered.
[22] See https://www.local.gov.uk/pas/about/pas-archive/biodiversity-net-gain-local-authorities.
[23] Nutrient Neutrality.
[24] With the AECMs as part of the Common Agricultural Policy, land-users were compensated for potential income losses generated from the protection or enhancement of biodiversity, soil, water, landscape, etc.

**Figure 6: Norms, subsidies and pricing instruments for nature restoration**

| | Types | Main design choices | Advantages | Disadvantages |
|---|---|---|---|---|
| Norms | Consumer standards, producer standards, obligations | Targeted parties, level of ambition, penalties for non-adherence | Clarity, simplicity, fairness, control over achievement policy goals | Appropriateness over time, inflexible, can stifle innovation |
| Subsidies | Loans, grants, guarantees, fiscal benefits | Subsidised activities or investments, levels of subsidy, eligible parties | Flexibility in including co-benefits, less resistance to implementation | Potential for windfall profits, budgetary costs, central planning, outcomes depend on behavioural assumptions |
| Pricing | Levies, taxes, cap-and-trade systems | Targeted parties, pricing levels, market-based or taxation | Decentral decision making, allocative efficiency, fairness | Complexity, administrative burden, outcomes depend on behavioural assumptions |

Source: Bruegel.

Member states where most of the degraded nature is privately owned may be more likely to opt for the cost minimisation pathway. If degraded land is mostly privately owned, the government must either incentivise or regulate private landowners to restore it, which can be expensive and politically sensitive. Governments may avoid strict regulations that impose high costs on landowners, fearing resistance or legal challenges, and instead prefer subsidies or tax breaks.

Member states' policy preferences are likely to depend on the prevailing types of private landownership, their budget constraints and considerations of political economy. Pricing instruments and norms can achieve efficient results. As they require administrative capacity both within governments and among targeted groups, such instruments are more suitable for countries in which most of the nature is owned by large, private landowners. Smallholders are less likely to be responsive to pricing instruments, and the administrative burden of both norms and pricing instruments is likely to be imposing for them. Subsidies may therefore be a more suitable instrument to reach smallholders. However, political economy considerations are also likely to play a part. Targeting large landowners with pricing instruments or norms can be met with pushback, especially if the targeted groups are well-concentrated and hold political sway or if they lack the means. As these conditions differ between countries, we are likely to see a large variety in supporting policies to ensure the targets of the NRL are met across the EU.

## 4 Conclusions

The Nature Restoration Law (NRL) is an important step in environmental policy, offering a framework to address biodiversity loss, climate change and food security. Our analysis of three distinct implementation pathways highlights trade-offs and opportunities available to member states as they navigate their restoration commitments:

1. Even spread across ecosystems: This pathway ensures balanced restoration efforts, with restoration targets distributed proportionally across all ecosystems within each member state. It incurs cumulative costs of €86.9 billion across the EU from 2025-2030 and delivers moderate climate benefits. This approach may appeal to countries aiming for ecological balance but does not optimise financial or climate outcomes, or any other specific co-benefits.

2. Cost minimisation: This pathway focusing on low-cost restoration projects results in financial savings in the first period. If implemented by all EU member states, this approach reduces costs over the period 2025-2030 by 81 percent, down to €16.5 billion. The focus on cost-efficient projects implies a lower intensity of restoration, even if the area covered is the same as in the other pathways. This pathway results in a large variation in restoration costs across projects and ecosystems. Agro-ecosystems often present the most cost-efficient opportunities so the bulk of restoration would happen in grasslands rather than forests or wetlands early on in this pathway, reducing the co-benefits for biodiversity in those habitats.

3. Carbon sequestration maximisation: Priority to high-carbon habitats results in a 54 percent increase in cumulative climate benefits by 2030 and 32 percent by 2040 compared to an even-spread approach. Forests and freshwater ecosystems dominate early restoration in this pathway, contributing over 76 percent to the total area restored by 2030. However, with a total cost of €117 billion, this strategy comes with a 35 percent increase in restoration costs during the same period. It demonstrates the potential of restoration to advance EU climate goals but underscores the trade-off between carbon outcomes and financial efficiency.

These results show that member states have plenty of leeway to select a suitable implementation pathway. Such strategising is necessary to make sure implementation pathways match national conditions and policy preferences. The pathways above represent only three of the many options available to member states, and in practice policy preferences are likely to be multifaceted. To highlight this, our study shows the feasibility of a pathway that yields both lower costs *and* higher climate benefits compared to an even spread across ecosystems. While our study does not consider other co-benefits, such as climate adaptation, increasing biodiversity, food security or clean water in its calculations, we fully recognise that these are no less important and also depend on nature restoration. Countries would do well to adopt a holistic approach to pathway selection, considering the full spectrum of ecological and societal gains alongside climate change mitigation.

Our study underscores the role of national conditions, such as land ownership patterns, in shaping feasible and effective pathways. In most EU countries, the majority of land requiring restoration is privately owned. For example, 60 percent of forests in Europe are under private ownership, which includes individual landowners, NGOs and corporations. In countries such as Spain and Germany, where private entities own substantial shares of agricultural and forest lands, policies should incentivise private investment, including norms, subsidies or pricing mechanisms. Conversely, the countries with substantial public landholdings may find it easier to implement direct restoration projects. These structural differences will influence not only the cost and pace of restoration but also the design of policies and governance mechanisms to ensure compliance with NRL targets.

Enhanced data and monitoring are critical to refining restoration strategies and addressing the limitations of current methodologies. For example, while our study demonstrates significant variations in project costs and carbon outcomes, gaps in granular data on ecosystem conditions and restoration potential hinder more precise modelling. Future research and policy efforts should prioritise closing these data gaps to support evidence-based decision-making.

These findings offer several actionable insights for policymakers:

1. Early strategic decisions matter: The approaches yield vastly different outcomes in the early years but converge later on. Member states should prioritise early investments in pathways that align with their goals, whether focused on cost-efficiency, climate mitigation, or broader ecological benefits.
2. Incentivising private investments: As land is owned mostly by large, private landowners, policies to involve their efforts in restoration are essential to target attainment under the NRL.
3. Tailored policy instruments: Given the diversity in landownership and national contexts, policymakers must carefully design and implement policy tools that align with the structural realities of their countries. This includes balancing norms, subsidies and pricing instruments to incentivise restoration effectively.
4. Holistic benefit planning: Policymakers must take into account broader societal and ecological benefits of restoration. These include, but go well beyond, financial consideration and carbon sequestration.
5. Improved data and monitoring: Enhancing the availability and granularity of ecological and economic data will be critical for refining restoration strategies and ensuring accountability over time.

The success of the NRL will depend on the collective efforts of the EU and its member states to navigate the challenges and opportunities of restoring Europe's natural heritage. By adopting adaptive, evidence-based strategies, Europe has the potential to set a global benchmark for effective and sustainable nature restoration. By exploring the trade-offs and synergies among different restoration pathways, this study provides a foundation for informed decision-making that can maximise the law's impact. As member states move toward implementation, a careful consideration of these trade-offs and synergies, along with each country's specific conditions, will be key to achieving the transformative goals of the NRL.

**References**


Darvas, Z. and K. Sekut (2025) 'Greening the EU budget: why climate mainstreaming needs reform' *Analysis*, 26 February, Bruegel, available at https://www.bruegel.org/analysis/greening-eu-budget-why-climate-mainstreaming-needs-reform

Dasgupta, P. (2021) 'The Economics of Biodiversity: The Dasgupta Review', HM Treasury, available at Final Report - The Economics of Biodiversity: The Dasgupta Review - GOV.UK

European Commission (2022) 'Impact assessment accompanying the proposal for a regulation of the European Parliament and of the Council of on nature restoration', SWD/2022/167 final, available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022SC0167&qid=1686750707844

ECB (2024) *Economic and financial impacts of nature degradation and biodiversity loss*, European Central Bank, available at https://www.ecb.europa.eu/press/economic-bulletin/articles/2024/html/ecb.ebart202406_02~ae87ac450e.en.html

EEA (2020) *State of Nature in the EU: Results from Reporting under the Nature Directives 2013-2018*, European Environment Agency, available at https://www.eea.europa.eu/en/analysis/publications/state-of-nature-in-the-eu-2020

EIB (2023) *Investing in nature-based solutions*, European Investment Bank, available at https://www.eib.org/attachments/lucalli/20230095_investing_in_nature_based_solutions_en.pdf

Gouch, C.M., J.W. Atkins, R.T. Fahey and B.S. Hardiman (2019) 'High rates of primary production in structurally complex forests' *Ecology*, 100(10)

Land is For Ever (2019) *Private land conservation*, available at https://landisforever.eu/wp-content/uploads/2021/03/Laymans-Report-V2.pdf

Land is For Ever (2021) *Recommendations to promote private land conservation to support the EU agenda*, available at https://landisforever.eu/wp-content/uploads/2022/04/Recommendations-to-promote-private-land-conservation-to-support-the-EU-conservation-agenda.pdf

EPA (2023) *Report on the social cost of greenhouse gases: Estimates incorporating recent scientific advances*, United States Environmental Protection Agency, available at https://www.epa.gov/environmental-economics/scghg

Erb, K. H., T. Kastner, C. Plutzar, A.L.S. Bais, N. Carvalhais, T. Fetzel, … and S. Luyssaert (2018) 'Unexpectedly large impact of forest management and grazing on global vegetation biomass', *Nature*, 553(7686), 73-76

Evison, W, L. Ping Low and D. O'Brien (2023) *Managing nature risks: From understanding to action*, PwC, available at https://www.pwc.com/gx/en/strategy-and-business/content/sbpwc-2023-04-19-Managing-nature-risks-v2.pdf?trk=public_post_comment-text

Gough, C.M., J.W. Atkins, R.T. Fahey, B.S. Hardiman (2019) 'High rates of primary production in structurally complex forests', *Ecology*, 100(10), available at https://doi.org/10.1002/ecy.2864

He, T., W. Ding, X. Cheng, Y. Cai, Y. Zhang, H. Xia, ... & Q. Zhang (2024) 'Meta-analysis shows the impacts of ecological restoration on greenhouse gas emissions', *Nature Communications*, *15*(1), 2668.

Holl, K. D. and P.H.S Brancalion (2020) 'Tree planting is not a simple solution', *Science*, *368*(6491), 580-581, https://doi.org/10.1126/science.aba8232

Jones, H. P. and O.J. Schmitz (2009) 'Rapid recovery of damaged ecosystems', *PloS one*, 4(5), available at https://doi.org/10.1371/journal.pone.0005653

Kamphorst, D. A., I.M. Bouwma and T.A. Selnes (2017) 'Societal engagement in Natura 2000 sites. A comparative analysis of the policies in three areas in England, Denmark and Germany', *Land Use Policy*, 61, 379-388, available at https://doi.org/10.1016/j.landusepol.2016.11.019

Kurth, T., G. Wübbels, A. Portafaix, A. Meyer zum Felde and S. Zielcke (2021) *The Biodiversity Crisis Is a Business Crisis*, Boston Consulting Group, available at https://www.bcg.com/publications/2021/biodiversity-loss-business-implications-responses

Meli, P., K.D. Holl, J.M. Rey Benayas, H.P. Jones, P.C. Jones, D. Montoya and D. Moreno Mateos (2017) 'A global review of past land use, climate, and active vs. passive restoration effects on forest recovery', *Plos one*, *12*(2), available at https://doi.org/10.1371/journal.pone.0171368

Tucker G., E. Underwood. A. Farmer, R. Scalera, I. Dickie, A.J. McConville and W. van Vliet (2013) *Estimation of the financing needs to implement target 2 of the EU biodiversity strategy*, Institute for European Environmental Policy, available at https://ieep.eu/publications/estimation-of-the-financing-needs-to-implement-target-2-of-the-biodiversity-strategy/

Verhoeven D., E. Berkhout, A Sewell and S. van der Esch (2024) 'The global cost of international commitments on land restoration', *Land Degradation & Development*, 35(16), 4864-4874, https://doi.org/10.1002/ldr.5263

**Annex**

In this study we use publicly available data to calculate how different policy options for nature restoration in the EU affect ecosystem restoration costs and carbon sequestration. We combine data on the state of ecosystems in member states with data on their potential carbon sequestration and data on restoration costs that vary by ecosystem and member state. This allows us to estimate what different policy scenarios for nature restoration will look like in terms of costs and carbon sequestration over time. Throughout this study, we use a social discount rate of 4 percent and calculate benefits and costs over the period 2025-2070, unless otherwise noted.

The data on the state of habitats contains data as reported by member states for the period 2013-2018 on the area and condition of habitats at the national biogeographical level. The structure of the ecosystem data is as follows:

a) Group level: A broad ecological or environmental category, such as forests.
b) Subgroup level: A narrower classification within the group, such as temperate forests.
c) Habitat type: A detailed and specific ecological descriptor, such as Sarmatic steppe pine forest.
d) Biogeographical region: The geographic and ecological context of a habitat, such as the boreal region.

The habitat area data included in this analysis is based on Directive Annex I terrestrial habitats and is in line with the Annex I habitats of the Nature Restoration Law. These habitats represent 24 percent of the EU land territory. Of that, almost 450 thousand $km^2$ (44 percent) is considered to be in need of restoration, with one third classified as Natura 2000.

The data contains estimates for the area that is in a good state, a not-good state and in unknown state at the national biogeographical level (level d, see above). For each, it contains a minimum estimate, a maximum estimate and an average. In our study we use the average estimate. We attribute the area of which the state is unknown by looking at the share of the area that is not in a good state compared to the area for which the state is known (1). If information on the $ShareNotGood$ is missing, we use the share at the national biogeographical level (level c) if that is available. If not, we use the national subgroup level (level b), then with the EU-average that habitat and finally with the EU-average of the subgroup. The calculation of the restoration area based on the available data can be expressed by formulas 1 and 2:

$$(1)\ ShareNotGood = \frac{AreaNotGood}{AreaNotGood + AreaGood}$$

$$(2)\ Restoration\ area = AreaNotGood + AreaUnknown * ShareNotGood$$

The restoration area is split into Natura 2000 area and not Natura 2000 area. We know the share of the total area at the national biogeographical level (level b) within Natura 2000. We assume that this share is the same for the area to be restored (4). To be able to combine the restoration data with the carbon data, we sum the restoration area at the member-state-group level (level c).

$$(3)\ Restoration\ area\ (N2000) = Restoration\ area * ShareN2000$$
$$(4)\ Restoration\ area\ (other) = Restoration\ area * (1 - ShareN2000)$$

In our study, we look at the additional carbon sequestration resulting from ecosystem restoration. We assume that ecosystems sequester additional carbon as they are restored, up until the potential carbon stock of that ecosystem[25]. We combine the carbon data with the restoration area data on habitat-type level (c). The carbon data consists of data on the annual sequestration rate, data on the carbon stock and the time to restore degraded ecosystems. The recovery time reflects the number of years it takes to restore an ecosystem from a degraded state. We use estimates of the recovery time on group level, taken from Jones and Schmitz (2009). In our analysis we assume a linear recovery trend. This is appropriate for restoration goals focusing on ecosystem services such as carbon sequestration (Meli *et al*, 2017).

We have information on the carbon sequestration rate of habitats in a good state and in a degraded state. The carbon sequestration rate is expressed in annual sequestered tons of $CO_2$ per hectare (ton $CO_2$/ha/y). This is known on a habitat type level (c) and taken from the impact assessment of the NRL (European Commission 2022). The sequestration rate of habitats in a degraded state is based on the improvement in the sequestration rate if an ecosystem is restored (see formula 5), known on group level (a) and taken from He *et al* (2024). Combining the difference between the sequestration rate in a good state and in a degraded state and the recovery period, we are able to calculate the annual growth of the sequestration rate during restoration. $h$ indicates the habitat, $E$ indicates the ecosystem group and $I$ is the improvement in percentages.

$$(5)\ Rate_{degraded,h} = \frac{Rate_{good,h}}{(1+I_{rate,E})}$$
$$(6)\ Rate_{improvement,h} = \frac{Rate_{good,h} - Rate_{degraded,h}}{Recovery\ period_E}$$

Our data contains information on the potential carbon stock of habitats in a good state and in a degraded state. The carbon stock is expressed in tons of $CO_2$ per hectare (ton $CO_2$/ha). The data on carbon stocks in a good state is available on habitat type level (c),[26] taken from the impact assessment of the NRL from the European Commission (European Commission 2022). The carbon stock of habitats in a degraded state is based on the improvement if an ecosystem is restored (see 7). This data is known on group level (a),[27] taken from Erb *et al* (2018). $h$ indicates the habitat, $E$ indicates the ecosystem group and $I$ is the improvement in percentages.

[25] In our study we cap the sum of the additional carbon sequestration once restoration has started at the difference between the carbon stock in a degraded state and the carbon stock of an ecosystem in a good state.
[26] The data has minimum and maximum estimates; we use the average.
[27] The data has minimum and maximum estimates; we use the average.

(7) $Stock_{degraded,h} = \frac{Stock_{good,h}}{(1+I_{stock,E})}$

The total costs of habitat restoration consists of one-off investment costs and annual maintenance costs. We create a dataset of investment costs and maintenance costs per hectare for different ecosystems. The majority of estimates is taken from Tucker *et al* (2013). In doing so, we follow the impact assessment of the NRL (European Commission, 2022). For each ecosystem group (level a), Tucker provides a best estimate and for most also a range of other estimates, both for investment and maintenance costs. We supplement this dataset with data from the impact assessment of the NRL (European Commission, 2022). All estimates are expressed in 2023 euro to correct for inflation[28]. Finally, for each ecosystem, we normalise all estimates such that the mean equals the *best estimate* as provided by Tucker. This is done in order to reduce bias, as different cost estimates come from diverse methodologies and have different assumptions.

Each restoration area (the combination of member state, habitat type and Natura 2000 classification) is split into multiple constructed restoration projects. We use the distribution of the range of historic project sizes found for each ecosystem (EIB, 2023) to randomly assign each restoration area to multiple smaller constructed restoration projects. This creates different restoration projects across the EU. Doing this allows us to combine each restoration project with cost estimates from our dataset. This is done to allow for cost differences between projects, even if the projects are in the same member state, have the same habitat type and the same Natura 2000 classification. To each restoration project, we randomly assign an estimate from the range of cost estimates from the same ecosystem type. We do this separately for the one-off investment costs and annual maintenance costs to create a range of different cost combinations.

We account for cost differences between countries. We use an empirical estimate from literature on how economic differences between countries relate to the costs of nature restoration. Verhoeven *et al* (2024) find that GDP is appropriate to account for country-to-country variation in restoration costs. Specifically, for countries with higher GDP the costs of restoration are higher, resulting from higher costs for labour and materials. Their results indicate that a 1 percent increase in GDP *per capita* (PPP) is associated with an approximate 0.264 percent increase in costs. We adjust both the one-off investment estimates and the maintenance estimates accordingly for each restoration project, see formula 8. We assume the EU as the baseline, $\beta$ takes the value of 0.264 and $GDP_c$ is the GDP *per capita* in purchasing power standards for a country (data from Eurostat). $h$ indicates the habitat and $p$ indicates the project.

(8) $Country\ estimate_{h,p} = Estimate_{h,p} * \left(\frac{GDP_c}{GDP_{EU}}\right)^{\beta}$

[28] For the year, we use the year of the source. For the adjustment factor, we use historical inflation rates in consumer prices (annual percent) from the World Development Indicators from the World Bank.

bruegel

Bruegel, Rue de la Charité 33, B-1210 Brussels
(+32) 2 227 4210
info@bruegel.org
**www.bruegel.org**