

HANDBOOK

GROUND:BREAKING

Unsealing to improve
Soil, Climate and Biodiversity



CIPRA
LIVING IN
THE ALPS

IMPRINT

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**MINISTÈRES
AMÉNAGEMENT
DU TERRITOIRE
TRANSITION
ÉCOLOGIQUE**

*Liberté
Égalité
Fraternité*

The International Commission for the Protection of the Alps, CIPRA, is a non-governmental umbrella organisation with national representations in seven Alpine countries, bringing together more than one hundred associations and organisations.

It promotes sustainable development in the Alps, in particular the preservation of cultural and natural heritage, as well as regional diversity, and proposes transnational solutions to the problems encountered in the Alpine region.

TABLE OF CONTENT

1 - Introduction 5

2 - Terms and framework conditions 7

 Soil sealing and its negative effects 8

 Soil-based ecosystem services 9

 Positive effects of desealing on soil quality, biodiversity and climate 10

 Desealing and its challenges 11

 Relevance for Alpine Territories 12

3 - International and EU strategies on soil, climate and biodiversity 13

4 - Desealing in the Alpine Countries 17

 Info box: Concrete desealing-measures 18

 Austria 19

 France 21

 Germany 23

 Italy 25

 Slovenia 27

 Switzerland 30

 Awards winners 31

5 - Political Recommendations 33



GROUND:BREAKING - IMPROVING SOIL, CLIMATE AND BIODIVERSITY THROUGH DESEALING IN URBAN AND PERI-URBAN AREAS OF THE ALPS.

Desealing can restore the natural functions of the soil in the long term. These are a prerequisite for adapting to the climate crisis and for safeguarding the water balance and food production. However, desealing projects often conflict with other land use interests, especially in urban areas. Since soil consumption goes on, desealing practices are necessary in any case to achieve a net-zero. This is where Ground:breaking comes in: It addresses the issue of desealing and the improvement of site-typical soil functions and biodiversity on several levels and shows how desealing succeeds and what it serves us for.



Objectives

- Strengthening the topic of desealing and soil upgrading at the political level.
- To make visible how desealing and/or upgrading of soils can be implemented in concrete terms.



Dialogue - and target groups

- Working groups of the Alpine Convention and the Macro-regional Strategy for the Alps of the EU (EUSALP)
- Experts in the administration
- Municipalities
- Planners
- Political decision makers
- Businesses
- Civil society organizations



Activities

- Accompanying and advising four model municipalities in Slovenia, Italy, Germany and Austria in the preparation and implementation of planned desealing measures.
- Transnational webinar series explaining existing international strategies and their relation to soil (e.g. EU Biodiversity Strategy 2030 and EU Soil Monitoring Law, EU Nature Restoration Law, Kunming-Montreal Biodiversity Framework).
- National webinars in the respective national language that focus on the prevailing soil policies, compare them with the objectives of the international strategies and identify possible courses of action.
- Communication measures and educational work on the topic. A central element is the Ground:breaker Award, an Alpine-wide desealing and soil improvement competition.

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INTRODUCTION

In the discussions around sustainable development and biodiversity conservation, the concept of **soil desealing** often remains in the background. It's a **vital part for restoring natural ecosystems**, yet complex and costly, which might explain its limited presence.

The “**Ground:breaking**” project seeks to change this perception by highlighting how soil desealing can significantly boost ecological resilience and sustainability.

1

GROUND:BREAKING

Unsealing to improve
Soil, Climate and Biodiversity



GROUND:BREAK

The project, titled “**Ground:breaking – Improvement of Soil, Climate, and Biodiversity through Soil Desealing in Urban and Peri-urban Areas of the Alps**”, is focused on reducing the ecological impact of sealed areas and on restoring the natural functions of soil. These functions are a key for adapting to climate changes, managing water supplies, and sustaining food production. Although soil desealing can sometimes clash with other land use interests, especially in cities, it is essential for reducing land consumption in an effective way.

“Ground:breaking” sets out to:

- Promote the importance of soil health and desealing at the political level, the administrative level and for the general public.
- Show clear, practical ways to improve and deseal soils.

Stakeholders and Target Groups:

- Alpine Convention working groups and EUSALP Action Groups.
- Administrations on all levels (local, regional, national, international).
- Local governments.
- Spatial planners.
- Policymakers.
- Business sector .
- Civil society.

Activities:

- Supporting four municipalities in Slovenia, Italy, Germany, and Austria in planning and carrying out soil desealing or soil enhancement activities.
- Hosting an international webinar series that educates, informs, and showcases different approaches to the desealing and improvement of soil.
- Running webinars and/or workshops in each participating country that focus on soil literacy and soil health and on how to align with broader soil protection strategies.
- Launching an Alpine wide desealing competition to find the most dedicated “Ground:breakers” and to promote the issue of desealing via good practice examples.

This handbook gives a detailed overview of international and EU strategies and their stance towards desealing, it showcases best practices and presents active implementation efforts across Alpine countries. It delves into the extensive impact of soil desealing on biodiversity and climate, highlighting the need for soil care after desealing activities. The information within provides essential insights and practical knowledge for planning and executing soil desealing projects. Designed for use by policymakers, spatial planners, and community leaders, the handbook offers the necessary resources and expertise to support effective soil restoration initiatives. By adopting the strategies and examples provided, significant strides can be made towards sustainable development, enhancing biodiversity, and improving ecological resilience.

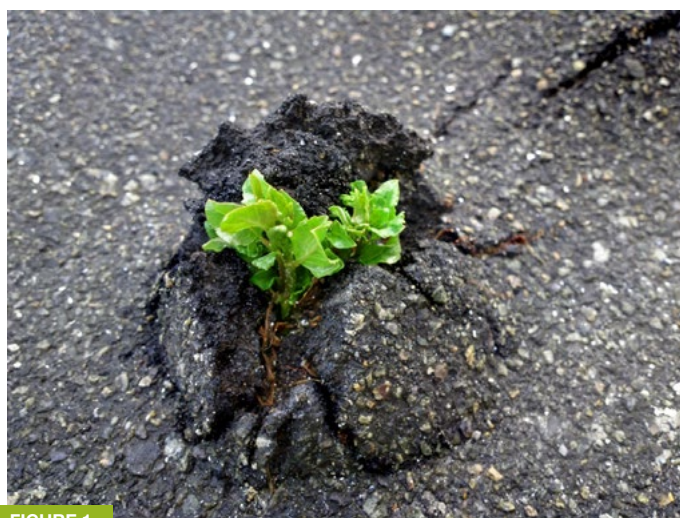


FIGURE 1

Ground:breaking

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TERMS AND FRAMEWORK CONDITIONS

Soil provides essential ecosystem services like producing biomass, storing water, and controlling floods. However, covering the soil with impermeable materials due to urban expansion severely disrupts these services, causing environmental and ecological problems. This chapter discusses how important soil is for maintaining biodiversity and human well-being, the negative impacts of soil sealing, and the advantages of reversing this process.

It highlights the importance of managing soil sustainably, particularly in sensitive areas such as the Alpine Space, to maintain ecosystem resilience and conserve natural resources for the future. This section also emphasizes the importance of restoring the natural functions of soil, setting the stage for better understanding the need to reverse soil sealing and improve ecosystem services.

2

GROUND:BREAKING

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GROUND:BREAKING

SOIL SEALING AND ITS NEGATIVE EFFECTS

Soil sealing occurs when materials like asphalt or concrete cover the earth's surface, typically due to urban development and infrastructure projects. This covering of soil has several widespread effects beyond just losing fertile land. One immediate impact is that it disrupts the natural water cycle. Impermeable surfaces block rainwater from soaking into the ground, increasing runoff which can lead to more flooding and reduce the replenishment of groundwater. This can worsen water scarcity, especially in areas already facing drought.

Soil sealing also harms soil quality. It interrupts natural processes essential for soil health, such as nutrient cycling and microbial activity, decreasing soil fertility and making the land less suitable for uses that depend on high-quality soil. It destroys habitats for plants and animals and thus reduces biodiversity. Additionally, sealed surfaces contribute to the heat island effect, where urbanized areas become much warmer relative to their surroundings, intensifying the effects of climate change.

Understanding the negative impacts of soil sealing is crucial for policymakers, urban planners, and local government officials to make knowledgeable decisions about land use and urban development.

The harmful effects of soil sealing include:

- 1. Loss of fertile land:** Sealing soil results in losing land that could be used for agriculture or preserved as natural habitats.
- 2. Increased risk of flooding:** Soil compaction reduces the soil's ability to absorb rainwater, leading to more runoff and higher flood risks in urban areas.
- 3. Changes to natural landscapes:** Sealing alters natural landscapes, disrupting local ecosystems and biodiversity.
- 4. Pollution and health risks:** Maintenance activities and the materials used in sealed areas can pollute soil and water, posing environmental and health risks.
- 5. Effects on microclimate:** Sealed surfaces absorb and retain heat, contributing to the heat island effect and exacerbating heatwaves in cities.
- 6. Reduced groundwater recharge:** Decreased water infiltration due to sealing leads to lower groundwater levels, affecting water availability for communities and ecosystems.

By fully understanding these impacts, officials and planners can take targeted actions to mitigate the negative effects of soil sealing, such as implementing green infrastructure, promoting sustainable urban planning, increasing green spaces, and adopting policies that balance development with environmental conservation. These measures address immediate soil sealing issues and support broader sustainability and resilience goals.



Soil sealing can have significant impacts, such as higher flood risk

©Lisa S./Shutterstock.com

FIGURE 2

SOIL-BASED ECOSYSTEM SERVICES

- Soil ecosystems are crucial for both nature and human activities. They are especially important for producing forest biomass, which includes wood, timber, biofuel, and edible forest products. The amount of these products depends on the soil's water and nutrients, influenced by soil type, weather, and how forests are managed. However, this production faces threats from harmful forestry methods, wildfires, and climate change, which can damage soil health and increase the risk of erosion.
- Soils provide essential services such as water retention, where they hold, store, and slowly release water for plants, evaporation, and groundwater recharge. Yet, these abilities can be weakened by unsustainable farming and forestry, as well as by soil sealing, which blocks water absorption.
- Soils also regulate surface runoff, acting as natural buffers that lessen flood risks by moderating and delaying peak water flows during

rainfalls, which helps to prevent floods and reduce soil erosion.

- Soils are valuable for preserving cultural and natural heritage, acting as archives that can reveal past environmental conditions and land-use patterns through their unique properties.
- In urban areas, desealing soils—removing impervious surfaces—plays a vital role in restoring biodiversity. It revives natural soil functions, supports the growth of small plants, and provides habitats for various insects, which are crucial for soil health and local ecosystems.
- Additionally, soils enhance human well-being by supporting recreational activities, especially in varied terrains like mountains, influencing their suitability for outdoor activities, thereby promoting health and well-being.
- Overall, soil is a vital resource that offers numerous ecosystem services, including water filtration, nutrient cycling, carbon storage, and providing habitats for diverse organisms, all of which are essential for life and human well-being.

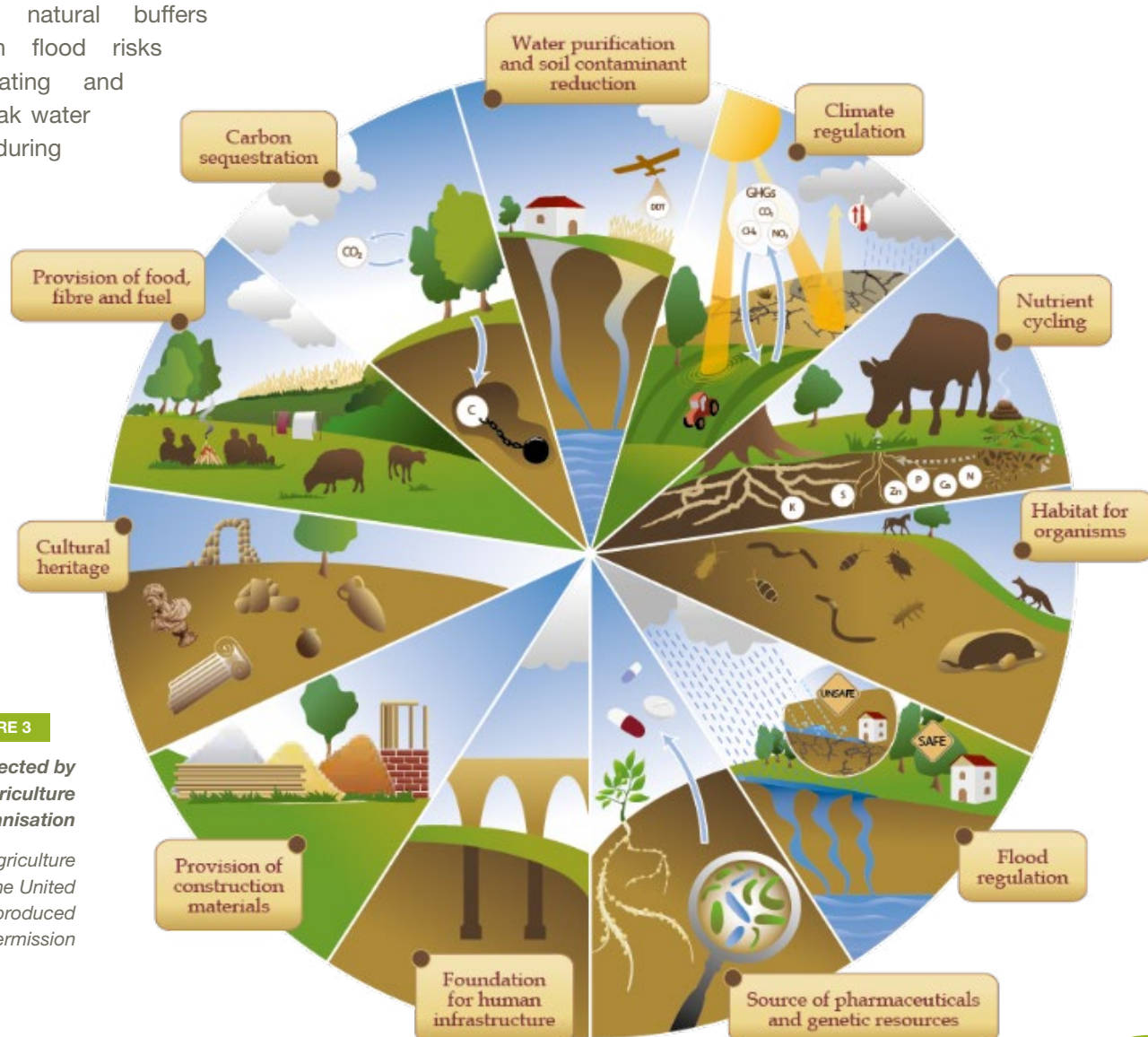


FIGURE 3

Soil Functions selected by the Food and Agriculture Organisation

© Food and Agriculture Organization of the United Nations (2015). Reproduced with permission

POSITIVE EFFECTS OF DESEALING ON SOIL QUALITY, BIODIVERSITY AND CLIMATE

Desealing surfaces involves completely removing any impermeable barriers, foreign materials, and compactions, followed by rebuilding with soils typical of the site to restore natural soil functions as much as possible, or to create a layer of soil that can support roots. This aims to align with the natural soil properties of the area, facilitating the restoration of essential soil functions.

To counter the adverse effects of soil sealing, a range of desealing strategies has been developed. These include removing impermeable layers to reinstate natural landscapes and incorporating permeable materials into urban design. Immediate benefits of desealing include enhanced soil quality, better water absorption, reduced flood risk, and improved groundwater levels. Such measures also boost microbial activity and nutrient dynamics, enriching soil fertility.

Moreover, desealing has a beneficial impact on biodiversity. By restoring natural environments, it creates vital new habitats that enhance local biodiversity, particularly critical in urban settings where green spaces act as ecological corridors to connect disjointed habitats, crucial for the movement and survival of species.

Desealing also positively affects climate change mitigation. Restored soils can sequester carbon dioxide, helping to reduce atmospheric CO₂ levels. Additionally, decreasing sealed surfaces can alleviate the urban heat island effect, aiding climate adaptation efforts. Over time, these actions enhance local environmental conditions and contribute to global climate change mitigation.

Desealing represents more than just reversing soil sealing; it is a strategic environmental intervention with immediate and enduring benefits for climate adaptation. It promotes land degradation neutrality and helps restore soil functions and ecosystem services. Socially, it improves public space quality, reduces health incidents, and boosts psychological well-being. Economically, it can be cost-effective, especially when backed by appropriate legal and financial support mechanisms.



INFO BOX

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[www.espon.eu/sites/default/files/2024-12/](http://www.espon.eu/sites/default/files/2024-12/no-net-land-take-trajectories_policy-brief.pdf)

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[S2468584417300326](http://www.sciencedirect.com/science/article/pii/S2468584417300326)



DESEALING AND ITS CHALLENGES

Restoring soil to its original, healthy state is a long and complex process due to the intricate nature of soil ecosystems, which comprise minerals, organic matter, and living organisms such as microbes and earthworms. When soil is sealed, its natural structure and functions are significantly disrupted, and recovering these can be a lengthy endeavour for several reasons:

- **Natural Processes:** Soil formation is a slow natural process that can span hundreds to thousands of years. Although human intervention can accelerate this, it remains time-consuming.
- **Soil Compaction:** Sealed or compacted soil has diminished porosity, which impedes water and air penetration. Reversing this is challenging and may require mechanical methods like tilling, potentially harming soil structure further.
- **Loss of Organic Matter:** Sealed soils often deplete in organic content, essential for fertility. Replenishing this matter is a gradual process.
- **Chemical Imbalance:** Degraded soils may suffer from imbalanced pH or nutrient deficiencies, necessitating careful and ongoing correction and monitoring.
- **Erosion:** Newly desealed soils are prone to erosion if not managed properly, demanding preventive strategies such as planting cover crops.
- **Microbial Communities:** A healthy soil hosts diverse microbial ecosystems, and restoring these complex communities is not straightforward.
- **Human Infrastructure:** Often, soil sealing results from urban development, and addressing this requires changes in land use policies alongside soil management.
- **Cost:** Restoring soil involves significant expenses due to the need for specialized equipment, materials, and continuous oversight.

Given the prolonged nature of restoring sealed soils and the broad implications for ecosystem health, it is crucial that soil health improvement efforts occur in conjunction with desealing initiatives. This comprehensive strategy should include:

- **Soil Remediation Techniques:** Utilizing methods like bioremediation or phytoremediation to remove contaminants and enhance soil structure.
- **Sustainable Land Use Planning:** Enforcing zoning regulations that preserve fertile land and promote green infrastructure, such as parks and green roofs.
- **Public Awareness and Education:** Raising awareness among the public and decision-makers about the importance of soil health to foster responsible land use.
- **Research and Monitoring:** Continuous soil health assessments to inform and refine land management policies.
- **Legislation and Policy:** Developing and enforcing policies that limit soil sealing and encourage sustainable practices, establishing a framework for soil conservation.

Additionally, it's important to consider the sensitivity of certain ecosystems, like high Alpine regions where interventions such as ski slope construction can lead to irreversible damage to vegetation and biodiversity, severely impacting erosion and soil health.

In conclusion, the task of restoring sealed soils to their natural state is multifaceted, requiring a concerted effort from various stakeholders, including policymakers, scientists, urban planners, and communities. The challenges are diverse, spanning the slow dynamics of natural soil formation, compaction reversal, and chemical balance restoration. This endeavour not only aims to achieve environmental sustainability but also addresses crucial issues like food security, water quality, and climate resilience, underscoring the necessity for immediate and long-term sustainable actions to fulfil our collective responsibilities towards the environment and future generations.



Ai-generated symbol of soil desealing

ChatGPT (OpenAI), DALL-E image generator, September 2024

FIGURE 4

RELEVANCE FOR ALPINE TERRITORIES

The Alpine Space is a **unique ecological zone** that serves as a critical water reservoir for Europe. It is also a biodiversity hotspot, home to species not found elsewhere. Soil sealing disrupts these vital ecosystem services. For instance, sealed soils can't absorb water, exacerbate flood risks, and affect water quality. They also can't act as carbon sinks, which is crucial for climate change mitigation. Moreover, the Alpine region is a significant tourist destination, and the natural landscape is one of its main attractions. Soil sealing can degrade these landscapes and, by extension, the tourism industry.

Because of the topography of the Alpine region, **space, and therefore soil, is a scarce resource**. Therefore, it is even more important to take care of this resource and manage it sustainably for future generations. Metropolitan areas in the Alpine space are rare, and the region is more **characterized by small and medium-sized cities with a lot of sealed space**. This sealing, often **connected to tourism infrastructure**, presents a contradiction against the "untouched" Alpine pristine landscape idealized in the tourism industry.

In this handbook, the importance of soil desealing in Alpine peri-urban and urban areas is examined, providing a basis for informed policymaking and urban planning.

To commence, it is essential to delineate the concepts of peri-urban and urban areas.

Peri-urban zones are "areas that are in some form of transition from strictly rural to urban. These areas often form the immediate urban-rural interface and may eventually evolve into being fully urban. Peri-urban areas are places where people are key components: they are lived-in environments." (CEMAT 2007)

Urban areas (cities) are "local administrative unit[s] where a majority of the population lives in an urban centre of at least 50 000 inhabitants" (Eurostat n.d.)

Alpine Soil Characteristics and Urban Impact: Alpine soils, characterized by their unique composition and ecological functions, are integral to the environmental stability and biodiversity of Alpine regions. These soils, often formed under cold climate conditions, are highly susceptible to changes in temperature and moisture levels. The fragility of Alpine soils makes them particularly vulnerable to environmental threats such as overgrazing,

acid deposition, urbanization, and climate change. Urban development, with its associated soil sealing, disrupts the natural soil processes, leading to reduced soil fertility, erosion, and loss of biodiversity. Moreover, the compact nature of urban soils hinders water infiltration, exacerbating runoff and flooding, which are critical issues in mountainous regions.

Soil desealing in urban and peri-urban areas of Alpine regions presents an opportunity to reverse some of these impacts. By exposing the soil surface, desealing allows for the reestablishment of natural soil functions, including nutrient cycling, water infiltration, and support for diverse microbial communities. This process can also facilitate the reconnection of fragmented habitats and support the migration and survival of various plant and animal species adapted to Alpine conditions. Thus, soil desealing in Alpine urban areas is not merely an environmental remediation measure but a crucial step towards preserving the unique ecological, social and economic balance of these regions.



INFO BOX

Additional links focused on the Alpine Space:

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Long-Term Action Plan. For the implementation of provisions and declarations on soil protection in the specific context of the Alpine region.

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INTERNATIONAL AND EU STRATEGIES ON SOIL, CLIMATE AND BIODIVERSITY

In this chapter, relevant international and European strategies are examined on how those could be used to support measures regarding desealing soil. These strategies could be a source of guidance and funding for municipalities, NGOs, etc. who aim to start projects in the realm of soil desealing and soil enhancement. Furthermore, these international strategies contribute significantly to the sustainable management of the Alpine region. The collaborative character of these initiatives underscores the transnational character of environmental challenges and the necessity for shared solutions.

3

GROUND:BREAKING

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GROUND:BREAKING

International strategies for fostering desealing in the Alpine region play a crucial role in environmental sustainability and the fight against climate change. These strategies are multifaceted and require multi-level cooperation, incorporating various approaches:

Firstly, **policy integration** plays a central role. Desealing strategies are integrated into broader environmental, urban planning, and development policies. This includes embedding desealing objectives within climate change mitigation and adaptation strategies. Such integration ensures that desealing is not a standalone effort but part of a comprehensive approach to sustainable development.

The European Union plays a significant role through its **policies and funding**. Recognizing the Alpine region's importance, the EU supports desealing initiatives through policies like the [EU Soil Strategy for 2030](#). Funding mechanisms, such as the European Regional Development Fund (ERDF) or the Interreg Alpine Space Program, possibly finance desealing projects, enabling broader implementation of these strategies.

Secondly, **cross-border cooperation** is essential for a long-term sustainable development due to the Alpine region's transnational nature. Sharing best practices, joint planning, and coordinated land use management across the countries in the Alpine region are vital for effective desealing efforts. This cooperation fosters a unified approach to managing the unique challenges of this diverse region.

Regulatory measures also play a significant role. Implementing regulations that limit soil sealing, promote desealing, and encourage sustainable land use practices are crucial. This includes zoning laws and building codes, as well as incentives for adopting green infrastructure.

Lastly, **monitoring and evaluation** are important for the success of these initiatives. Establishing international

frameworks for monitoring soil sealing and the effectiveness of desealing measures is necessary. This not only helps in adapting strategies over time but also in sharing successful approaches and learning from experiences.

Here you find a **short overview of various strategies** regarding the desealing of soil. Desealing soil emerges as a multifaceted solution that aligns well with various international and EU strategies. It offers a practical approach to addressing key environmental challenges, including biodiversity loss, climate change mitigation, and sustainable land management. The practice of desealing soil not only contributes to the specific goals of each strategy but also represents a broader commitment to ecological restoration and sustainable development. By integrating desealing soil into these strategies, stakeholders can create more resilient, biodiverse, and sustainable landscapes, ultimately contributing to a healthier planet and society, achieving a more resilient and sustainable environmental future for the Alpine region.

The Sustainable Development Goals (SDGs) are a universal call to action to end poverty, protect the planet, and ensure that all people enjoy peace and prosperity by 2030. Adopted by all United Nations Member States in 2015, **the SDGs are a collection of 17 interlinked global goals** designed to be a “blueprint to achieve a better and more sustainable future for all.” The SDGs cover a broad range of social and economic development issues, including poverty, hunger, health, education, climate change, gender equality, water, sanitation, energy, environment, and social justice. The SDGs, particularly those focusing on life on land (SDG 15), climate action (SDG 13) and sustainable cities and communities (SDG 11), align well with soil desealing projects. Municipalities can seek funding through programs that support SDGs implementation, often available at both national and international levels.

SUSTAINABLE DEVELOPMENT GOALS



FIGURE 5

The 17 Sustainable Development Goals (SDGs)

© United Nations

In the context of the [Kunming Montreal Global Biodiversity Framework](#), desealing soil can play a pivotal role in achieving its objectives. This framework focuses on the conservation of biodiversity. Projects that aim to deseal soil can be aligned with its goals by emphasizing the restoration of natural habitats and ecosystems. This practice aligns with the Framework's emphasis on sustainable spatial planning and the conservation of nature for the benefit of humanity. Funding may be available through international grants focused on biodiversity conservation.

Under the [Paris Agreement](#), which seeks to limit global warming and emphasizes climate change mitigation and adaptation, desealing soil can be a vital tool. By enhancing the soil's ability to act as a carbon sink, it aids in balancing anthropogenic emissions. Additionally, restoring soil health can reduce greenhouse gas emissions, such as nitrous oxide, and improve water management, thereby contributing to climate resilience. This linkage can be used to access climate-related funding, particularly from sources dedicated to fulfilling the commitments of the Paris Agreement.

The [EU Soil Strategy for 2030](#) aiming for good soil health by 2050 by setting measures by 2030, also benefits from desealing soil. This strategy focuses on combating desertification, restoring degraded land, and achieving net greenhouse gas removals. Desealing soil directly supports these objectives by restoring degraded soils, enhancing carbon sequestration, and promoting sustainable land use.

In line with the [Soil Monitoring Law](#), which proposes a directive for comprehensive soil monitoring, desealing soil can provide valuable data and insights. It addresses soil degradation, a key concern of the law, and contributes to improving soil health and resilience against climate change. The Soil Monitoring Law asks relevant authorities to determine potential sites for desealing and renaturation. Furthermore, it provides member states with criteria and indicators for measuring soil condition and the degree of soil sealing.

The [EU-Mission: A Soil Deal for Europe](#) can leverage the practice of desealing soil. This strategy focuses on reducing desertification, conserving soil organic carbon stocks, and stopping soil sealing.

Desealing soil aligns perfectly with these goals, offering a practical approach to restoring soil functions, enhancing biodiversity, and engaging communities in soil health initiatives.

The [Nature Restoration Law](#) is a regulation aimed at restoring nature across the EU. Desealing soil under this law can enhance ecosystem resilience, contribute to biodiversity, and support restoration targets, particularly for terrestrial ecosystems dependent on healthy soils. For urban areas, it sets the goal of no net decrease of green spaces by 2030 and an expansion thereafter, where a connection to desealing measures can be drawn.

The [Protocol "Soil Conservation" of the Alpine Convention](#) emphasizes preserving Alpine soil sustainably. Desealing soil in this context can improve water and nutrient cycles, manage risks like flooding, preserve habitats, and promote sustainable agriculture and forestry, aligning with the protocol's objectives.

- The [Long-term action plan for the implementation of provisions and declarations on soil protection in the Alpine region](#) underlines the importance of soil as a valuable resource in mountainous regions. Desealing soil here can enhance carbon sequestration, aid in flood management, restore ecosystems, create habitats, and contribute to resource management and public awareness, in line with the action plan's goals.
- The [Climate Action Plan 2.0](#) by the Alpine Convention, which aims for no additional land-take and land sealing by 2050, can benefit from Desealing soil. This practice can enhance soil quality, promote carbon sequestration, and support sustainable land use planning, contributing to the plan's objectives of transforming the Alpine region into a climate-neutral and resilient area.



Understanding and communicating the added value of international strategies like the Sustainable Development Goals (SDGs), the Kunming Montreal Global Biodiversity Framework, the Paris Agreement, the EU Soil Strategy for 2030, and other relevant frameworks and laws to local stakeholders is crucial for several reasons:

1. Alignment with Global Objectives:

These international strategies set a global agenda that transcends national borders, focusing on common challenges such as climate change, biodiversity loss, and sustainable development. By aligning local projects with these goals, stakeholders can contribute to global efforts, ensuring their actions are part of a larger, coordinated response.

2. Access to Funding: Many international agreements and strategies come with funding opportunities to support their implementation. Local stakeholders who align their projects with these strategies can access a broader range of financial resources, including grants, loans, and other funding mechanisms specifically designed to support the objectives of these global agreements.

3. Enhanced Project Visibility and Support:

Projects that are aligned with well-recognized international goals can gain increased visibility and support from both the public and private sectors. This can lead to enhanced community engagement, potential partnerships, and increased interest from investors who are looking to support sustainable and responsible initiatives.

4. Knowledge Sharing and Best Practices:

Engaging with international strategies facilitates access to a vast pool of knowledge, expertise, and best practices developed around the globe. Local stakeholders can benefit from lessons learned in other contexts, adapting successful strategies to their local conditions and avoiding common pitfalls.

5. Policy Support and Regulatory Alignment:

Many countries have committed to these international agreements, translating their objectives into national laws and policies. By aligning projects with these strategies, stakeholders can ensure compliance with current and future regulations, positioning their initiatives as contributing to national targets and objectives.

6. Long-term Sustainability and Resilience:

International strategies often emphasize sustainability and resilience, encouraging practices that are environmentally sound, economically viable, and socially equitable. Local projects that align with these goals are more likely to be sustainable in the long term, contributing to the resilience of local communities and ecosystems.

7. Enhanced Ecosystem Services and Biodiversity:

Projects like soil de-sealing directly contribute to the restoration of ecosystems and biodiversity, aligning with the objectives of frameworks such as the Kunming Montreal Global Biodiversity Framework. These actions support the provision of essential ecosystem services, including water regulation, carbon sequestration, and habitat provision, which are crucial for human well-being and environmental health.

8. Climate Change Mitigation and Adaptation:

Aligning local projects with international strategies such as the Paris Agreement enhances their contribution to climate change mitigation and adaptation. Practices like soil de-sealing can increase carbon storage, reduce greenhouse gas emissions, and improve resilience to climate impacts, directly contributing to global efforts to combat climate change.



DESEALING IN THE ALPINE COUNTRIES

This chapter examines the recognition and management of soil desealing within the Alpine countries. It assesses political engagement with the issue, reviews relevant legislation, and explores integration with spatial planning. Additionally, it identifies factors influencing the adoption of desealing practices.

4

GROUND: BREAKING

Unsealing to improve
Soil, Climate and Biodiversity

FIGURE 6

*An AI-imagination of
desealing in the Alpine Space*

© ChatGPT (OpenAI), DALL-E
image generator, October 2024)



Initial sections focus on the political discourse surrounding desealing, analysing whether and how it is addressed by policymakers. This is followed by an examination of laws that either promote or regulate desealing, providing an overview of the legal context. The chapter further investigates how desealing initiatives are incorporated into spatial planning frameworks, highlighting the strategic approach to land use.

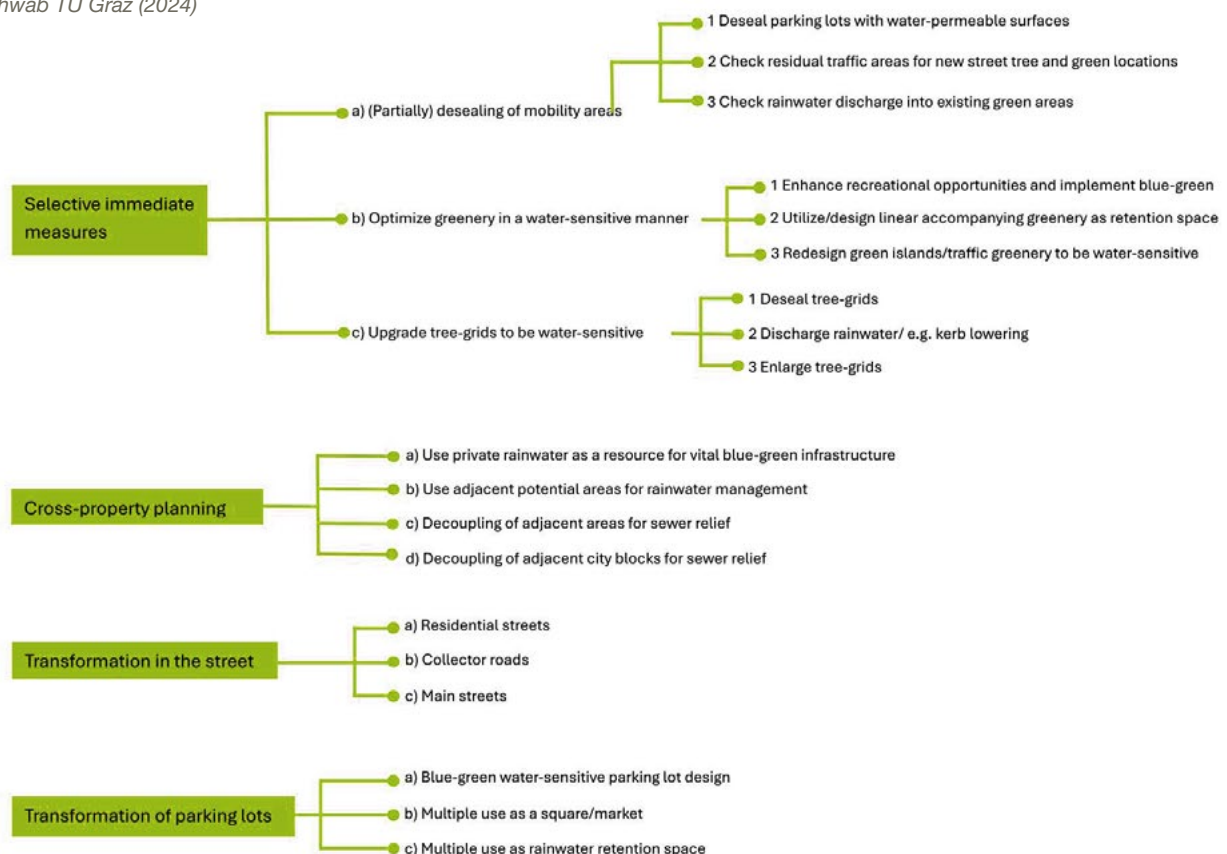
The discussion then shifts to the practical application of desealing, presenting case studies from urban and peri-urban settings within each Alpine country. These examples detail project initiators, funding sources, objectives, targeted areas, and specific desealing measures implemented. Through these case studies, the chapter aims to provide insights into successful strategies for soil improvement and the challenges encountered.

This overview aims to offer a concise and informative exploration of soil desealing efforts, serving as a resource for understanding the complex dynamics at play in the Alpine region's approach to managing land use and promoting environmental sustainability.

FIGURE 7

Approaches and examples for desealing measures

© Research project PeriSponge/
Eva Schwab TU Graz (2024)



INFO BOX

Concrete desealing-measures

To carry out concrete desealing activities, various approaches are possible, both on a small and larger scale. Examples are shown in the following mind map. Great potential is for example given when desealing traffic areas. Additional examples for desealing measures can be found in chapter IV.

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F. David & C. Manzoni Pratique du ZAN

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Ministère de la transition écologique et de la cohésion des territoires (2023a). Zéro Artificialisation Nette. Guide Synthétique.

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AUSTRIA

In Austria, soil protection and desealing measures are recognized as critical components of environmental and sustainable development strategies. Austria's efforts are guided by both national legislation and regional initiatives that reflect the country's commitment to preserving natural resources and promoting sustainable land use.

Austria's approach to soil protection is embedded within broader environmental and land-use policies. Relevant provisions are for example contained in the Law on the Remediation of Contaminated Sites ("[Altlastensanierungsgesetz](#)"), the Fertilisers Act ("[Düngemittelgesetz](#)"), the Water Rights Act ("[Wasserrechtsgesetz](#)"), the Waste Management Act ("[Abfallwirtschaftsgesetz](#)") and, in particular, the Soil Protection Acts of the Federal Provinces. These laws aim to prevent soil degradation, contamination, and sealing, ensuring that land use is managed in an environmentally sustainable manner. The national strategy for sustainable development also highlights the importance of soil as a resource, emphasizing conservation and the reduction of land take for settlement and traffic to minimize soil sealing. The Soil Protection Acts of the Federal Provinces mark a significant effort towards soil conservation, its success may be challenged by the potential for fragmented implementation across different governance levels and the reliance on voluntary measures without stringent enforcement or specific targets.

Specifically, Austria has set ambitious targets to limit soil sealing and promote desealing where possible, as part of its broader environmental and climate goals. For example, the [Austrian strategy for biodiversity](#) and the [national action plan for adaptation to climate change](#) both include

measures to protect soil quality and function, recognizing soils' vital role in carbon sequestration and as a basis for biodiversity.

Financial and technical support for soil protection and desealing projects is available through various programs, often co-financed by the European Union and the Austrian government. These programs support local and regional authorities in implementing measures to reduce soil sealing, rehabilitate contaminated sites, and enhance green infrastructure in urban areas.

At the regional level, federal states (Länder) have significant autonomy in land-use planning and soil protection, leading to a variety of approaches tailored to local conditions and needs. Initiatives such as green space planning, urban redevelopment, and the promotion of permeable surfaces in construction are examples of how regions and municipalities are actively working to counteract soil sealing and promote sustainable land management. Some federal states (e.g. Styria or Lower Austria) also offer subsidies for unsealing measures, which are aimed at municipalities, associations and individuals. However, challenges remain in harmonizing objectives across different levels of governance and sectors, ensuring that soil protection and desealing are integral parts of land-use planning and development policies.

Furthermore, there are legitimate concerns about the scale of soil sealing in Austria. Around 12 hectares of land are sealed in Austria each day, significantly affecting biodiversity and ecosystems. This rapid sealing of soil conflicts with the government's target of reducing this rate to 2.5 hectares, indicating that desealing is far from being as widespread as needed to counteract the negative environmental impacts.



Good example:

Nibelungenplatz Tulln

(Lower Austria)

The project to redesign the [Nibelungenplatz in Tulln](#) - initiated by DnD Landschaftsplanung ZT KG - includes the [redesign of the square](#) from May 2023 to June 2024 following a comprehensive public participation process and a referendum in 2021. The aim is to transform the square into a future-proof, climate-adapted and multifunctional public space. Elements such as a monastery garden, work and workout zones, fog play for cooling off, a bar with an e-bike charging station, marquees, seating and play areas, natural shade provided by trees based on the sponge city principle and infrastructure that integrates modern technologies are planned. The aim of the redesign is to make the square a place for people instead of cars, to increase the quality of stay and the attractiveness of the city.

In order to finance the project, a LEADER grant was submitted for the redesign, which was confirmed with a funding commitment of around € 150 000. The project also received a funding commitment from the state of Lower Austria, which will cover 30% of the total construction costs.

The decision to deseal Nibelungenplatz in Tulln was made in order to transform the square from a parking lot into a park. This step aims to connect a place to spend time in nature within the city centre.

A key focus is on creating areas that are open to infiltration and multifunctional in order to increase the permeability of the soil and enable a near-natural design. The use of permeable paving systems and the greening of certain areas are steps that are typically taken to convert sealed surfaces back into healthy soil by improving water filtration and storage and helping to restore natural soil functions.



FIGURE 8

Nibelungenplatz before and after desealing
© Stadtgemeinde Tulln

Good example:

Dorfbachplatz Hard

(Vorarlberg)

An example of a short-term and participatory desealing project can be found in western Austria, on the shores of Lake Constance in the municipality of Hard in Vorarlberg. As part of a project by architecture and spatial planning students at the Vienna University of Technology, part of the forecourt of a primary school was desealed. During the planning, which was carried out by the students considering the wishes and needs of the pupils and the local population, it became clear that there was a desire to deseal a larger area than originally planned. The students and local people worked together on the redesign, which resulted in a total excavation area of 400 square meters. In addition to the desealing, new green infrastructure was installed to reduce the urban heat island effect. This, together with new seating and lighting, has also improved the recreational value of the space.

Half of the project costs (approximately € 65 000) were covered by various federal state grants and the national funding programme “KLAR! Climate change adaptation model regions“. The project can be seen as a good example of a participatory and synergetic approach based on ‘learning by doing’.



FIGURE 9

Forecourt of the primary school before desealing
© Marktgemeinde Hard



FRANCE

Since the beginning of the 20th century, the urbanisation has led to a significant consumption of land. This artificialisation of the land varies between 16 000 and 60 000 hectares per year, depending on the source. According to a study published in July 2019 280 000 hectares of land will be artificialized by 2030, an area bigger than Luxembourg.

The growth in the artificialization of land of 70% in the last 40 years has mainly occurred at the expense of agricultural land, for housing (42% of artificialized land), transport infrastructure (28 %), services and leisure (16 %) such as shopping areas. It is highest in metropolitan areas and coastal zones.

In 2003, France started its ambitious process in order to protect and enhance its natural heritage by adopting different national strategies, such as the National Biodiversity Strategy «[Stratégie nationale biodiversité 2030 \(SNB\)](#)», laws and plans. With the adoption of the Climate and Resilience Act («[La loi Climat et résilience](#)») on 22nd of August 2021, France has set itself the goal of achieving 'zero net artificialisation of land' by 2050.

In the upcoming ten years 2021 – 2031, France plans to halve the consumption of natural, agricultural and forest area compared with the previous decade (2011 – 2021). This is defined in Article 194 of the Climate and Resilience Act: «the consumption of space as 'the effective creation or extension of urbanised areas in the territory concerned'».

The government is making with the [ZAN Act](#) the 0% net artificialization of land a priority reform. The Act, adopted the 20th of July 2023 «LOI n° 2023-630 du 20 juillet 2023 visant à faciliter la mise en œuvre des objectifs de lutte contre l'artificialisation des sols et à renforcer l'accompagnement des élus locaux», aims to facilitate the implementation of objectives to combat the artificialization of land and to strengthen support for local elected representatives to adopt low-land-use development models. Furthermore, this reform covers the observation, planning and control of land artificialization. The ZAN act aims to provide local elected representatives support in implementing unsealing activities on a local level. This law aims to take better account of environmental consequences when building and developing land, without neglecting the needs of territories in terms of housing, infrastructure and

activities. The objective therefore tends to prohibit any net artificialisation of soils over a given period. This does not necessarily imply a total halt to the development of new areas. This will be conditional on the renaturation of an equal proportion of artificialized areas. Everything that is 'taken' from nature must be 'given back'.

The Ministry of Ecological Transition and Territorial Cohesion has published a [summary guide](#) to ensure that the 'zero net artificialisation' reform is properly understood. This document sets out the key points of the reform: how to define and measure the consumption of greenfield land and net artificialisation, how to plan for their reduction within the framework of regional schemes and local urban planning documents, how to mobilise levers (density, nature in the city, economic activities, wasteland, etc.) and how to provide support for local authorities, particularly in terms of engineering and budgetary and fiscal tools.

Good example:

Spatial planning instrument in the territory

« Pays de Maurienne »

The syndicat du Pays de Maurienne is implementing its ScOT (« Le schéma de cohérence territoriale » / The territorial coherence plan), approved in 2020, in a mountainous catchment area covering 1/3 of the Savoie department. With its exceptional environmental wealth, the area is also subject to numerous natural hazards. The Maurienne has therefore been developed in a very limited environment, where open space is limited and therefore needs to be shared between different uses (in the valley bottoms and in the mountains), guided by different spatial planning processes. The territorial coherence plan, called ScOT, is in line with the ZAN act to save land, and the same time an ambitious urban renewal project (in towns, villages and tourist resorts). The definition of this ZAN trajectory for the Maurienne will be carried out in conjunction with the [SRADDET](#), a strategic, prescriptive and integrating plan for the regions, and in the context of a mountain region marked by the following specific features: The creation of an international rail infrastructure (TELT) impacting the valley floor, the transition of the tourism model (in resorts and valleys) towards a low-carbon profile, by redesigning tourist activities and mobility to adapt to climate change.

The village centre of Volonne

The eco-neighbourhood covers an area of 1.9 hectares and fits into the existing urban fabric. One of the objectives of the new eco-district was to upgrade public spaces with facilities that meet the expectations of different users but also to give space to nature in the city centre. Therefore, one action in particular was the unsealing of a parking space and the redevelopment of a section of the departmental road. Furthermore, planting of the area with local species to encourage biodiversity, shade and coolness in the summer period.



Eco-neighbourhood Volonne
© H  l  ne Despagne

GERMANY

Soil desealing is not regulated uniformly in Germany and the responsibility lies within the federal states and local authorities, but there are general targets for soils at federal level. By 2030, the designation of settlement and traffic areas is to be reduced to 30 hectares, and by 2050, no more fertile soils are to be removed. Furthermore, there is a “natural climate protection” action program. This program has € 4 billion available until 2026. One of the goals is to protect soils as carbon reservoirs. Changes to soil protection are also currently being examined and a soil protection regulation is being promoted at European level. There are other funding programs such as “Desealing of land” from the Federal Ministry of Economics and Climate Protection (BMWK) or the BMU funding program “Climate adaptation in social institutions”. The Federal State Committee for Soil Protection (LABO) has set up a working group in which experts have developed a calculation model based on the available regional data on soil sealing, which can be used to calculate soil sealing within the settlement and traffic area. There is an increasing awareness of environmental issues and sustainable urban development. Almost half of the settlement and traffic areas designated in Germany are sealed, with the majority being traffic areas.

There is no standardized data collection of soil sealing in Germany. Although the sealing of various building plots is recorded in order to calculate wastewater charges. However, the data is not publicly accessible and is held by wastewater companies. In addition, selected regions are recorded in various research projects.

Soil desealing is primarily defined in the [Soil Protection Act](#) (§§ 5 BBodSchG) and the [Building Code](#) (§ 179 BauGB). In the BauGB, desealing measures mainly relate to urban areas. Although the BBodSchG contains an authorization

for the federal government to oblige landowners to take desealing measures under certain conditions, the federal government has not yet made use of this authorization.

According to the German government's fifth [soil protection report](#), the existing legal regulations are not sufficiently effective. In practice, the laws are hardly ever applied. For effective implementation of desealing, clear responsibilities should be defined within the authorities and concrete procedural standards developed at working level.

The federal government has introduced the mandatory “[Sustainable Building](#)” guidelines in order to fulfill its role model function in building culture and sustainability. This guideline is based on the scientifically sound [Federal Sustainable Building Assessment System](#) (BNB) and can be used not only for federal construction projects, but also by other public clients and the private sector.

Soil desealing is generally known in spatial planning, but this is still mostly based on a voluntary basis. Desealing is only mandatory if the sealing is in conflict with planning regulations. Above all, federal and state subsidies offer an incentive in spatial planning to deseal areas. In addition to special urban development law, urban land use planning can contribute to desealing by including the overplanning of existing urban districts. This includes the designation of areas to be built on and areas to be desealed in the planning documents, with corresponding area balances as part of the environmental assessment. The proportion of land to be kept free influences the extent of building use and the areas of land that can be built on in the development plan.

Soil desealing is recognized as an important environmental policy measure in Germany, but implementation varies depending on political will or local resources or circumstances. Soil desealing is often not an explicit topic but is included in other environmental issues.



Good example:

Nikolaikirchhof in Altenburg

Altenburg is a small town in Thuringia with a population of around 31 000. The urban layout of the churchyard has existed since the 16th and 17th centuries. During the GDR era, a garage building was built in the churchyard and the surrounding area was primarily used as a parking lot, so the quality of the space was correspondingly low. In 1999, the garage building was removed and archaeological excavations were carried out. The churchyard was then completely renovated. The square was paved and furnished with seating and trees in the middle. In addition, an desealed green plateau with extensive greenery was created. The renovation was funded with almost € 600 000 from the federal-state program for urban monument protection. The renovation measures led to an enormous enhancement of the churchyard, which now also serves as a place to spend time and offers a large infiltration area. Parking facilities were rejected by the population in a referendum, as the churchyard should now primarily be used as a place to spend time and for events.



Good example:

Former Forellenhof Roter in Berlin-Spandau

“Desealing potential in Berlin” is a project of the Senate Department for Mobility, Transport, Climate Protection and the Environment with the aim of actively improving Berlin’s soil quality by recording sealed, unused areas that could be permanently desealed. The following example was listed within this project.

The project of desealing the former Forellenhof was fully financed with € 260 000 by the Berlin Program for Sustainable Development (BENE) with funds from the European Regional Development Fund and the state of Berlin. The project area is a former fish farm with an area of around 4000 m² in the Spandau district of Berlin. The site was returned to the Roads and Green Spaces Department in 2018. The building stock comprised a restaurant, a sales building including a cold store, a smokehouse including a chimney, a pump house including a well system and a shed, a shelter and a stable. The aim of the desealing project was to open up the site for public and recreational use. A total area of 2400 m² was desealed and the project was carried out in 2020. The desealing measures included the dismantling of the buildings, trout pools, breeding facilities and underground pipelines. Waste materials were disposed of. The site was leveled, neighboring buildings were renovated and a traffic order for the access road was applied for.

FIGURE 11

Green area at the Nikolaikirchhof
© David Engert



ITALY

Italy faces significant soil consumption, with about 21 hectares lost daily, according to the [SNPA 2023 report](#). Urban planning recently began addressing this issue, focusing on expanding urban areas without considering the reconversion of already urbanized lands. European guidelines acknowledge the challenges of reverting sealed soils, resulting in scarce desealing initiatives and guidelines. National and regional legislation is slowly emerging to protect agricultural areas and mitigate hydro-geological risks, aiming for zero soil consumption by 2050. However, laws specifically targeting soil desealing are lacking.

The National [Biodiversity](#) and [Climate Change Adaptation Strategies](#) highlight soil degradation and the negative impacts of urbanization on natural habitats and hydro-geological stability. The SNPA's report advocates for soil desealing as part of a broader goal towards zero net soil consumption, emphasizing urban regeneration.

European and global guidelines recommend avoiding soil sealing when possible and adopting mitigation and compensation measures to maintain a balance. Regional legislation varies, promoting urban regeneration over new soil consumption but rarely focuses on desealing. Exceptions include laws from the Marche and Emilia Romagna regions encouraging urban regeneration and the re-naturalization of consumed soils.

The [SOS4Life](#) project's guidelines for land take compensation and urban regeneration highlight the ongoing efforts to address soil consumption and promote sustainable urban development.

The [Contratti di Fiume](#) (River Contracts) is a voluntary strategic and negotiated planning with the aim of defining the suitable structure of a river basin in terms of ecosystem functionality, hydraulic risk mitigation and water quality improvement. In Lombardy, it represents a progressive framework which involves all the stakeholders of the river basin for the definition of strategic goals and the

implementation of shared and multi-objective actions to achieve them. The Contratti di Fiume process facilitates desealing interventions by supporting municipalities in addressing technical issues also with innovative ideas.

Desealing interventions are critical in urban areas where surfaces such as roads and pavements contribute to increased flooding, reduced water quality, and increase urban heat islands. By restoring the natural landscape through the removal of these surfaces and the implementation of green infrastructure, urban resilience to climate change can be notably enhanced. The Contratti di Fiume initiative provides a structured method for planning and executing such interventions by fostering collaboration between municipalities, residents, environmental organizations, and other stakeholders. One of the main examples is represented by the Call4Ideas for the realization of desealing projects.

The Call4Ideas aimed at selecting interventions for climate change adaptation and mitigation, launched in 2021 by Lombardy Region in collaboration with ERSAF. This initiative focused on changing the approach in the stormwater management, moving from harsh engineering solutions to the implementation of Sustainable urban Drainage Systems (SuDS) to enhance urban permeability, facilitating the infiltration of rainwater, thereby reducing the risk of flooding and the formation of urban heat islands. These interventions, once completed, will make it possible to desealing a surface of more than 26.000 square meters and the creation of more than 5.600 square meters of SuDS capable of holding on site more than 1.800 cubic meters of stormwater.

The Municipality of Cucciago responded to this call by proposing a significant renovation of a local parking area. With regional funding targeted at de-impermeabilization projects, the municipal authorities undertook an ambitious transformation of the parking lot into a more sustainable space. The project incorporated permeable paving solutions and rain gardens designed to absorb and manage stormwater efficiently. This intervention not only aimed to mitigate excess runoff but also enhanced the aesthetic and ecological value of the urban area.



Good example:

Desealing of urban areas in the municipalities of Forlì, San Lazzaro di Savena and Carpi

Interventions carried out as part of the LIFE Project “SOS4Life”, co-financed by the European Union and conducted between 2017 and 2019 in Emilia Romagna with the collaboration of the Region and the municipalities of Forlì, San Lazzaro di Savena and Carpi.

It aimed to draw up guidelines for the implementation of urban ecological restoration projects towards the 2050 target of zero net soil consumption according to EU guidelines. The project involved devising a methodology for reclassifying urban soils on the basis of their potential from the point of view of ecosystem functions, calculated with indicators derived by data such as Soil Biological Quality index (QBS-ar), CEC (Cation Exchange Capacity), soil reaction (pH), saturated hydraulic conductivity (Ksat), carbon sequestration, land capability map, infiltration capacity, water content at field capacity and average depth of the surface water table. Once an assessment of the ecosystem services that can be provided by these soils had been carried out, the estimation of the impacts of sealing allowed the compensation of this loss of ecosystem services through the desealing of urban areas in the three municipalities. The demonstration actions concerned two public car parking in Forlì and Carpi and a part of an industrial area in San Lazzaro di Savena affected by abandoned buildings on a total area of 10 750 square meters.

The first of the three experiments carried out was the Museum Garden in Forlì. The objective of the intervention was the requalification of the area in front of the San Domenico Museums, used as an elevated car parking area, replacing it with a public green area. The intervention involved a 6500 square meters paved area demolished, 3700 cubic meters of concrete demolished and disposed of, and 6500 cubic meters of vegetated soil brought back, of which 1650 of top soil. The sealed surface area was removed and replaced with soil and infrastructure for public green areas, increasing from 6% permeable surface area before the intervention to 74% after the intervention.

Total amount of the intervention € 1 000 000 (€ 500 000 allocated by the Fondazione Cassa di Risparmio di Forlì; € 300 000 by the state and € 200 000 by the Municipality of Forlì).

Some projects containing desealing interventions carried out within the framework of the Cli.C Bergamo! (Climate Change Bergamo) co-financed through the Climate Strategy Call for Proposals of the Cariplo Foundation, which involved the Municipality of Bergamo and other municipalities of the Colli di Bergamo Park.

Good example:

Pilot desealing interventions in the Colli di Bergamo Park

The action consisted in the identification of a public open space (the ‘Donatori del sangue’ car parking area in the municipality of Sorisole) with the design and construction of small green areas to replace paved parts.

The main objectives were increasing the absorption and storage capacity of greenhouse gases, reducing the urban heat island, increasing urban drainage through Nature Based Solutions, increasing natural capital and biodiversity, increasing the availability of high liveability and attractiveness of urban open spaces. Secondary objectives included securing against high-intensity weather phenomena and increasing responsiveness to the impacts of climate change.

The selection of the pilot area where the desealing action and the related co-design process will be implemented involved all the municipalities of the Parco dei Colli. The desealing action covers an area of approximately 1000 square meters on a total redeveloped area of approximately 3000 square meters, in which approximately 200 trees and shrubs suitable for meeting landscape and naturalistic requirements were planted.

Total cost of the intervention: € 250 000. The intervention was carried out between 2020 and 2022. Costs were sustained by Parco dei Colli di Bergamo, Fondazione Cariplo and Regione Lombardia.



FIGURE 12

Parking place before desealing

© Comune di Forlì



FIGURE 13

Area in Forlì after desealing

© Comune di Forlì

SLOVENIA

The average net annual increase in built-up land in Slovenia over the period 2015-2022 was 630 ha per year. A continuation of this trend would mean that 5.88% of the total land area would be built on in 2030 and 6.50% in 2050. Already now, data show that new development often comes at the expense of existing land which is in actual use agricultural land. Since 2010, their built-up area has increased by 6.5%, while the area of fields, plantations and meadows has been decreasing. Since 2015, 30% of building permits have been issued for agricultural land. Judging by the current municipal spatial plans, where as much as 26% of the land zoned for residential use is on land that is currently agricultural in actual use and used for agricultural activities, such trends will continue and intensify in the future without appropriate measures. The area of built-up land (as defined in the [Spatial Planning Legislation ZUreP-3](#)) in Slovenia is 115 523 ha, representing 5.70% of the land area. From 2010 to 2022, there is a general decline in the agricultural use categories fields, permanent crops and grassland, with fluctuations in between. The area of arable land and plantations has been decreasing since 2018 and has decreased by 1.94% until 2022. The decrease in grassland areas was mainly observed in the period 2010-2014, when it decreased by 6.41%. It should be pointed out that the decrease is not only due to the built-up area, but also to overgrowing. In Slovenia (2023) there are 1070 functionally degraded areas with a total area of 3225 ha, representing 0.16% of Slovenia.

Slovenia has integrated the objective of reducing the net annual growth rate of built-up land, derived from the EU Soil Strategy, into national strategies and programmes ([National Environmental Protection Programme 2030](#) and [Spatial Development Strategy 2050](#)). The National Environment Programme 2030 foresees a reduction in the net annual increase in built-up land by 25% by 2030 and zero increase in built-up area from 2050 onwards. Soils are a non-renewable natural resource, taking tens of millennia to form and regenerate, but are vital for people and the environment to provide ecosystem services. In the Spatial Development Strategy of Slovenia 2050 (SPRS 2050), the objective of reducing net annual growth is implemented through spatial planning instruments (which are spatial planning and land policy measures under the ZUreP-3). The SPRS 2050 contains the objective of reducing the net annual increment of built-up land to 0% in 2050 and reducing the proportion of degraded areas. The Strategic Plan for Circular Spatial Management 2024-2030 foresees various measures to achieve the strategic objectives, including the preparation of Guidelines on the Unsealing of Soils of Public and Private Urban Areas. Soil unsealing refers to the removal of impermeable layers, e.g. asphalt, to restore or improve the permeability of the soil surface, with the aim of restoring natural soil processes and allowing water to infiltrate into the soil. The measure ensures the maintenance/restoration of the flat terrain. The guidelines should include measures for unsealing, which may include greening of soils and roofs, replacement with permeable materials, water retention measures, etc.



Good example:

Unsealing of Mislejeva Street, Ljubljana

The example of ground unsealing next to the “Mladi rod” kindergarten in Ljubljana, Mislejeva Street, was conceived as a small project by the non-profit urban design studio ProstoRož to initiate a debate on comfortable, pedestrian-friendly urban design of streets frequented by children and on the importance of water-permeable surfaces in cities. To successfully implement the pilot project, they needed the support of a local institution, so based on an analysis of the streets where kindergartens are located in Ljubljana and interviews with the headmasters together with representatives of the Municipality of Ljubljana, they chose the kindergarten on Misljeva street. The renovation took place in two phases. At the time of the initiative, the street was undergoing sewage renovation. Instead of reverting to its original state, the designers proposed to maintain the asphalt in places that are crucial for traffic flow, while paving the remaining areas with grass grates. A new traffic plan was also proposed and tested with users.

In the second phase, the grass grates in some parts were removed and replaced by greenery. The foyer of the kindergarten on Misljeva Street was transformed into an area that communicates from the outside that children live in this building. The renovated public space aimed to address some of the children’s needs, as observed by parents and teachers: children want and need more greenery, a playground, more benches and better road safety.

The planting plan included perennials and shrubs that are adapted to the urban and shady environment and that do not require much maintenance. The street has 475 new plants, which the kindergarten children helped to plant. A large rock has been placed as a climbing frame and play area for the children. The traffic regime has also been changed to prevent private vehicles from passing the main entrance of kindergarten, thus encouraging sustainable arrivals. In total, 115 m² of asphalt on Mislejeva Street was replaced with green and water-permeable surfaces. The street also received 7.5 metres of new benches and new bicycle racks. The project duration was from April to November 2023.



FIGURE 14

Opening of the new Mislejeva Street

© Nik Rovar

Good example:

Northern Park – Navje, Ljubljana

The area is located in the very centre of the city Ljubljana, directly next to the railway station or the newly planned Ljubljana Passenger Centre and next to a neighbourhood with a very high density of inhabitants that includes the important cultural monument Navje and has outstanding views of the Ljubljana Castle. The size of the area (over 8 hectares in total) allows for the design of a true urban park, which, as the city's most public green space, combines a range of distinct meanings, functions and contents.

The North City Park is Ljubljana's second major public park, developed in phases to transform degraded areas in the city centre. Spanning 9 hectares, the site had previously been an illegal car park with non-functional areas, but the redevelopment has given the city a huge green space with children's playgrounds. To make it a success, it was necessary to buy the land, to ensure the phased development of the project, and all while building on the idea of the park as a green space with a cultural touch, dedicated to reading culture.



FIGURE 15

Northern Park Ljubljana in May 2008 (top) and August 2024 (bottom)
© Google Earth Version 9.180.0.1

SWITZERLAND

Even though Switzerland is not part of the Ground:breaking project, our research revealed several examples for desealing measures in Switzerland. Therefore, these are shortly described as good practice inspirations for desealing.

Good example:

“Break up – Basel bricht auf” Basel

The city of Basel is undertaking the “Break up - Basel bricht auf” project to unseal 3,500m² of land. What sets this initiative apart is its focus on private, rather than public, areas. Since a large portion of land is privately owned, this project offers a unique opportunity to unseal areas beyond the city’s direct control and to show private property owners how to build in a more nature- and climate-friendly way. The consulting services were carried out by *Nature in Basel association*. Supported by the Christoph Merian Foundation, the project ran from 2023 to 2024, a follow-up project has already been approved.



INFO BOX

Additional resources for Switzerland

Asphaltknackerinnen

Under the name Asphaltknackerinnen (English: Asphalt Crackers), the environmental communications agency Plan Biodivers GmbH provides free consulting services for potential unsealing projects. They connect interested individuals with landscaping companies and cover the costs of the waste disposal. In Zurich, private parking lots, areas on properties, and railway transshipment sites have already been unsealed through this initiative.

Plan Biodivers Umweltkommunikation & Planung.
Asphaltknackerinnen.

www.planbiodivers.ch/asphaltknackerinnen

Plan Biodivers Umweltkommunikation & Planung. Referenzen und Projekte: Asphaltknackerinnen.

www.planbiodivers.ch/referenzen-und-projekte/asphaltknackerinnen

entsiegeln.art

The collective art project addresses the topic of desealing through artistic expression. It offers resources such as awareness-raising initiatives (e.g. unsealing labs) and even hands-on excursions where participants can learn practical techniques for desealing. The art project is carried out in collaboration with different partner organizations and project teams.

entsiegeln.art

Mission B

The platform Mission B documents over 800 examples of biodiversity promotion measures, including unsealing projects across Switzerland, providing inspiration for civil society, businesses, and public authorities. The biodiversity projects can be submitted by those implementing them.

MissionB. Entsiegeln – für mehr Biodiversität.
missionb.ch/de/entsiegeln

MissionB. Projekte.
missionb.ch/de/projekt



GROUND:BREAKER AWARD

This Alpine wide unsealing competition represented one of the most important activities in the project « Ground:breaking ». Its goal was to collect good practices of desealing and soil improvement measures in urban and peri-urban areas in the EUSALP Perimeter. Municipalities, civil organisations and initiatives, companies, research institutions and private citizens could participate with already implemented desealing and soil improvement activities. All types of activities could take part : from turning parking lots into green spaces, reviving degraded soil to enhance biodiversity, eliminating heat islands, making surfaces permeable for water again to creating recreational spaces - at best, such measures go hand in hand. In total, 45 projects were submitted within the application period from June to November 2024. An international jury of five highly qualified members from Slovenia, Austria, Germany, Italy and France found the most dedicated Ground:breakers. Evaluation criteria comprised the social dimension, biodiversity and climate adaptation, extra points could be collected in the categories of circular economy/use of resources as well as economic efficiency. The three most outstanding projects were presented within an Award Ceremony at the CIPRA Annual Conference on February 27, 2025 in Salzburg/A and shared a prize money of 4500 euros.

AWARD WINNERS

Hubersdorf/CH

From a Parking Lot to Nature Paradise

The first place of the Award went to the private initiative of the Murer family. A 600 m² car park of a former restaurant was unsealed with an excavator. Subsequently, a near-natural-site was established, including a centrally located watering hole. Numerous native wild plants and shrubs were planted and various small biotopes created, such as piles of stones and wood. These structures invite several animals, such as amphibians, reptiles, birds and insects. At the same time, the near natural garden increased the quality of life and joy. Remarkable was the outstanding and impressive private effort in removing impermeable surfaces with significant impacts in soil recovery. It serves as practice example for private desealing projects.



FIGURE 16

Parking lot before and after desealing

© Christine Murer

Lochau/A Potato-Power

A project of the Austrian association « Bodenfreiheit » was selected as second place. Compacted and degraded soil due to construction vehicles, covering 635 m², was re-vegetated. Together with local residents of all ages a permaculture method was implemented : potatoes were covered with hay instead of being buried. This leads to a deep rootage which subsequently loosens the soil. Other parts of the area had to be loosened with an excavator to remove old railway lines, under guidance of a soil scientist. Together with a landscape planner, native seeds were then sown and fruit trees planted. Now it serves as a freely accessible fruit-growing area for all local people. The project was noted as best practice example for soil improvement and considered an impressive initiative with involvement of experts and strong community involvement, all soil improvement measures were realized voluntarily. A feature of the project is furthermore its educational value. The participants learned many facts about soil as basis for life, natural methods of soil improvement, the importance of natural habitats and the value of open spaces. In conjunction with the adjacent renaturalized Oberlochauerbach stream, the area can also serve as a wild island in the settlement area.



FIGURE 17

Potato-Power

© Verein Bodenfreiheit

Bruneck/IT : Renaissance of a bus station

The third place was dedicated to the project of the municipality of Bruneck/IT. An approximately 1,800 m² former bus station was unsealed and turned into an intergenerational recreation and meeting place in the center of Bruneck. The paving was removed, paving stones were recycled. The park was designed according to biodiversity criteria, in consultation with the biodiversity working group. The working group consisted of responsible city councillors and interested citizens contributing their ideas. Habitats for plants and insects were created by using native plants, herbaceous and perennial plants were used throughout the area instead of conventional lawns. The area now accommodates a pergola, drinking fountain, natural stone walls, a shady tree and walking paths, connecting to the surrounding infrastructure. Remarkable are the educational aspects of the project and urban biodiversity enhancement integrated in urban planning.



FIGURE 18

Renaissance of a bus station

© Gemeinde Bruneck

POLITICAL RECOMMEN- DATIONS

The international and European strategies make little reference to soil desealing, although desealing could significantly promote the objectives of these strategies in various ways.

5

GROUND:BREAKING

Unsealing to improve
Soil, Climate and Biodiversity



OUND:BREAK

As outlined in the previous chapters of this handbook, soil desealing is beneficial for biodiversity, climate resilience, water management, and overall ecosystem health. Despite its critical importance, the concept of soil desealing remains underrepresented in many policy frameworks.

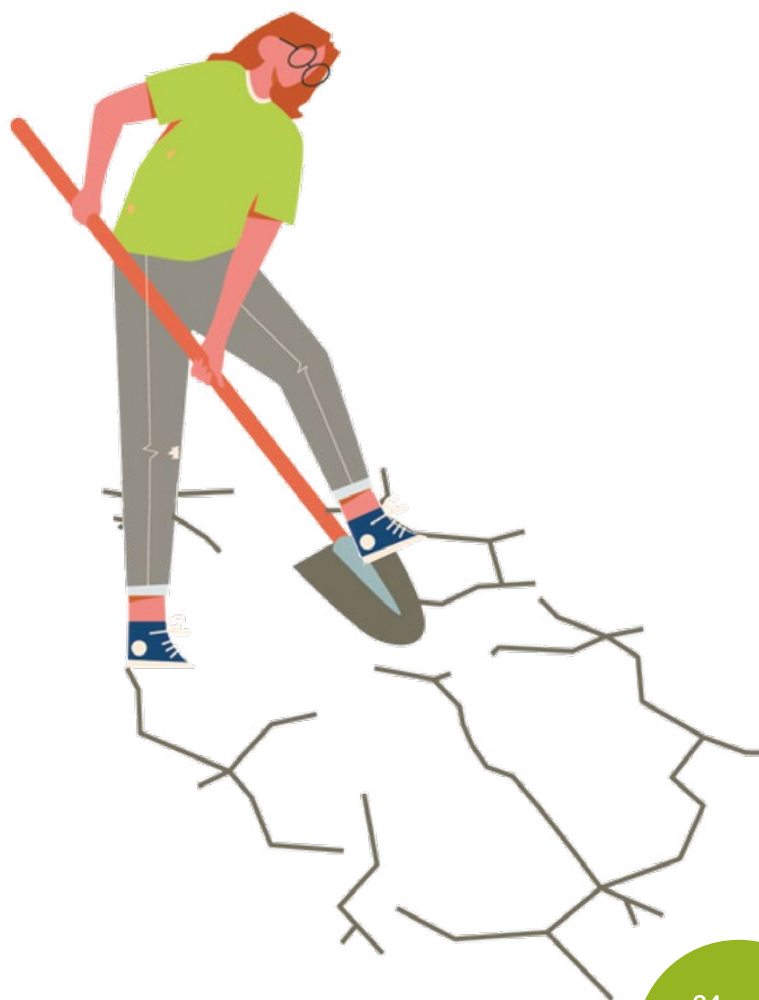
The earlier chapters detailed the adverse effects of soil sealing, such as disrupted water cycles, reduced soil fertility, increased flooding risks, and the urban heat island effect. These impacts are particularly pronounced in the Alpine region, which serves as a vital water reservoir and biodiversity hotspot for Europe. The sealing of soils in this region not only degrades local ecosystems but also undermines the broader environmental goals set by international agreements like the Sustainable Development Goals (SDGs), the Kunming Montreal Global Biodiversity Framework, and the Paris Agreement. By addressing soil desealing more explicitly, policymakers can leverage its benefits to achieve these global environmental objectives. Desealing initiatives can restore natural soil functions, enhance carbon sequestration, improve water infiltration, and create habitats for diverse plant and animal species. These actions are essential for mitigating climate change, preserving biodiversity, and ensuring sustainable land use. It is important to note that once soil has been sealed, it cannot be restored to the same quality, i.e. with its full effect, as this takes centuries. Alpine soils are particularly vulnerable due to the region's unique topography. Research conducted for this project indicates that, also compared to other areas, Alpine regions still have significant potential for implementing desealing initiatives.

To better integrate soil desealing into the various levels of policy and generally make it more accessible, a number of things still need to be done:



Awareness and Integration into Strategies:

- **Increase Awareness:**
Create awareness among policymakers about the benefits of soil desealing for biodiversity, climate mitigation, and ecosystem services. Highlight how desealing aligns with international and European strategies such as the Sustainable Development Goals (SDGs), the Kunming Montreal Global Biodiversity Framework and the various EU-Strategies.
- **Policy Integration:**
Integrate desealing strategies into broader environmental, urban planning, and development policies. Ensure that desealing objectives are embedded within climate change mitigation and adaptation strategies.
- **Cooperation between various governance-levels:**
It is essential for the various governance levels to collaborate more effectively. Enhanced cooperation between spatial planning and soil protection, for instance, can significantly promote soil desealing. Spatial planning, through its planning instruments, has the potential to curb soil sealing, making this integrated approach crucial for sustainable development.





Financial Support and Incentives:

- **Funding Programs:**

Establish and promote funding programs for desealing projects. These could be co-financed by national governments and the European Union through mechanisms like the European Regional Development Fund (ERDF) and the Interreg Alpine Space Program.

- **Incentives for Desealing:**

Provide financial incentives for private landowners and municipalities to engage in desealing activities. This could include grants, tax breaks, or subsidies for projects that restore natural soil functions and enhance green infrastructure.



Legal and Regulatory Framework:

- **Regulatory Measures:**

Develop and enforce regulations that limit soil sealing, promote desealing, and encourage sustainable land use practices. This includes implementing zoning laws and building codes that favour permeable surfaces and green infrastructure.

- **Net Zero Soil Consumption:**

Establish legal requirements for net zero soil consumption, where for every new sealed area, an equivalent area must be desealed. This would ensure a balance and prevent further soil degradation.



Technical Support and Standards:

- **Quality Standards:**

Develop and enforce quality standards for desealing projects to ensure that the restored areas meet certain criteria. This includes maintaining and improving soil quality, enhancing water infiltration, and supporting biodiversity.

- **Technical Assistance:**

Provide technical support to municipalities and landowners for planning and executing desealing projects. This could involve expert consultations, workshops, and guidelines on best practices.



Research, Monitoring, and Collaboration:

- **Continuous Research:**

Support ongoing research into effective desealing techniques and the long-term impacts of desealing on soil health and ecosystem services. This can help refine and improve desealing strategies over time.

- **Monitoring and Evaluation:**

Establish international frameworks for monitoring soil sealing and the effectiveness of desealing measures. Share successful approaches and lessons learned through transnational cooperation and knowledge exchange platforms.

- **Cross-Border Cooperation:**

Foster cooperation between Alpine countries to share best practices, jointly plan, and coordinate land use management to enhance the effectiveness of desealing efforts.



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Figure 10: Eco-neighbourhood Volonne © Hélène Despagne

Figure 11: Green area at the Nikolaikirchhof © David Engert

Figure 12: Parking place before desealing © Comune di Forlì

Figure 13: Area in Forlì after desealing © Comune di Forlì

Figure 14: Opening of the new Mislejeva Street © Nik Rovani

Figure 15: Northern Park Ljubljana in May 2008 (top) and August 2024 (bottom) © Google Earth Version 9.180.0.1

Figure 16: Parking lot before and after desealing © Christine Murer

Figure 17: Potato-Power © Verein Bodenfreiheit

Figure 18: Renaissance of a bus station © Gemeinde Bruneck

GROUND: BREAKING

Unsealing to improve Soil, Climate and Biodiversity

Improvement of soil, climate and biodiversity through desealing in urban and peri-urban areas of the Alpine region

Healthy soils provide food, ensure biodiversity, offer recreational spaces and play an important role in mitigating and adapting to the climate crisis. Our lives depend significantly on healthy soils. Soils are more than just surface - they provide us with food, filter and purify groundwater and drinking water, act as buffers by binding substances such as CO₂ and also contribute to biodiversity. Every day a large quantity of healthy soil is lost every day, mainly caused by soil use and improper cultivation by humans.

How are European, Alpine wide and national strategies taking into account the topic of soil protection? In which policies, strategies and laws can we find measurements regarding the adaptation/mitigation of the climate and biodiversity crisis in the Alpine Space? And how can the different policy levels in the Alps contribute to the global and European strategies?

This handbook gives an overview of the global and European biodiversity and soil strategies on the topic of unsealing, passing the European and Alpine wide level up to the national level. Benefits for the Alpine Convention and the potential for improvement in the field of unsealing in the individual Alpine countries will be shown and underlined by good practice examples.



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