Strategic Environmental Assessment (SEA) for the

ALPINE SPACE PROGRAMME 2021+

ENVIRONMENTAL REPORT

Final version

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1. Introduction into the report and description of relevant sources of information on the state of the environment

According to **Directive 2001/42/EC**, a Strategic Environmental Assessment (SEA) shall allow the **precautionary view of both positive and negative significant environmental impacts** likely to occur by the implementation of plans and programmes of several matters (defined in Art. 3 (2)), which are prepared and/or adopted by a national/regional/local authority by requirement through legislative, regulation or administrative provisions.

To this aim **the SEA analysed the state of the environment with regard to several environmental issues** (soil, water, climate, air, flora, fauna, biodiversity, human health, population, cultural heritage, material assets and landscape) and described their **likely development without the plan/programme**. Outcomes of this second step are contained as key findings of the scoping and presented together with the key environmental objectives.

In order to identify the relevant information on the state of the environment, authorities in the scope of the programme were consulted at the beginning of the assessment procedure through the contacts of the Task Force and national bodies involved in the process. In order to facilitate the feedback, the SEA team provided a compilation of relevant data (documents, data management sites), which should be necessarily included. Firstly, data sources (EU, national and regional level if applicable) were presented which cover environmental information on all/a large number of environmental issues. Secondly, the report presents matter specific data sources for the environmental issues. Thirdly, the SEA collected **regulations and standards at EU and national level** concerning the environmental issues mentioned above – involving also the environmental authorities over feedback loops through the Task Force and national bodies. The SEA team screened these relevant sources of mandatory framework conditions for the development of the environmental issues and concretized also key environmental objectives for the whole territory.

Against this background the SEA assessed the **likelihood of both positive and negative environmental impacts of the "ASP2021+".** More details on the methodological approach of the SEA are described in section two of this report. Additionally, **alternatives** considered throughout the process are described (section six) as well as hints to **mitigation of environmental impacts** (section eight). Moreover**, interrelationships between the environmental issues** but also **synergies between the priorities and specific objectives** are outlined (section seven). Finally, **recommendations for a SEA monitoring** (section nine) are provided based on the experience of the recent monitoring carried out for the previous funding period. The **non-technical summary** (section ten) contributes an overview of the main outcomes and findings of this environmental report, suitable also for the general public.

Figure 1: Alpine Space programme area extended to EUSALP area. Source and copyright Interreg Alpine Space programme

The present report was established during a project time of two years from 2019 onwards to June 2021 in close cooperation and coordination with the programming bodies. During this time, the area for the new Alpine Space programme was enlarged to the EUSALP delineation (Figure 1) and this expansion was also considered throughout this report.

(1) Environmental reports *(selection of relevant documents)*

a. General information – several environmental issues

EEA – European Environment Agency (2018): Environmental Indicator Report 2018- In support to the monitoring of the Seventh Environment action Programme. Copenhagen, Denmark. https://www.eea.europa.eu/airs/2018

EEA – European Environment Acency (2015): The European Environment - State and Outlook SOER 2015. Copenhagen, Denmark.

Alpine Convention (2018): The Alps in 25 maps, Innsbruck/Bozen, Austria/Italy. https://issuu.com/alpconv/docs/alpconv___the_alps_in_25_maps_a5_20/1?ffande=3524583/60111871

Umweltbundesamt (Environment Agency Austria) (2016): Elfter Umweltkontrollbericht. Umweltsituation in Österreich. Vienna, Austria. https://www.umweltbundesamt.at/umweltsituation/umweltkontrollbericht/ukb/

Ministère de la transition écologique et solidaire (2019): L'environnement en France - Édition 2019 - Focus environnement and santé, Paris, France. https://www.statistiques.developpement-durable.gouv.fr/lenvironnement-en-france-edition-2019-focus-environnement-sante

Bundesamt für Umwelt – BAFU (2018): Umwelt Schweiz 2018, Bericht des Bundesrates (Hrsg.), Bern, Switzerland. https://www.bafu.admin.ch/bafu/de/home/zustand/publikationen-zum-umweltzustand/umwelt-schweiz-2018.html

Veneto region (2008): up-to-date online information, last published report in 2008 ("Rapporto sugli indicatori ambientali del Veneto - Edizione 2008"), Italy: http://www.arpa.veneto.it/arpavinforma/indicatoriambientali/indicatori_ambientali

Friuli Venezia Giulia: Agenzia Regionale per la protezione dell' ambiente del Friuli Venezia Giulia - ARPA FVG (2018): Rapporto sullo stato dell'ambiente in Friuli Venezia Gulia, Palmanova (UD), Italy. http://www.arpa.fvg.it/cms/istituzionale/consulta/Pubblicazioni/Rapporto-sullo-Stato-dellAmbiente-2018.html

Trentino: Agenzia provinciale per la protezione dell'ambiente (2016): 8° rapporto sullo stato dell'ambiente della Provincia di Trento, Trento, Italy. http://www.appa.provincia.tn.it/rapporto_ambiente_2016/

Landesagentur für Umwelt – Agenzia per la protezione dell'ambiente (2018): Performance plan 2018-2020, Bozen, Italy. Further detailed information on indicators online https://umwelt.provinz.bz.it/dienstleistungen/umweltinformationen.asp

Umweltbundesamt (2017): Daten zur Umwelt 2017, Indikatorenbericht, Dessau, Germany.

Umweltbundesamt (2019): Veröffentlichung des 6.Globalen Umweltberichts (GEO-6) 2019: Analyse der Implikationen für Deutschland Abschlussbericht, Dessau, German. https://www.umweltbundesamt.de/publikationen ´

Bayrisches Landesamt für Umwelt (2019): Umweltatlas Bayern, München, Germany. https://www.umweltatlas.bayern.de/startseite/

b. Climate/ Air (including Climate Change)

Alpine Convention (2019): Climate-neutral and Climate resilient Alps 2015. Decleration of Innsbruck, Alpine Climate Target system 2050, 7th report on the state of the Alps.

Alpine Convention (2018): The Alps in 25 maps, Innsbruck/Bozen, Austria/Italy. https://issuu.com/alpconv/docs/alpconv___the_alps_in_25_maps_a5_20/1?ffande=3524583/60111871 (Map 21-25)

Alpine Convention (2007): Declaration on climate change. https://www.alpconv.org/fileadmin/user_upload/downloads/downloads_en/1_convention_en/convention_protocols_en/ac_IX_declarationclimatechange_en_fin.pdf

Alpine Convention (2007): Protocol on the implementation of the 1991 Alpine Convention in the field of transport. Transport protocol. Online: https://www.alpconv.org/fileadmin/user_upload/downloads/downloads_en/1_convention_en/convention_protocols_en/transportprotocolEN.pdf

EEA – European Environment Agency (2018): Eutrophication of terrestrial ecosystems due to air pollution, European Environment Agency (AIRS_PO1.1) (https://www.eea.europa.eu/airs/2018/naturalcapital/ eutrophication-of-terrestrial-ecosystems)

EEA – European Environment Agency (2018): Greenhouse gas emissions, (AIRS_PO2.5) (https://www.eea.europa.eu/airs/2018/resource-efficiency-and-lowcarbon-economy/greenhouse-gas-emission).

EC - European Commission (2013): Adapting infrastructure to climate change. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. An EU Strategy on adaptation to climate change. SWD 2013, 137 final. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52013SC0137andfrom=en

EC - European Commission (2013): The EU Strategy on adaptation to climate change. Strengthening Europe's resilience to the impacts of climate change. https://ec.europa.eu/clima/sites/clima/files/docs/eu_strategy_en.pdf

Ministère de l'ecologie, du Developpment durable et de l'Ènergie (2016): Chiffres clés du climat France et Monde, Édition 2016, Paris.

Bundesamt für Umwelt – BAFU (2018): Deposition von Luftschafstoffen in der Schweiz. Moosanalysen 1990-2015, Bern.

Bundesamt für Umwelt – BAFU (2013): Klimaänderung in der Schweiz, Indikatoren zu Ursachen, Auswirkungen, Maßnahmen, Bern.

Bundesamt für Umwelt BAFU (2018): Luftqualität 2017, Messresultate des Nationalen Beobachtungsnetzes für Luftfremdstoffe (NABEL), Bern.

BAFU – Bundesamt für Umwelt (2014): Anpassung an den Klimawandel in der Schweiz, Aktionsplan 2014–2019. Zweiter Teil der Strategie des Bundesrates vom 9. April 2014, Bern.

BNT vormals BMLFUW – Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft (Hrsg.) (2012a): Die österreichische Strategie zur Anpassung an den Klimawandel. Teil 1 – Kontext. Wien

BNT vormals BMLFUW – Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft (Hrsg.) (2012a): Die österreichische Strategie zur Anpassung an den Klimawandel. Teil 2 – Aktionsplan. Handlungsempfehlungen für die Umsetzung. Wien

BNT vormals BMLFUW - Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft (2017): Die österreichische Strategie zur Anpassung an den Klimawandel. Aktualisierte Fassung, Wien.

BMNT (vormals BMLFUW), Land Burgenland, Land Kärnten, Land Oberösterreich, Land Salzburg, Das Land Steiermark, Tirol, ZAMG, Uni Graz, Universität Salzburg, Z-GIS (2016): Endbericht. ÖKS15 | Klimaszenarien für Österreich. Daten – Methoden – Klimaanalyse. https://data.ccca.ac.at/en/dataset/endbericht-oks15-klimaszenarien-fur-osterreich-daten-methoden-klimaanalyse-v01/resource/06edd0c9-6b1b-4198-9f4f-8d550309f35b

BMU – Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (2009): Dem Klimawandel begegnen. Die Deutsche Anpassungsstrategie, Berlin.

BMU – Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (2015): Aktionsplan Anpassung der Deutschen Anpassungsstrategie an den Klimawandel vom Bundeskabinett am 31. August 2011 beschlossen, Berlin.

Bayerisches Staatsministerium für Umwelt und Verbraucherschutz (2016): Bayerische Klima - Anpassungsstrategie Ausgabe 2016. München.

c. Soil (and Land)

Alpine Convention (1994): Protocol on the implementation of the Alpine Convention of 1991 relating to spatial planning and sustainable development. “Spatial Planning and Sustainable Development” Protocol. Online: https://www.alpconv.org/fileadmin/user_upload/downloads/downloads_en/1_convention_en/convention_protocols_en/protokoll_RaumplanungGB.pdf

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Bundesamt für Umwelt BAFU, Bundesamt für Landwirtschaft BLW, Bundesamt für Raumentwicklung ARE, Nationales Forschungsprogramm NFP 68 (Hrsg., 2015): Bodenschätze. Nachhaltige Nutzung der Ressource Boden.

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Bundesamt für Umwelt – BAFU (2017): Boden in der Schweiz, Zustand und Entwicklung, Bern.

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d. Water

Birk, S., Strackbein, J., Hering, D. (2010): WISER methods database. http://www.wiser.eu/results/method-database/

Bundesamt für Umwelt BAFU (2019): Hydrologisches Jahrbuch der Schweiz 2018. Abfluss, Wasserstand und Wasserqualität der Schweizer Gewässer.

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EEA – European Environment Agency (2018): Freshwater use, (AIRS_PO2) (https://www.eea.europa.eu/airs/2018/resource-efficiency-and-low-carboneconomy/freshwater-use).

EEA – European Environment Agency (2018): Surface waters (AIRS_PO1.9) (https://www.eea.europa.eu/airs/2018/natural-capital/surface-waters).

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BMLFUW - Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft (2015): Nationaler Hochwasserrisiko-Managementplan, Rmp 2015.

Umweltbundeamt Dessau (2018). Umwelt und Landwirtschaft, Dessau.

e. Flora/Fauna/Biodiversity

Alpine Convention (2018): The Alps in 25 maps, Innsbruck/Bozen, Austria/Italy. https://issuu.com/alpconv/docs/alpconv___the_alps_in_25_maps_a5_20/1?ffande=3524583/60111871 (Map 15-18).

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EEA – European Environment Agency (2018): EU protected species, (AIRS_PO1.7) (https://www.eea.europa.eu/airs/2018/natural-capital/eu-protected-species).

EEA – European Environment Agency (2018): EU protected habitats (AIRS_PO1.8), (https://www.eea.europa.eu/airs/2018/natural-capital/eu-protected-habitats).

Katsanevakis S, Deriu I, D'Amico F, Nunes AL, Sanchez SP, Crocetta F, Arianoutsou M, Bazos I, Christopoulou A, Curto G, Delipetrou P, Kokkoris Y, Panov V, Rabitsch W, Roques A, Scalera R, Shirley SM, Tricarino E, Vannini A, Zenetos A, Zervou S, Zikos A, Cardoso AC, (2015). European Alien Species Information Network (EASIN): supporting European policies and scientific research. Management of Biological Invasions 6(2) 147-157. http://dx.doi.org/10.3391/mbi.2015.6.2.05

European Alien Species Information Network - EASIN https://easin.jrc.ec.europa.eu/easin

Ministère de la transition écologique et solidaire, Commissariat général au développement durable (2019): Atlas environnemental des sttion de ski et des communes support de stations, Paris.

Bundesamt für Umwelt - BAFU (2017): Biodiversität in der Schweiz, Zustand und Entwicklung. Bern.

Bayerisches Landesamt für Umwelt (2019): Alpenbiotopkartierung Bayern, München, Germany.

f. Landscape

Alpine Convention (2018): The Alps in 25 maps, Innsbruck/Bozen, Austria/Italy. https://issuu.com/alpconv/docs/alpconv___the_alps_in_25_maps_a5_20/1?ffande=3524583/60111871 (map 15)

Council of Europe Landscape Convention (2000): European Landscape Convention

Bundesamt für Umwelt BAFU (2017): Wandel der Landschaft: Erkenntnisse aus dem Monitoringprogramm Landschaftsbeobachtung Schweiz (LABES).

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g. Human health/ Population

Alpine Convention (2006): Declaration "Population and culture" https://www.alpconv.org/fileadmin/user_upload/downloads/downloads_en/1_convention_en/convention_protocols_en/popCult_en.pdf

Bundesamt für Umwelt BAFU (2018): Lärmbelastung in der Schweiz, Bern.

Bundesamt für Umwelt – BAFU (2018): Deposition von Luftschafstoffen in der Schweiz. Moosanalysen 1990-2015, Bern, Switzerland.

Bundesamt für Umwelt – BAFU (2016): Umweltbelastungen des alpenquerenden Güterverkehrs, Bern, Switzerland.

Bundesamt für Umwelt BAFU (2014): Luftverschmutzung und Gesundheit, Bern.

Bundesministerium für Nachhaltigkeit und Tourismus – BMNT (2018): Umgebungslärmaktionsplan Österreich, Allgemeiner Teil, Zusammengefasste Betroffenheitsauswertung, Wien, Austria. https://www.laerminfo.at/

h. Cultural heritage and material assets

Alpine Convention (2018): The Alps in 25 maps, Innsbruck/Bozen, Austria/Italy. https://issuu.com/alpconv/docs/alpconv___the_alps_in_25_maps_a5_20/1?ffande=3524583/60111871 (Map 19)

Ständiges Sekretariat der Alpenkonvention (2013): Nachhaltiger Tourismus in den Alpen, Zustandsbericht, Innsbruck/Bozen, Austria/Italy.

(2) Legal requirements and standards (focus on EU regulations, national regulations if relevant)

a. Soil

Comission of the European Communities (2001): COMMUNICATION FROM THE COMMISSION A Sustainable Europe for a Better World: A European Union Strategy for Sustainable Development. COM(2001)264 final.

Commission of the European Communities (2006b): COMMUNICATION FROM THE COMMISSION TO THE COUNCIL, THE EUROPEAN PARLIAMENT, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Thematic Strategy for Soil Protection. COM(2006)231 final.

Commission of the European Communities (2006c): Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing a framework for the protection of soil and amending Directive 2004/35/EC. COM(2006) 232 final.

Commission of the European Communities (2009): COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS - Mainstreaming sustainable development into EU policies: 2009 Review of the European Union Strategy for Sustainable Development. COM(2009) 400 final

Commission of the European Comunities (2006): COMMUNICATION FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT on Thematic Strategy on the Urban Environment. COM(2005) 718 final.

Council of the European Union (2006): COUNCIL REGULATION (EC) No 1083/2006of 11 July 2006 laying down general provisions on the European Regional Development Fund, the European Social Fund and the Cohesion Fund and repealing Regulation (EC) No 1260/1999. Official Journal of the European Union, L210/25.

ESPON (2007): ESPON 2013 PROGRAMME European observation network on territorial development and cohesion - Adopted by European Commission Decision C(2007) 5313of 7 November 2007. CCI 2007 CB 163 PO 022.

European Commission (1999): ESDP European Spatial Development Perspective - Towards Balanced and Sustainable Development of the Territory of the European Union. Luxembourg, Luxembourg: Office for Official Publications of the European Communities.

European Community (2005): PROTOCOL on the implementation of the Alpine Convention of 1991 in the field of soil conservation Soil Conservation Protocol. Official Journal of the European Union, L337/29.

European Parliament and Council (2002): DECISION No 1600/2002/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 22 July 2002, Official Journal of the European Communities, L 242/1.

European Parliament and Council (2012): DECISION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on a General Union Environment Action Programme to 2020 "Living well, within the limits of our planet". COM(2012) 710 final.

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Italian Legislation (2006): Environment Regulation. D.LGS 152/06.

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b. Water

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Council of the European Communities (1991): Council Directive 91/271/EEC of 21 May 1991 concerning urban waste-water treatment. Official Journal of the European Communities, L 135/40.

Council of the European Communities (1991b): Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources. Official Journal of the European Communities, L 375/1.

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European Parliament and Council (2000): DIRECTIVE 2000/60/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 October 2000 establishing a framework for Community action in the field of water policy. Official Journal of the European Communities, L327/1.

European Parliament and Council (2006): Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration. Official Journal of the European Communities, 372/19.

European Parliament and Council (2008): DIRECTIVE 2008/1/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 15 January 2008 concerning integrated pollution prevention and control. Official Journal of the European Union, L 24/8.

Austrian Parliament (1959): Wasserrechtsgesetz 1959 - WRG 1959. BGBl. Nr. 215/1959.

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2. Methodological approach

As a follow-up to the first and second SEA report elaborated in 2008 and 2013 in compliance with the SEA Directive (2001/42/EC), this third application of a Strategic Environmental Assessment builds upon a **methodological approach** tested already in the previous two assessment processes. Additionally, it **integrates results of the monitoring process** (mid-term monitoring Alpine Space Programme 2014-2020), which takes place in parallel to the elaboration of the SEA.

The well-established approach of the SEA team is presented in the following pages of section 2 "Methodological approach". Overall, the assessment methodology was agreed with the institutions involved in the development of the Alpine Space Programme 2021+ and the representative of the Commission of the European Union.

a. Assessment approach to identify likely significant environmental impacts

Subject of the environmental assessment of the Alpine Space Operational Programme are the Priorities and the Objectives within the Priorities. These assessment subjects reflect the level of detail of the Alpine Space Operational Programme and allow for an evaluation of the environmental effects on a strategic level.

The assessment of environmental impacts is carried out **against the background of the description of the state of the environment** as well as trends and **the likely development without the programme**.

The evaluation of likely impacts by the programme includes the following aspects:

- The **likelihood of significant environmental effects based on the evaluation of the past programme and its implementation**: if in the past a similar priority did not cause any significant impacts then the same can also be expected for the current programme.
- The **likelihood of significant environmental impacts based on the available information**: Within the Priorities the context and rationale of the Priority, the indicative activities of the Priorities and the target groups, target sectors, target areas and main beneficiaries are all listed. This information shows even for these very broad and general objectives how possible projects can look like and what kind of projects the Programme partners expect. This interpretation of the

Priorities and Objectives is used to estimate the environmental effects and to justify the assessment results.

The assessment of environmental impacts is based on a verbal argumentation. The argumentation is formalised in assessment tables. The basis for the assessment provides the zero variant**.** It constitutes the likely development path of the region (and its environmental issues) thereof without the implementation of the programme. Additionally, information of the past programming period serve as back ground information. As a follow-up to the first and second SEA report elaborated for the Alpine Space Programme in 2008 and 2013 in compliance with the SEA Directive (2001/42/EC), a first environmental monitoring was conducted to assess the results of the implemented programme and projects funded under the Alpine Space Programme 2014-20 in the past seven years. It builds upon an indicated approach of the first two SEAs carried out for the Alpine Space Programme and comprised a validity check of the statements made in the SEA, including preventive, compensatory and offsetting measures (GRDP 2006, p.30).

The results of the monitoring (Jiricka-Pürrer et al. 2020) serve now as important source of information for the Strategic Environmental Assessment. Overall, the monitoring confirmed the positive awareness of benefits considering environmental sustainability by the Alpine Space Programme's responsible institutions and experts involved. Environmental topics and achievements were wide-spread in the outcomes among all priorities. No significant negative environmental impacts were identified at the end of the five-step monitoring process, despite uncertainty pertaining from the SEA for some Specific Objectives, which were documented in the Environmental Report of 2013.

The assessment is structured as follows:

- Interpretation of possible outcomes of the actions for each specific objective and their relevance for the environmental issues including also the background information of the monitoring results of similar objectives;
- Presentation of the main findings in the assessment table: The assessment table includes environmental issues, the possible impacts and an explanation of the classification including indirect effects as well as the mentioning of possible mitigation measures (see below);
- Explanation of the results and description of the background.

Environmental impacts are classified in five categories, ranking from significant positive environmental impacts, to no significant environmental impacts and finally significant negative environmental impacts. Significant negative impacts are differentiated into high, medium and slight categories according to the following classification rules (

While negative impacts were classified in order to allow the consideration of mitigation measures, if relevant, in three categories, positive impacts are addressed in one category. As the programme attempts to contribute strongly to significant positive impacts on the environment the summarizing table after each assessment of the specific objectives outlines the variety of environmental objectives which are addressed. Moreover the positive interrelationships between the specific objectives are outlined.

Table 1).

While negative impacts were classified in order to allow the consideration of mitigation measures, if relevant, in three categories, positive impacts are addressed in one category. As the programme attempts to contribute strongly to significant positive impacts on the environment the summarizing table after each assessment of the specific objectives outlines the variety of environmental objectives which are addressed. Moreover the positive interrelationships between the specific objectives are outlined.

Table 1: Assessment Scheme for SEA

Assessment Scheme	
positive impacts	• Significant positive impacts on the environmental issue likely expected
no significant impacts	• No relevancy concerning the respective environmental issue
high negative impacts	• Highly negative impacts on the environmental issue, no mitigation measures available
medium negative impacts	• Highly negative impacts on the environmental issue(s) are expected, but effective mitigation measures are available • Medium significant impacts on the environmental issue, no mitigation measures available
slight negative impacts	• Medium significant impacts on the environmental issue are expected, but effective mitigation measures are available • Low impact on the environmental issue

- SEA classifies impacts as likely to be **"high negative",** if the expected effects on the environmental issues are severe and irreversible and cannot be minimized by any mitigation measures.
  This is the case if areas, which are highly sensitive to environmental impacts are likely to be affected, e.g. near-natural landscapes in protected areas, or if the environmental effect can be intensive and might be irreversible, e.g. in case of sealing of larger areas/ land consumption.

- An environmental impact is classified as **"medium negative**" if, from the context of the Objective, it can be concluded
  - that only areas with medium sensitivity against environmental disturbances are prone to negative impacts.
  - environmental impacts are of medium scale.

  Furthermore, the objective is assessed as having a "medium negative" impact in case of a high negative impact that can be reduced accordingly by mitigation or compensation measures.

- A significant environmental impact is classified as **"slight negative",** whose effect on the environmental issues are significant
  - but very limited in time or space and

- provoke only slight disturbances to the original state of the environmental issue and/or
- concern an environment that is relatively insensitive to environmental impacts, e.g. monotonous agricultural landscapes with intensive use or settlement areas with a high share of building land.

Moreover, objectives with medium significant impacts are classified as slight if mitigation and compensation measures can be applied, which appropriately reduce the negative impact(s).

b. Environmental indicators for the assessment of environmental impacts

One aim of the SEA is to provide **a transparent background for the consideration of environmental impacts** likely to occur. For this purpose, **indicators serve as a baseline to ensure comparability** between the objectives but also **to allow monitoring** after the implementation of the programme. In Table 2 the major indicators for the assessment of likely environmental impacts are presented.

Climate change related topics are **considered across all environmental issues if relevant as one over-arching challenge** (impacts by climate change on the sensitivity of the environmental issues).

Table 2: Indicators for the assessment of the environmental issues

Environmental Issues	Indicators
Soil	• Sealing • Influence on soil quality (contamination) • Susceptibility to erosion
Water	• Influence on ground water (quality, scarcity, etc.) • Impact on surface water (quality, quantity) • Connectivity of water bodies
Climate/Air	• Air quality • Influence on greenhouse gas emissions • Influence on mirco- and mesoclimate conditions
Fauna/Vegetation/Biodiversity	• Habitat fragmentation/ disturbance of corridors and networks • Influence on habitats and species (condition) • Focus on Natura 2000 sites and PA under category I to III of the IUCN criteria
Landscape	• Landscape functionality and characteristics • Landscape aesthetics and natural scenery • Maintenance of cultural landscapes
Human Health/ Population	• Emissions (such as noise, air pollution, vibrations) • Emission related diseases • Impact on recreational capacity/ attractiveness for recreation
Material Assets/Cultural Heritage	• Impact on cultural ensembles/ traditional settlement structures • Impact on cultural heritage by emissions/ vibrations • Enhancement of exchange of immaterial cultural heritage

3. State of the Environment, Environmental Trends (Zero variant) and Key Environmental Objectives

a. Soil

STATE OF THE ENVIRONMENT

The state and protection of soil in the Alps is of importance for both the environment as well the inhabitants. Many vital ecosystem services such as in biodiversity and fertility, reservoir and climate regulation, soil as a resource and especially structural functions are provided by soil (Dominati, Patterson and McKay 2010, JRC 2009, 2012, Havelick and Mitchell 2014, BAFU 2015). The Alpine convention has recognized the value of soil in both Protocol on Soil Conservation (Alpine Convention 2005) as well as Article 3 of the Spatial Planning and Sustainable Development Protocol (1994) as they call to the prudent use of natural resources in recognition of its natural functions, functions for conserving natural history along with its importance for human settlement and agriculture. The concentration in these documents are given to the ecological importance of this valuable resource. And although the mapping, monitoring and protection of soil as a joint and cross-border task of the Alpine nations was also brought forward by the Alpine Convention in the 1990s, data availability and collection continuous to be lacking (JRC 2016, BAFU 2015). The Alpine Soils Platform (2017) currently offers best practice, case study, and consultancy services along with information about soils as a result of the Links4Soil project. The large-scale collection of soil data remains challenging, as there is little harmonization across the classification methods. In this regard, Baruck et al. (2016) indicate the concentration on individual or point based collection and highlight that Alpine-wide classification systems are not applied. Olesen (2013) also addresses the need for soil data to achieve progress in legislation and policy on soils role in climate change.

Recognizing these critiques, the general state of soil in the alpine nations can still be discussed. Soil is influenced by both natural phenomena as well as human activity. The Alpine region is characterized by a variety of soil influencing factors such as climate, vegetation, geological features and topography which all lead to particularly interesting dynamics and diverse soil features (Baruck et al. 2016). These features that make soil so diverse and unique can partially take the form of threats. Climate change, especially in combination with human economic activity and development policies can lead to degradation of soil. These threats include soil erosion through wind and water, decline in soil organic matter, compaction, sealing, contamination, and decline in soil biodiversity (Robinson et al. 2017). Amongst these threats it can be said that human activity demonstrates stronger links to sealing and contamination threats, while climate more strongly affects soil with regard to erosion (JRC 2016).

The implementation and on-going activities of Soil Thematic Strategy of 2006 has been documented (European Commission 2012). The state of soil in Europe continues to be affected by three main issues: Sealing, contamination and erosion.

Estimates indicate 2.8 million potentially polluted sites in the EU, of which 650.000 contaminated sites are listed in national or regional registries due to different activities (Figure 2). 65.500 contaminated sites have been cleared. According to the National Environmental Implementation Reviews (EC 2019a-e), contamination cites in Italy (22.100), France (6.478), Germany (260.883) and

Austria (68.596) remain high in number. Amongst the alpine nations, only Slovenia (378) is seen to have low contamination rates. While remediation has been successful in select areas in Europe and the above nations engage in remediation, problems remain. As remediation is a slow process and the number of contaminated areas very high, the rate of remediation remains low. Remediation follows soil criteria which require strategic management and inspection, especially in industrial areas or concerning waste management.

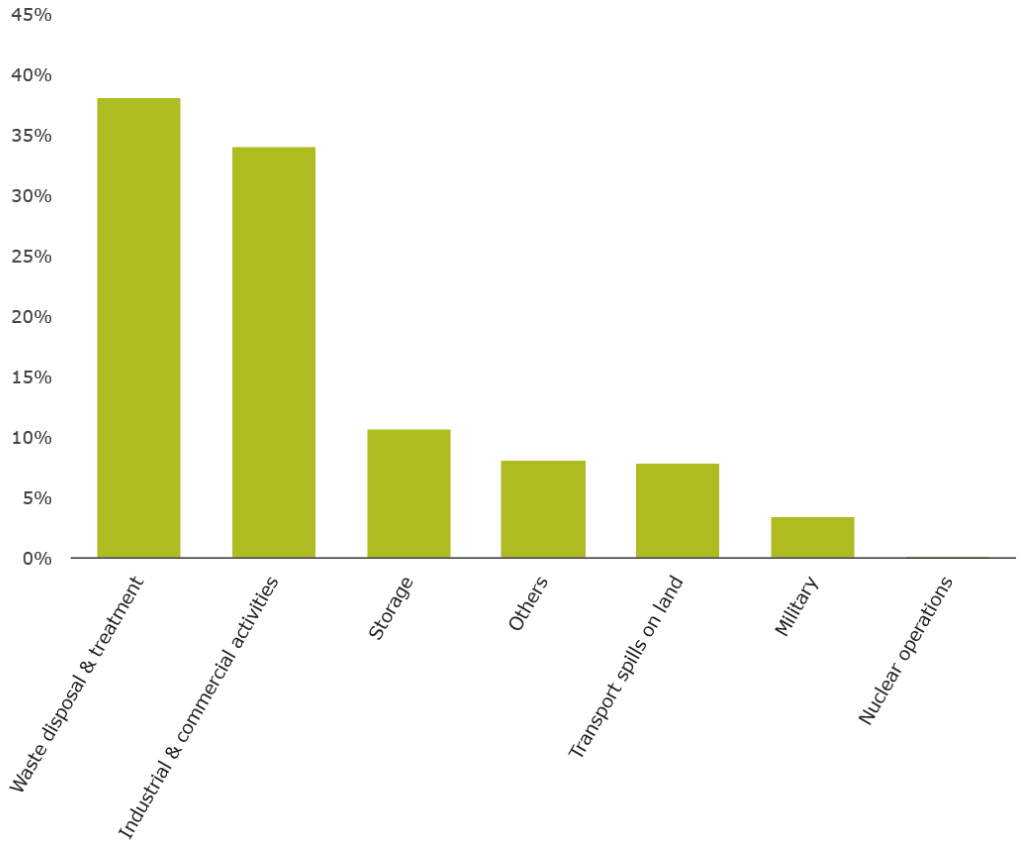

Figure 2: Key sources of soil contamination. EEA 2014

Another threat to soil caused through human activity is sealing. Poor spatial planning or poor strategic use of this finite resource often results in land-use and infrastructure developments leading to soil sealing (JRC 2016, ÖROK 2011). Generally, sealing is recognized as an important environmental topic and incorporated into the national policies of the alpine nations in key spatial planning regulations (Environmental Agency Austria 2011). To actively reduce sealing improved spatial planning, avoiding urban sprawl, strategic use of brownfields and the protection of open space are required. This should be accompanied through reliable data collection to monitor mitigation efforts.

Sealing leads to less available fertile soils, reduction of soil functions, loss of water retention, soil carbon sequestration and carbon storage, and fragmented landscapes (JRC 2016). Over the past twenty years, there have been slight fluctuations in land-take rates, there is a general increase in land take and therefore sealing due to human activity. Current artificial land coverage is highest in Germany (7.3%) and Italy (7%) with Austria and France following closely behind (6.6% and 5.3% respectively). Slovenia has the lowest rate of artificial land cover at 3.3% (European Commission 2019a-e). While some nations follow target values to reduce sealing, Italy and Slovenia do not (Environmental Agency Austria 2011).

Table 3 illustrates the growing artificial surface per land cover type between 2000 and 2018 for the Alpine nations Austria, France, Germany, Italy, Slovenia and Switzerland. Industrial and commercial use along with low density sprawl continues to be the leading and strongest growing land cover types.

Table 3: Increase in artificial surface per land cover type and land take for Austria, France, Germany, Italy, Slovenia and Switzerland 2000-2018. EEA 2019. https://www.eea.europa.eu/data-and-maps/dashboards/land-take-statistics

	Landtake 2000 - 2018		km^2	%		
	Austria	**France**	**Germany**	**Italy**	**Slovenia**	**Switzerland**
Industrial and Commercial	34,97	662,47	418,18	426,91	3,74	5,88
	16,67%	**30,74%**	**30,28%**	**44,79%**	**16,67%**	**20,45%**
Urban sprawl - diffuse	30,63		329,92	205,69	0,73	3,45
	14,68%		**23,89%**	**21,58%**	**3,25%**	**12%**
Construction	21,7	184,53	137	112,41	7,47	6,56%
	10,40%	**8,56%**	**9,92%**	**11,79%**	**33,30%**	**22,81%**
Mines	30,3	251,36	352,22	87,86	2,92	8,17
	14,52%	**11,66%**	**25,50%**	**9,22%**	**13,02%**	**28,41%**
Transport	12,34	143,11	25,16	57,17	5,18	1,00%
	5,91%	**6,64%**	**1,82%**	**6%**	**23,09%**	**3,48%**
Sport and leisure	76,1	68,34	71,48	32,05	1,24	3,65
	36,77%	**3,17%**	**5,18%**	**3,36%**	**5,53%**	**12,66%**
Dumpsites	0,43	12,07	14,19	10,75	0,96	
	0,21%	**0,56%**	**1,03%**	**1,13%**	**4,28%**	
Airports	0,52	8,44	25,25	6,57	0,19	0,06
	0,25%	**0,39%**	**1,83%**	**0,69%**	**0,85%**	**0,21%**
Green urban areas	0,59	2,07	2,43	3,54		
	0,28%	**0,10%**	**0,18%**	**0,37%**		
Harbours			2,51	7,76		
			0,18%	**0,81%**		
Urban sprawl-dense	0,44	814,39	2,77	2,41		
	0,21%	**37,78%**	**0,20%**	**0,25%**		
Total	**208,02**	**2146,78**	**1381,11**	**953,12**	**22,43**	**21,29**

Extreme weather events pose a threat to increasing erosion (Figure 3). In accordance with current weather patterns and climate change, erosion in the Alps is expected to increase further as soil production is slower than erosion (BAFU 2014). While erosion by water is a natural process, it is also influenced by vegetation cover along with the impacts from deforestation, agriculture and construction which influence and accelerate erosion rates in addition to the threats arising from climate change. Erosion, therefore, carries a high anthropomorphic element. The results are loss of biodiversity, vegetation cover and growing sediment amounts in rivers and lakes. An increase in landslides is expected as well (BAFU 2014). Work on soil erosion indicators and mapping continues. Land-use planning will be crucial to ensure erosion can be limited and must consider the high erosion

risk the Alps imply through their topography but also the importance of vegetation cover and the influence of human activity.

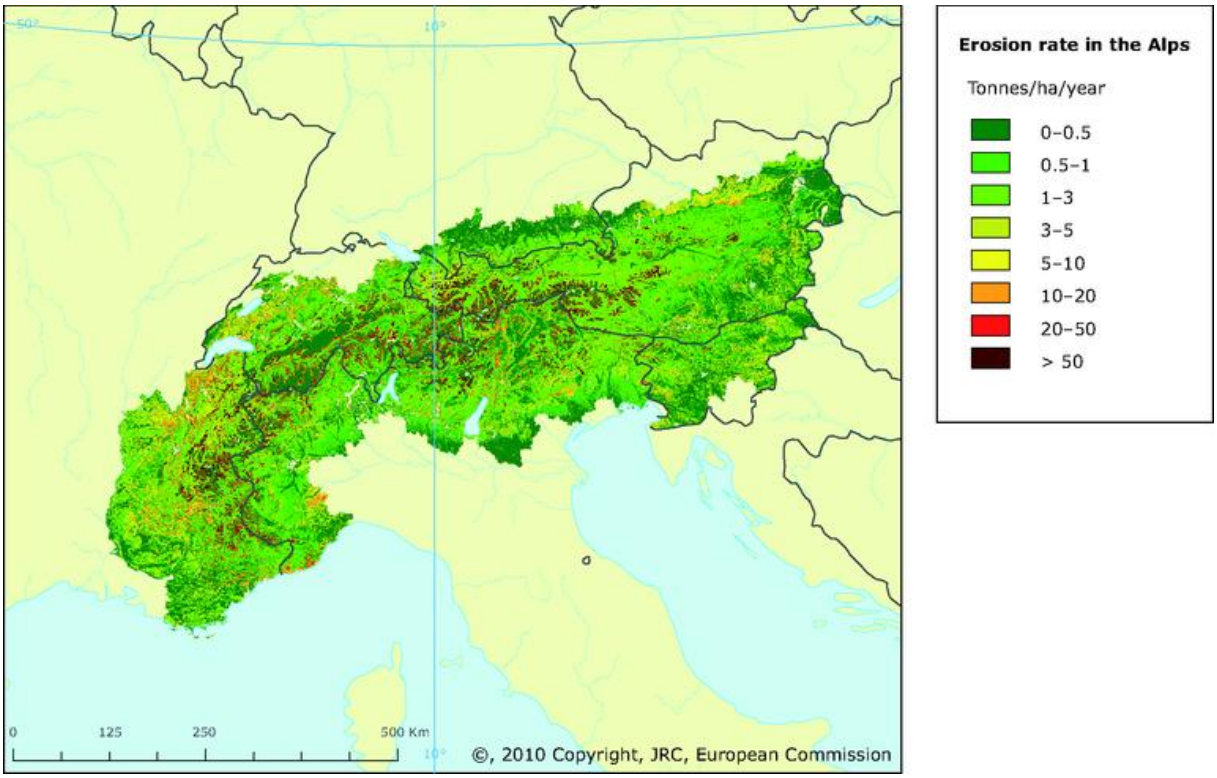

Figure 3: Soil Erosion in the Alps (European Commission 2017)

Summarizing the current state of soil in the Alps, clear threats of climate change and human activity continue to be visible and have not been strongly reduced over the past decade. The collection of data to monitor both the threats and mitigation efforts continue to be an issue (Stolte et al. 2016).

TREND (ZERO VARIANT)

Soils both affect and are affected by climate change. Under climate change, ecosystem performance will change in regard to its microclimate; greatly influencing nutrient values, plant-based nitrogen levels, carbon storage, vegetation cover and overall productivity (Körner 2003, Winkler 2019). Aside from the microclimatic changes, trends indicate that the soil threats of erosion, sealing and contamination are on the rise.

Soil erosion caused by water is a rising trend (FAO and ITPS 2015). Further erosion of soils will lead to loss of organic matter in peat soils, decline of mineral soils, and desertification (JRC 2015). Biodiversity is at risk. As erosion increases the soils ability to store, buffer and filter will reduce. This leads to additional risk of natural hazards including flooding and landslides. However, current trends indicate that this risk is to be considered moderate (FAO and ITPS 2015).

Soil sealing will cause compaction, pollution and negatively impact local climate (JRC 2015). While the current condition is poor, the trends indicate that sealing and land take are slowing (FAO and ITPS 2015, EEA 2014). In the Alps, sealing continuous to occur predominantly in the valleys and around the urban areas due to the morphology of the mountain range (ESPON 2019). Climate change adaptation aggravates conflicts about land use in those parts of the alpine territory, where preventative measures to natural hazards are required (see human health/population) and/or land is taken for renewable energy production for the purpose of climate change mitigation. Additionally, in metropolitan areas the scarcity of space and the simultaneous need for urban expansion combined with further sealing can create increasing conflicts of interest around the use of open spaces. The reduction of sealing can prevent the reduction of heat islands. In this context multiple land-use concepts will gain stronger importance. Benden et al. (2015) emphasize the need for further research on diverse synergies in the utilization of space and point out the benefits in coping with multiple impacts of climate change simultaneously.

Soil contamination continues to be a threat to soil According to the FAO and ITPS (2015), the number of polluted sites is expected to increase. It is worth mentioning, that the expected increase is also linked to improved monitoring and data collection. Current estimates indicate 2.5 million potentially contaminated sites of which roughly 342.000 have been identified. Of these, 15% have been remediated (EEA 2014). The EEA (2014) expects an increase of about 50% of the currently identified sites by 2025. The EEA report (EEA 2014) illustrates how great the difference between identified and estimated sites actually is, though.

As remediation remains a slow and costly activity, this means the current trend is a contamination rate which is higher than the remediation rate. Should remediation remain slow, soil contamination will continue to negatively impact biodiversity, biomass production (also in agriculture and forestry) and erosion (JRC 2015). After remediation, soils tend to demonstrate simpler morphologies, although characteristics are restored in the medium to long-term (Curtaz et al 2015). Meaning that even after intense use, recovery is quick.

In order to face the current trends head on, it is necessary to collect extensive soil data across the alpine nations to ensure that evaluation and monitoring of soil erosion, sealing and pollution can be conducted. Much more pressing, however, is the necessity to engage in pro-active land-use planning and establish mandatory rules for soil protection (Geitner et al. 2017, Pintaldi et al. 2017, Alpine Soil Platform 2017). The strongest negative trends stem from anthropogenic acts. Therefore, the only solution is to adapt human activity accordingly.

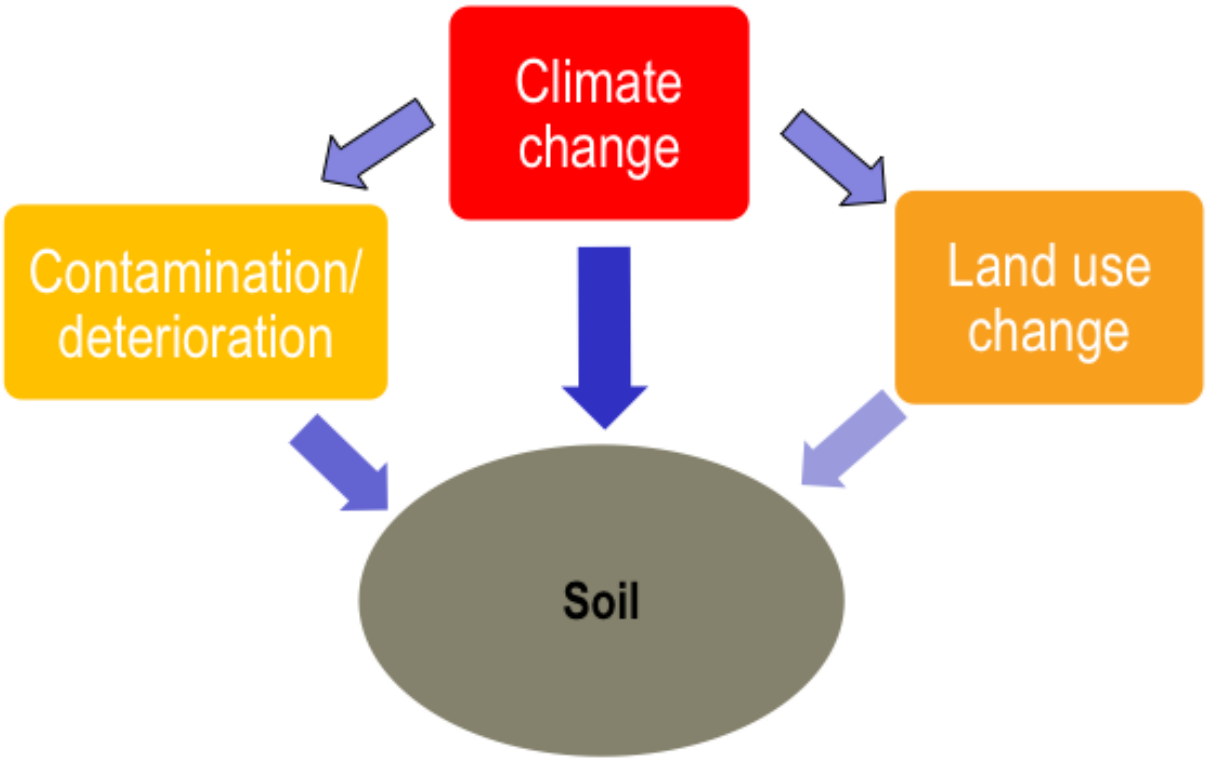

Figure 4: Key challenges for soil

KEY ENVIRONMENTAL OBJECTIVES "SOIL":

- Reduce sealing through improved spatial planning, strategic use of brownfields, protection of open space
- Enhance soil quality and retention capacity
- Prevent erosion (adapt to climate change)
- Remediate contaminated soil, follow soil-quality criteria, strategic management/inspection (part. industry and waste)
- Control/ mitigate land degradation
- Enhance soil biodiversity

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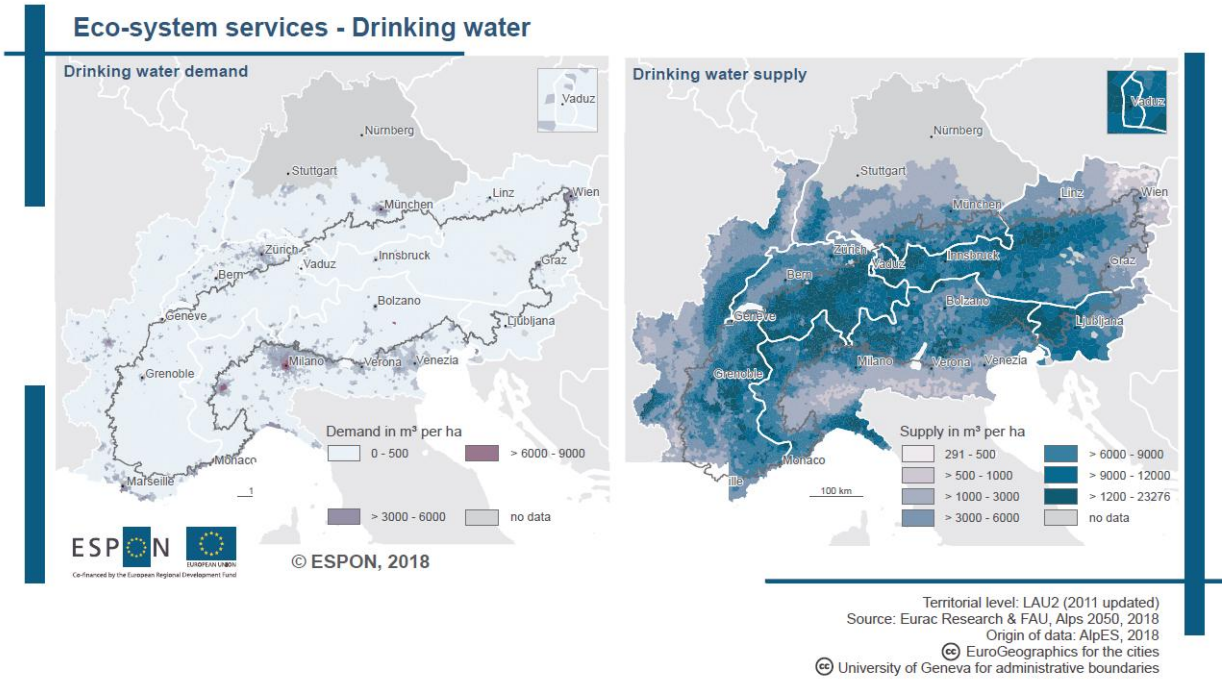
b. Water

STATE OF THE ENVIRONMENT

The Alps are both an important fresh water resource (Figure 5) in Europa and an area with strong water demand for diverse sectors (European Environment Agency 2016). Alpine rivers transport huge amounts of debris. Thereby new habitats are constantly created, while others are destroyed. Fluvial systems are therefore highly dynamic. Alpine surface water bodies are largely influenced by modifications, most of all for the production of energy leading to structural and functional deficits of many alpine water bodies. Both quantity and quality are influenced, however, also by a series of sectors such as industry, tourism, agriculture and hazard protection. In some parts of the Alpine Space territory also waste water deteriorates still the quality of surface water bodies (e.g. European Commission 2019e). Alpine rivers and lakes originally contained a very specific, highly specialized fish fauna. Over the past decades exotic species were introduced. As the alien species affect the local species, these interferences are harmful to the alpine water bodies.



Map 30 Eco-system services – Demand and supply of surface water

Figure 5: Drinking water supply and demand in the Alps and surrounding areas (AlpES 2018, ESPON 2019)

In addition to the before mentioned factors such as land use change and the introduction of neobiota, climate change has a strong impact on both water quality and quantity in the Alpine area (BMFLUW 2012 and adapted version 2017, BMU 2011, BAFU 2014, Szolgayova et al. 2014). Due to an increase in mean annual temperatures, a rise in water temperatures and associated change in oxygen levels have already been observed (Palmer et al. 2014). Already in 2009, the EEA summarised impacts of changing water resources and their implications on biodiversity. Especially cold-water fish species are stressed by warmer water temperatures, whereas other fish seem to profit (e.g. Cyprinidae). These could lead to shifts and losses of species in rivers, streams and lakes, particularly

in the greyling and trout regions (Melcher et al. 2013, Schmied et al. 2014, Burckhardt-Holm 2009). Pletterbauer et al. (2012) also discuss climate change-related changes in river flow regimes and impacts on Austrian fish. Seasonally altered runoff intensities (not only intense rainfall and glacial melt but also low water levels) amplify the altered habitat conditions.

In response to these challenges alternative options for cooling and consideration of variants for the discharge of cooling water (industrial purposes) in times of water temperature rise were already recommended by adaptation documents such as Hohenwallner et al. (2015) or BMNT/BMFLUW (2012b, NAS part II), which recommended consideration of increasing water temperature in context of water management (measures). The Bavarian Ministry of the Environment additionally, emphasized the importance of near-natural (river) bank planting and improvement of the structure of the water bodies in order to reduce impacts of high temperatures (heat waves) on fresh water bodies (Bayerisches Staatsministerium für Umwelt und Verbraucherschutz 2016). The findings of Trimmel et al. (2016) scientifically sustain and highlight the relevance of this attempt.

A variety of conflicting topics related to heat/drought have already emerged with diverse scale and intensity, depending on the region in the Alpine Space territory. Water scarcity is a complex field in the Alpine Space territory. Newly emerging or exacerbated conflicts are likely as a high number of sectors are involved and affected directly or indirectly by climate change and adaptation to it (Figure 6). The Bavarian Ministry of the Environment (Bayerisches Staatsministerium für Umwelt und Verbraucherschutz 2016) already recommended the development of local low water management concepts for extreme low water events to ensure water supply and coverage of demand for all water users (e.g. definition of alarm levels or cartographic detection of areas prone to water scarcity). The adaptation strategy of the Federal state Tyrol (Hohenwallner et al. 2015) recommended knowledge-brokerage among all sectors to enhance the awareness for up-coming more frequent events of low-water-levels and the optimization of coordination of water demand and real consumption patterns (exact and transparent data on water consumption of all user groups/ sectors in particular energy production, tourism, water management). The drought management plan of East Anglia ((Anglian Water's Drought Plan 2014) views the complexity of impacts on water resources' quantity and quality resulting from drought (exacerbated in times of heat waves).

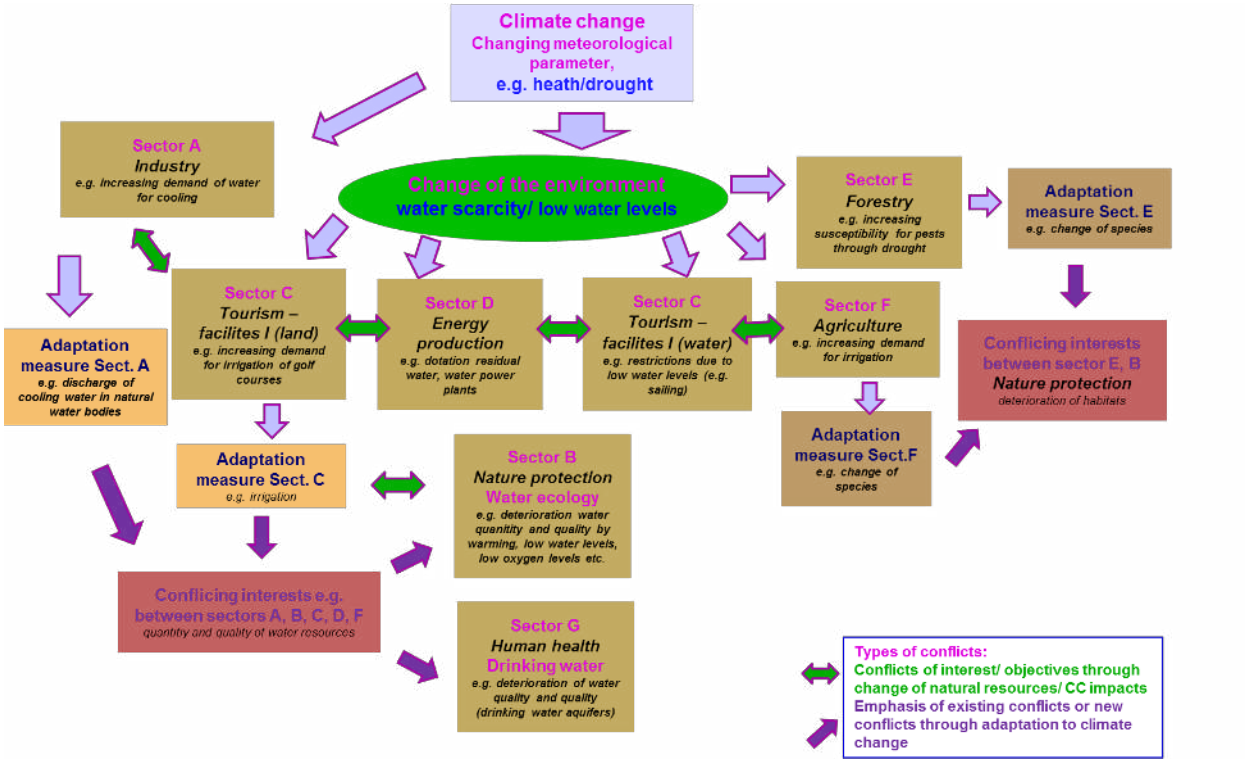


Figure 6: Sectors strongly affected by water scarcity in the alpine territories based on the analysis of National and Federal state Adaptation strategies (Jiricka-Pürrer and Wachter 2019)

Increasing pest pressure was highlighted as a potential for conflicts in several studies and adaptation documents (e.g. BMFLUW 2012, Umweltbundesamt 2018), when greater use of pesticides is required, affecting adjacent water bodies and/or ground water resources. Being a source of drinking water for a large area, the alpine (water) ecosystems should be kept free of pollutants that might be harmful to human health. In addition to agriculture also other sectors partly deteriorate ground water quality. A major concern regards industrial activity together with wastewater run-off from traffic infrastructure. They still cause an increasing leakage of nitrogen compounds and phosphorus into groundwater bodies, added to the impact of farming on alpine water resources.

The environmental implementation reviews (European Commission 2019 a-e) confirm that further achievements are necessary in line with the targets of the Water Framework Directive, the Nitrates Directive, the Bathing Water Directive and the Drinking Water Directive. Declines in aquatic biodiversity were reported explicitly for the Italian Alps (Tiberti et al. 2014) because of human-induced changes in environmental conditions. Particularly in Italy but also in France improvements are urgent to ensure the fulfilment to the objectives of the Urban Waste Water Treatment Directive (European Commission 2019 d). For Germany, France and Slovenia compliance to the Nitrates Directive is an on-ward challenging topic (European Commission b, d, e). Efforts were made in all countries to accomplish the targets of the Floods Directive through setting objectives and developing measures for prevention and protection. Both are highly relevant as the intensity and frequency of flooding increased (Alpine Convention 2018). National operation plans (flood risk management plans such as. BMFLUW 2015) are important tools to provide information on hazards and actions to reduce and/or react to them. Natural hazards aggravated by climate change are reflected in detail in the section “human health/natural hazards” (see section “Human health”).

TREND (ZERO VARIANT)

Decline in glaciers and permafrost areas due to climate change will have long-term effects. Decreasing runoff in spring and early summer below 900 m will affect water resources and availability of drinking water on the long run as e.g. Nachtnebel et al. (2014) illustrated for the south-eastern Austrian Alps. Groundwater-recharge might increase in winter but decline in all other seasons. Reduction of spring discharges from near-surface sources are likely. So far, however, no reliable statements are possible as strong regional differences can be expected (Nachtnebel et al. 2014). The changing precipitation regimes together with higher temperature will ultimately also cause impacts also on other aquatic biodiversity.

Overall for most areas in the alpine territory drought management strategies will be needed to tackle **water scarcity** challenges (BAFU 2014, BAFU 2019, Bayrisches Staatsministerium für Umwelt und Verbraucherschutz 2017, BMNT 2012a and b, BMNT 2017, BMU 2011, Ministère de la transition écologique et solidaire 2019). Examples for drought management strategies were examined e.g. by a EU Horizon2020 project for East England (Anglian Water's Drought Plan 2014). Serious impairments for waterpower and other sectors with (increased) water usage will turn up more frequently. Residual flows need to be adapted to these changing water conditions.

Higher quantities of nutrients emitted from agricultural use to water bodies and wet habitats due to the lack of adaptation of fertilizer inputs to changed climatic conditions (e.g. in times of heavy rainfalls or alternatively in times of drought) can **deteriorate water quality further** (BMNT 2017). **Rise in water temperatures and changes in oxygen level** in combination with **pollution** will lead to alternate habitat conditions for many alpine species (Bayrisches Staatsministerium für Umwelt und Verbraucherschutz 2017, BMNT 2012a and b, BMNT 2017). **Decline of water levels** will additionally affect alpine flora and fauna, in particular in areas with already prevalent low water levels (Eitzinger et al. 2014 for Austria). Exceptionally low water levels, as occurred for many alpine lakes already in the previous summers such as e.g. Lake Lucerne, Lake Zug and Lake Zurich in Switzerland (BAFU 2019b) will occur more frequently. In response to alternated conditions the share of **neobiota** might increase and deteriorate the conditions for the alpine species.

Next to drought events heavy rainfalls will continuously influence alpine water bodies and impair and increasing **risk of flooding** (for further details see sub-section "human health/natural hazards"). Flood risk management plans such as BMFLUW (2015) will need to be up-dated continuously and coordination with other planning instruments is highly relevant to avoid conflicts of interest, identify synergies instead and apply a precautionary approach in flood risk prevention.

In order to meet climate mitigation targets further structural **modification of alpine water bodies** are likely. This is particularly alarming in countries such as Austria, where only three percentage of larger alpine rivers are still naturally branched. To mitigate and partly compensate these impacts the continuation of river restoration will maintain its importance.

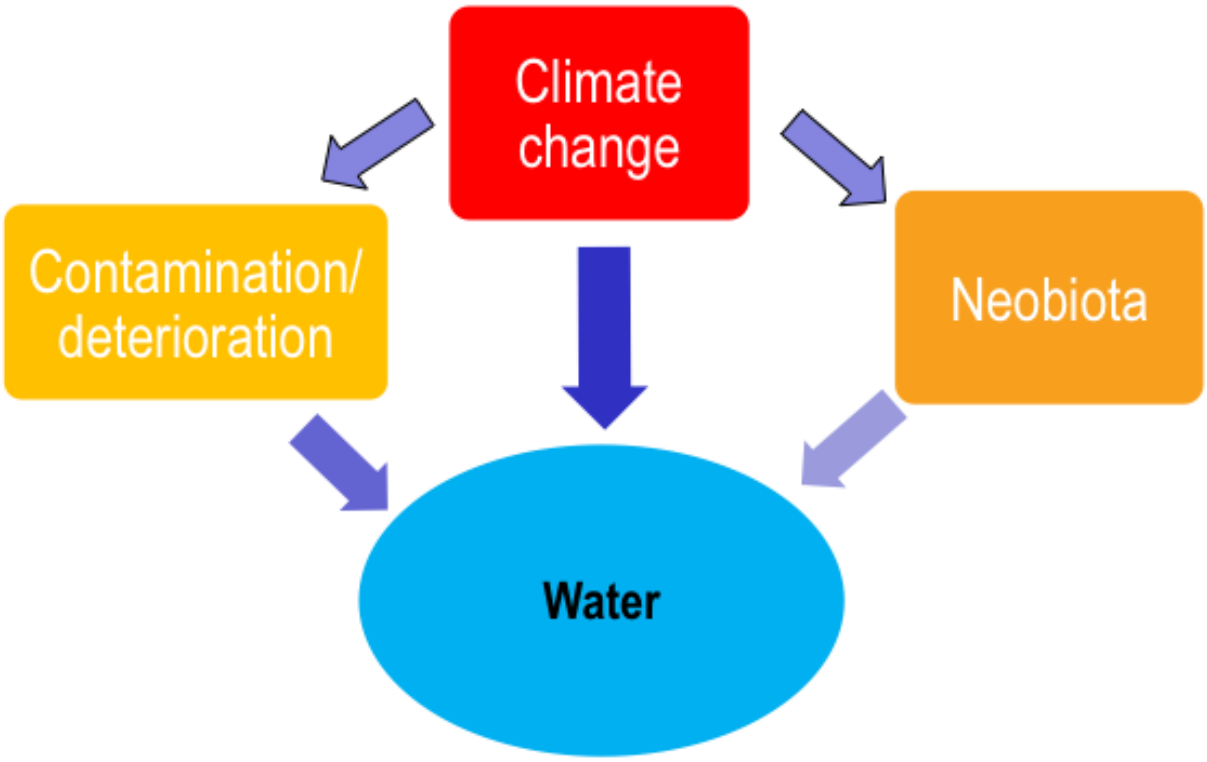


Figure 7: Key challenges for water (surface and groundwater bodies)

KEY ENVIRONMENTAL OBJECTIVES "WATER":

Quantity

- Use water resources rationally to prevent/tackle water scarcity related to drought (and heat waves) with more frequent occurrence and length due to climate change
- Foster integrative approaches for flood risk prevention in line with the Floods Directive

Quality

- Improve protection of water bodies according to the Water-Frameworks-Directive, Nitrate-Directive, Directive on drinking Water
- Monitor the water quality of contaminated water resources and maintenance of their chemical and ecological state (according to the WFD)
- Enhance/maintain the biodiversity of water bodies and improve drinking water quality

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c. Climate / Air (including climate change)

STATE OF THE ENVIRONMENT

Climate

The climate in the Alps is predominantly characterized by cool polar air from the north, continental air mass from the east, warm Mediterranean air from the south and wet western air coming from the Atlantic. Average temperatures and precipitation vary with altitude, influencing vegetation and animal life. Winter snowfalls, especially in higher altitudes can carry risks of natural hazards. The alpine space, due to its multitude of different terrains and altitudes, is prone to very diverse climatic conditions that can appear on small scales.

Overall, temperatures in the Alps are rising roughly twice as fast as in the rest of the northern hemisphere and have already risen by 2°C (Permeant Secretariat of the Alpine Convention 2017). There is a recognition that weather patterns are changing with shifts towards precipitation and temperature extremes, natural hazards, flooding, droughts, and reduction of snow cover (Gobiet et al. 2014, Permanent Secretariat of the Alpine Convention 2017). These are threats also discussed in corresponding sections of this report.

Certain GHGs are seen to effect global warming. Most notably are carbon dioxide, methane, nitrous oxide and fluorinated gases. Carbon dioxide being the most common produced through human activity (EEA 2017, Le Treut et al. 2007, IPCC 2019). Impacts on climate change which are likely to aggravate in the future are elaborated further in the “trend” section.

In addition to the production of GHGs through human activity, the topography of this mountain range leads to inversion layers in lower altitudes and has barrier effects that form a trap for pollutants (Schröder et al. 2013). The state of the alpine air quality is elaborated in the next subsection “air”.

An alpine phenomenon, with similar background as inversion, however on a meso - to micro climate range, which is linked to the steepness of the alpine hills, is trapping of cold air. Emerging during the evening hours, the cold air is gliding down the slopes. At the bottom of the valley lakes of cold air arise. About 100-300 meters above the bottom of the valleys a warm zone tends to predominate. Problems arise if the cold air is dammed behind obstacles (houses, walls, etc.) as lakes of cold air are formed in front of the barrier. This effect leads to an amplification of freeze above the barriers, whereas beneath them the local climate is slightly warmer than elsewhere (fewer freezes) (Tappeiner, Cernusca, Pröbstl 1998).

With climate change the blockage of cold air can impair negative impacts in times of heat waves. Complementary the interruption of fresh air corridors became more problematic with increasing temperatures and longer lasting heat waves. Alpine cities such as Munich already started to reflect these impacts in their municipal adaptation strategies (Bayerisches Staatsministerium für Umwelt und Verbraucherschutz 2017).

Air

Pollutants greatly influence air quality and can come from numerous sources including the use of fossil fuels in energy, transport and households, agriculture, industry, and waste management (Umweltbundesamt 2018, EEA 2019, Figure 8). 2018 data from the European Environment Agency has shown that France, Italy, Slovakia, Slovenia and Switzerland are all meeting the emission ceilings for NH_3, NMVOC, NO_x and SO^2 of the Gothenburg Protocol. Austria and Germany have not been able to meet the NO_x ceiling.

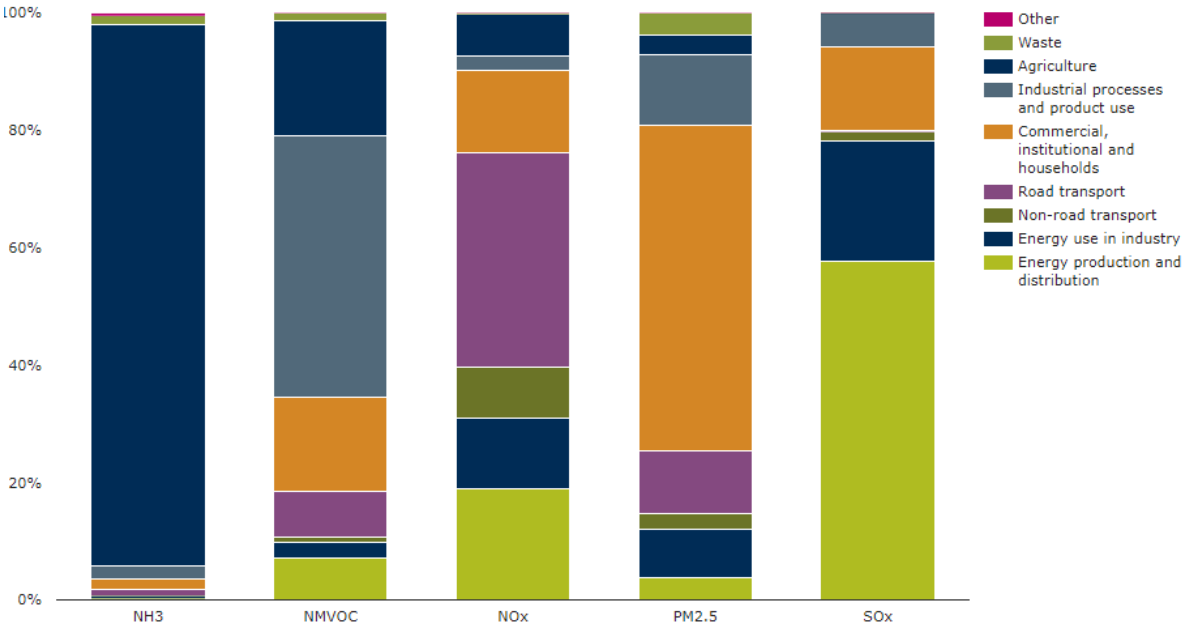


Figure 8: Emissions of the main air pollutants in Europe by sector, EEA 2019. https://www.eea.europa.eu/data-and-maps/indicators/main-anthropogenic-air-pollutant-emissions/assessment-6

Generally, the main air pollutants are in a slow yet steady decline across Europe. A trend that is also reflected in national reports of Austria (Umweltbundesamt 2019), France (EEA 2019a), Germany (Umwelt Bundesamt 2019a), Italy (EEA 2019b), Slovenia (EEA 2019c) and Switzerland (BAFU 2018).

In Switzerland, studies have followed the significant reduction of pollutants since 1990 as well (BAFU 2018). Furthermore, in regard to eutrophication of terrestrial ecosystems, a 42% decline in NOx and a 9% decline in NH_3 have been recorded between 2000 and 2016 in the EU (EEA 2019), meaning the exposure of ecosystems to pollutants has been reduced.

TREND (ZERO VARIANT)

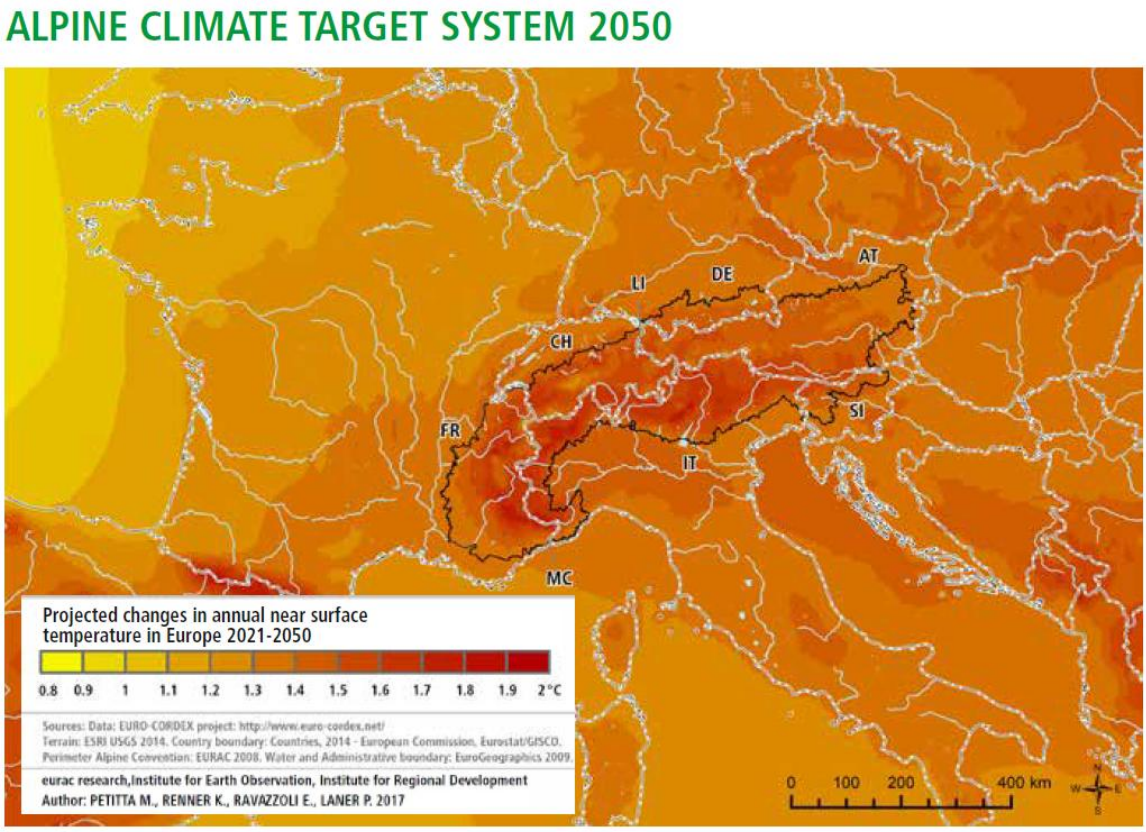
Climate

The effects of **global climate change** will manifest themselves spatially very differently and are already visible today - also in Austria - in many places. The best examples of this are the increasing decline and decay of the ice and glacier areas, the thawing of permafrost areas in higher latitudes and in the high mountains, seasonal shift of precipitation distribution, altered flow regime of rivers, as well as increasing heat and drought periods. A large number of ecosystems and central economic sectors (including the transport sector) are particularly sensitive to these climatic changes (see sections to all other environmental issues). Weather patterns are going to change with shifts towards precipitation and temperature extremes, leading to climate change impacts, particularly relevant for the Alpine Space, such as erosion, flooding, droughts, wet snow avalanches and reduction of snow cover (Gobiet et al 2014, Permanent Sectretariat of the Alpine Convention 2017, Alpine Convention 2019). Table 4 provides an overview about the climate change stressors (meteorological phenomena and impacts related to their changed occurrence).

Table 4: Climate change signals and related impacts which continuously will affect the Alpine Space

Climate change signal (meteorological phenomena)	Climate change impact
Heavy precipitation	Flooding
Heavy precipitation	Erosion/landslide
Aridity	Drought
Aridity	Low water levels
Snow storms	Heavy snow fall, wet snow avalanches
Icing	Icing/ice-breaking
Freeze thaw weathering	Landslide/permafrost melt
Heat waves	Heat waves/ fire
Temperature rise	Temperature variability/ medium temperature rise
Storm	Strom damage
Storm	Wind erosion
Storm	Wind comfort (changing conditions)
Storm	Wind throw

Due to its location in the transitional area of different climatic influences and the spatial proximity of different climatic zones, it can generally be assumed in the Alpine region that climate change is also very inhomogeneous and distinct local differences occur. Figure 9 shows the average rise in temperature projected for the timeframe 2021-50 (Alpine Convention 2019).



Projected temperature change in Europe: *The map shows the projected temperature change in the Alpine area (2021-2050) compared with the reference period (1971-2000). The temperature rise is likely to be more severe in the Alpine region compared to other European areas, with a projected rise by almost 2 °C.* [2]

Figure 9: Climate projections – temperature change (2021-50 compared to 1971-2000) Source: Alpine Convention (2019, p. 7)

Reduction of GHG is a continuous key issue to meet the targets of the Paris Agreement from 2015, the Declaration of Innsbruck and the Alpine Climate Target System 2050 (Alpine Convention 2019). Depending on the extent and success of climate change mitigation measures impacts will vary significantly. In particular synergies between adaptation and mitigation should be key targets. Figure 10 shows the variety of sectors relevant for both adaptation and mitigation in the Alpine Space. Adaptation to climate change as well as mitigation targets are likely to aggravate conflicts of interest in the alpine areas (see also trends for “soil”, “water”, “flora/fauna/biodiversity”, “landscape”, “human health natural hazards”). National and scarcely also Federal state adaptation strategies such as BMNT (2012b) or Hohenwallner et al. (2015) addressed cross-sectorial conflicts in some depth, also providing a detailed overview of adaptation measures prone to cause conflicts, as well as the sectors likely to be involved in such issues. Other adaptation strategies included the topic of emerging conflicts in the description of the vulnerabilities facing certain sectors/fields of activities, but remained at a very general level without referencing concrete adaptation measures in their statements.

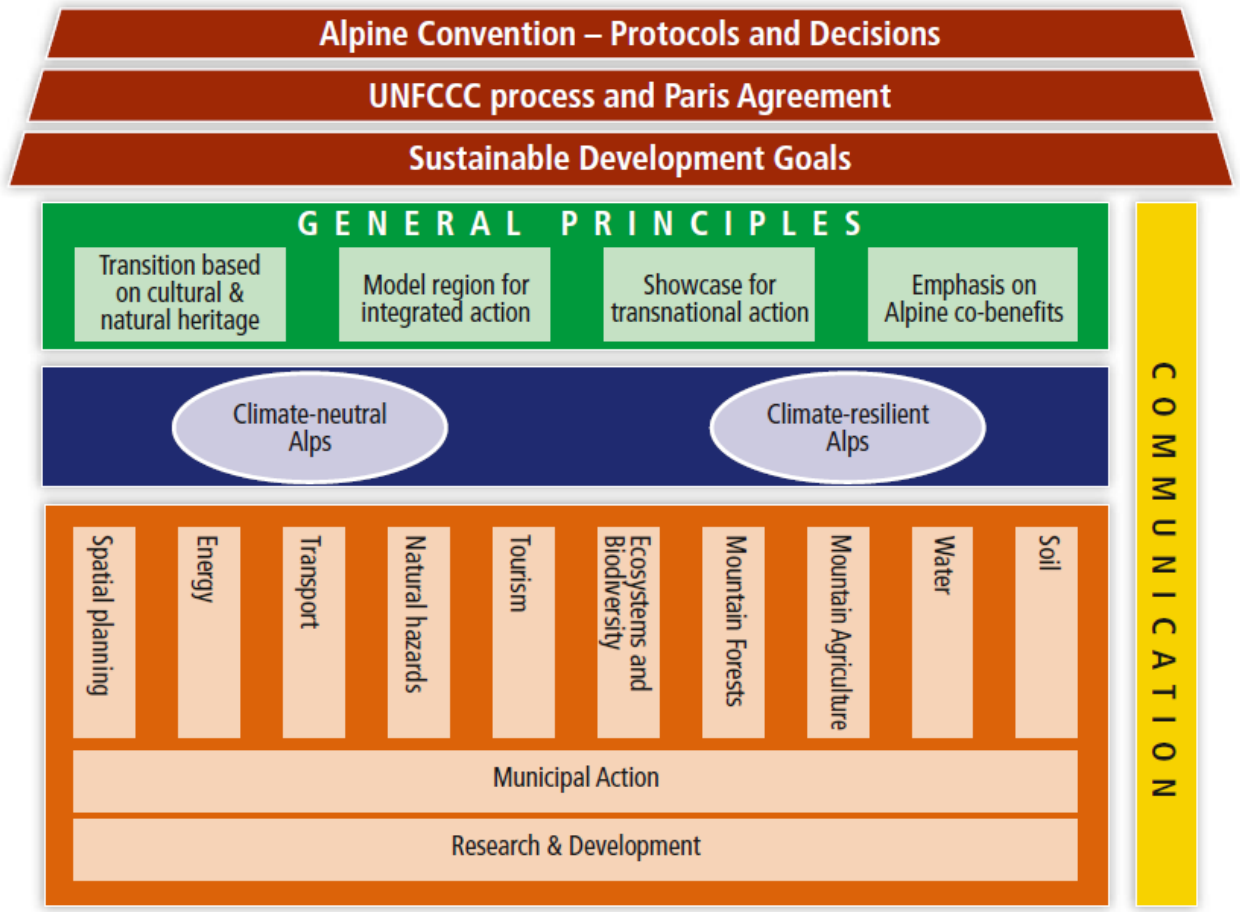


Figure: ***Overview of the Alpine Climate Target System 2050***

Figure 10: Overview of the Alpine Climate Target System 2050 (Source: Alpine Convention (2019, p. 9)

Further **changes in urban micro and meso climatic conditions** are likely because of further sealing and construction of infrastructure (e.g. for mobility purposes). Fresh air corridors will gain a more important role in particular in metropolitan areas, however (Brandenburg et al. 2013, Schlick and Dickhaut 2019). Heat islands are going to increase (BAFU 2014, Bayrisches Staatsministerium für Umwelt und Verbraucherschutz 2017, BMNT 2012a and b, BMNT 2017, BMU 2011). Impairment of thermal comfort can lead to health problems (including deaths, heat stroke, etc.; interrelationships with "human health/population". Both heat stress in buildings and open spaces is supposed to continue.

Air

The general trend on **emissions** of the main air pollutants is a slow yet steady decrease across Europe (Figure 11). In Germany PM_{10} has reduced by 38% and $PM_{2.5}$ by 49% between 1995 and 2016 (Umweltbundesamt 2019b). Austria has reduced $PM_{2.5}$ by 0,42% between 1990 and 2014 (EC 2019a). In Switzerland this trend is estimated to be between 40% and 50% reduction between 1998 and 2017. A study on transalpine freight transport (BAFU 2016) has shown, that emissions are being reduced, but traffic remains one of the highest contributors to NO_x and particulate matter. Some rises in $PM_{2.5}$ are shown in France (EC 2019d), Italy (EC 2019c) and Slovenia (EC 2019e).

A trend that is also reflected in national reports of Austria (Umweltbundesamt 2019, EEA 2019f), France (EEA 2019a), Germany (Umweltbundesamt Desslau 2019, EEA 2019g), Italy (EEA 2019c), Slovenia (EEA 2019d) and Switzerland (FOEN 2018, EEA 2019e). In Switzerland, studies have followed the significant reduction of pollutants since 1990 as well (BAFU 2018a and b).

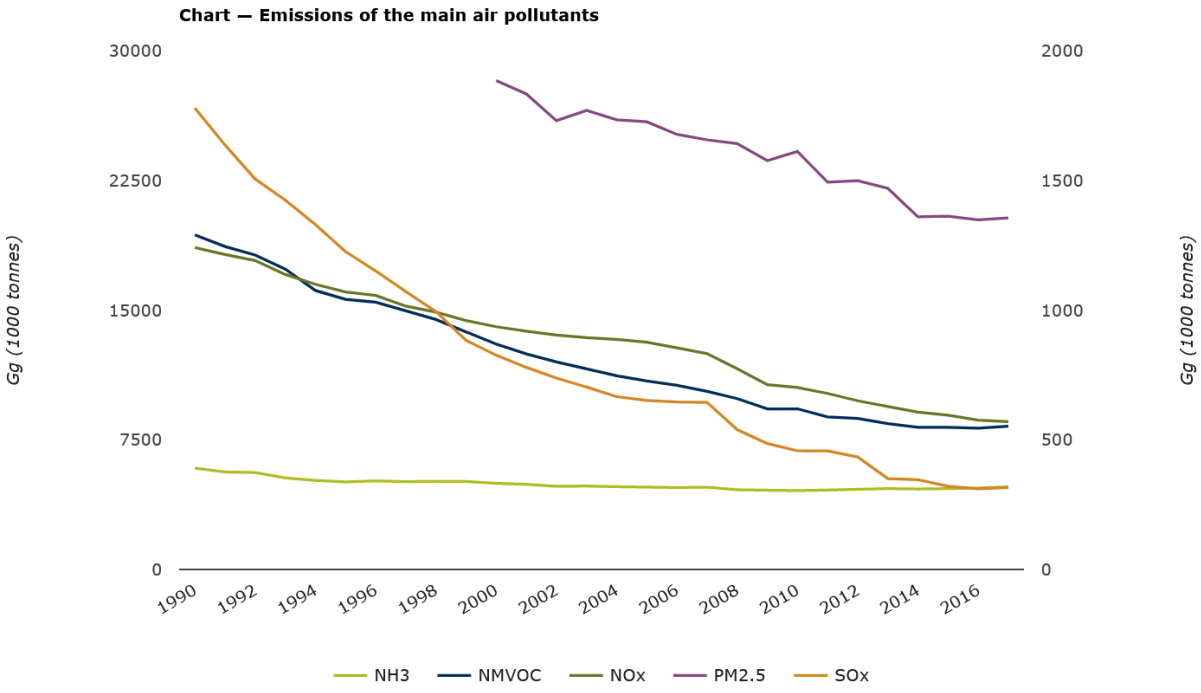


Figure 11: Emissions of the main air pollutants (Source: EEA 2019)

This being said, climate change and conditions accompanying influence air quality, when for example, a partly **dryer climate** leads to **higher levels of pollutants** and the alpine topography hinders dilution and transport of pollutants and the risk of heat waves or forest fires further increase the possibility of air pollution in the Alpine regions (Permanent Secretariat of the Alpine Convention n.d.). The trends indicate a reduction of emissions resulting from human activity but at the same time, negative impacts from climate change cannot be ignored.

To continue to address **air quality** in Alpine regions in light of climate change, greater consideration should be given to decision makers and policy to be implemented at local and regional level (Permanent Secretariat of the Alpine Convention n.d., Melamed, Schmale and Schneidemesser

2016). The continuation of reduction of emissions is expected. As data collection on air quality is more readily available than for other categories listed in this report, the monitoring of progress of indication of trends is easier to obtain. A future focus on decision makers and policy should link air quality to climate change and human health (Melamed, Schmale and Schneidemesser 2016). Linking the reduction of particulate matter with traffic would also be beneficial (BAFU 2016). New climate friendly technologies are likely to contribute to this target. At a local level monitoring should include early warning systems and adjust monitoring systems to local needs (Permanent Secretariat of the Alpine Convention n.d.).

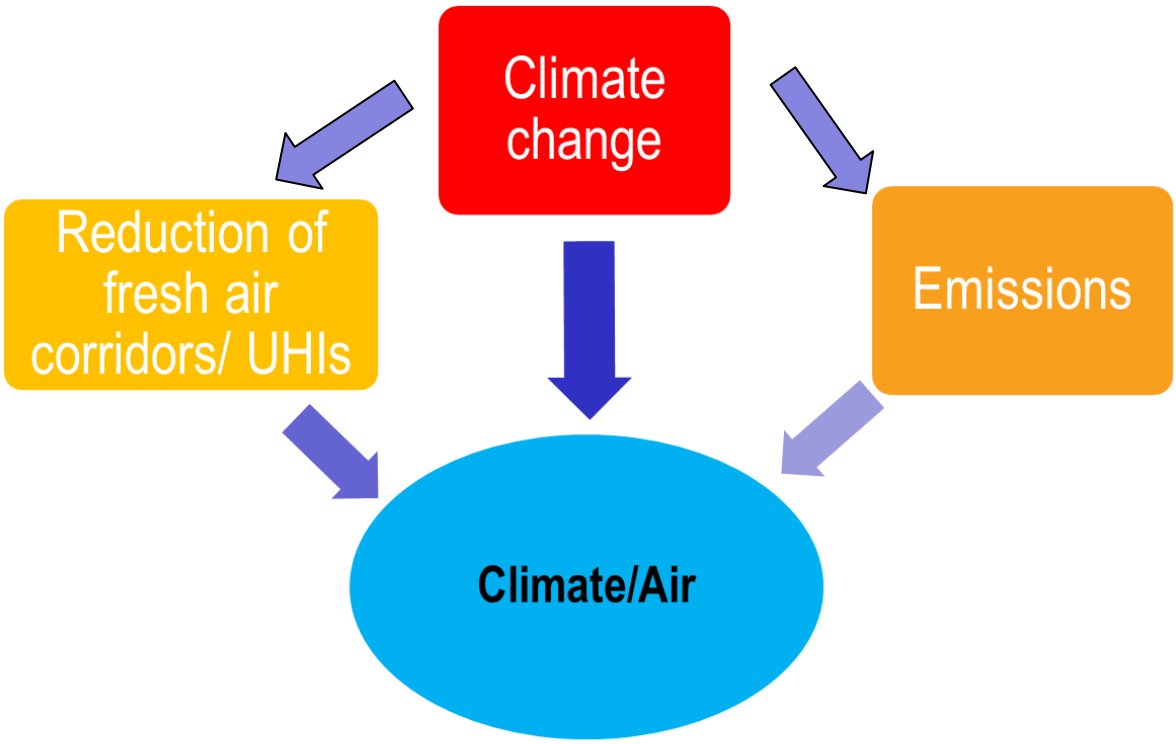


Figure 12: Key challenges for climate/air

KEY ENVIRONMENTAL OBJECTIVES "CLIMATE/AIR":

- Improve Air quality: Reduce the seasonally very high load of pollution – particularly PM10 and finer matter (focus alpine valleys)
- Mitigate climate change: Reduce Green House Gases (GHGs)

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d. Fauna, Vegetation, Biodiversity

STATE OF THE ENVIRONMENT

The Alps are acknowledged as one of the most important biodiversity hot spots in Europe (WWF 2004 and 2006, European Commission 2006 amongst others) due to its complex geomorphology and climatic variety and thus resulting habitat diversity. Still, more than 45% of the Alpine territory is covered by forests and woods (Figure 13) The landscape was also shaped by a long tradition of human presence. Longstanding farming and livestock grazing resulted in characteristic cultural landscapes and many species rely on permanent but low-intensity land-use (Cernusca, Tappeiner, Bayfield 1999, WWF 2006). Many endemic species can be found (most of them occur either in the Eastern or the Western part of the Alps) due to former glaciation and isolated peaks. The amount of species generally increases from North to South and from higher alpine areas to lowlands (Broggi, Staub, Ruffini 1999).

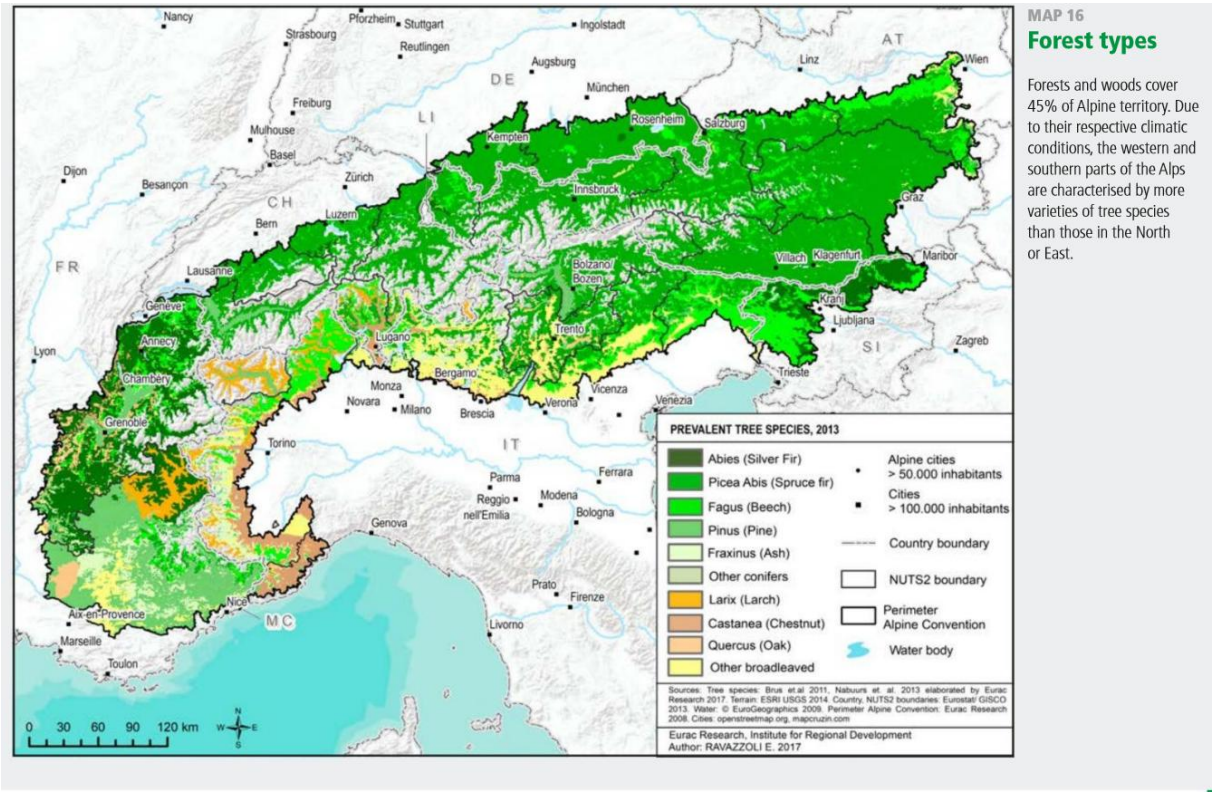

Figure 13: Forest cover in the Alps. Permanent Secretariat of the Alpine Convention (2018): The Alps in 25 maps; Map 16

Unique Fauna of the Alpine Space

The exact number of animal species in the Alps is not known, but the WWF (2004, 2006) estimates about 30.000. Especially, invertebrate species such as insects, worms or snails are highly divers and offer more than 20.000 species estimated.

As for birds, there are about 200 breeding species in the Alpine area and about 200 additional ones migrating. Birds of prey, in particular falconiformes such as the golden eagle (*Aquila chrysaetos)* of which around 1200 pairs were breeding in the Alps in the early 2000s, the peregrine falcon (*Falco peregrinus)* and the bearded vulture (*Gypaetus barbatus)* were highly endangered by human interference, but over the last few years their populations have started to recover. An example for this positive development is documented for the golden Eagle in the Western Alps. In the year 2003, 129 pairs were recorded and this number has risen up to 168 pairs in 2016 (Fasce et al. 2017). The authors attribute the population growth to a reduction of human persecution and, mostly to the creation and improvement of appropriate habitats. This has been achieved mostly by the creation of numerous protected areas, enabling an increase in the prey population as food resources. The bearded vulture was re-introduced in the Alps in the 1980's and has reached a population of about 20 breeding pairs but mostly restricted to protected areas (Schwarzenberger et al. 2013).

About 50 species breed above 2000 meters altitude, such as the rock partridge (*Alectoris graeca*) or the Eurasian dotterel (*Charadrius morinellus*). Other species are restricted to special habitats such as mountain forests (e.g. *Tetrao urogallus, Picoides tridactylus, Serinus citrinella*). Another rare species is the common rock thrush (*Monticola saxatilis*), which is spread over the whole alpine area (WWF Germany 2004; Mebs and Schmidt 2006, WWF s.a.).

Only few amphibian species can be found in the Alps. Those which live there are, however, highly specialized and dependent on scarce living spaces (e.g. caves). In total, there are 21 species of amphibians of which one is endemic (*Salamandra lanzai*) and is listed as "vulnerable" in the IUCN Red list (Sindaco et al. 2009) but with a stable population. 15 species of reptiles are living in the Alps although none of the species are strictly alpine (WWF Germany 2004; Alparc s.a.).

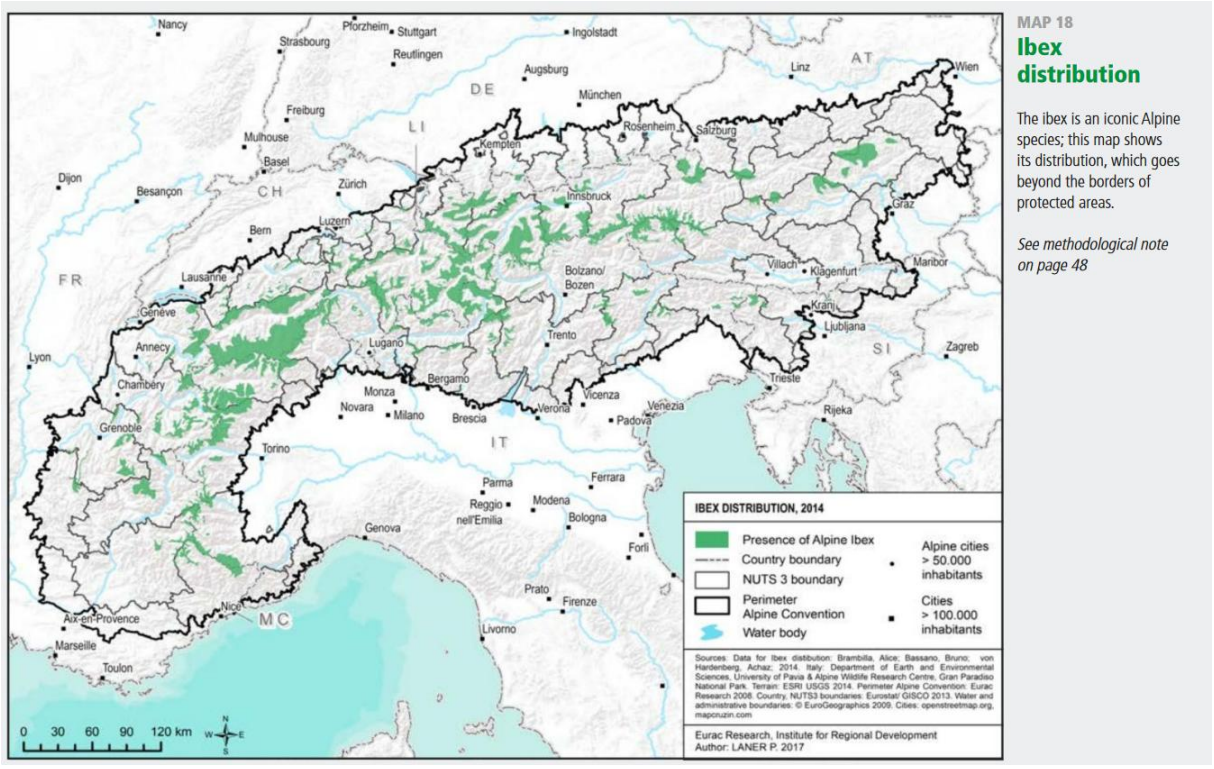

Figure 14: Presence of ibex in the Alps. Source: Permanent Secretariat of the Alpine Convention (2018): The Alps in 25 maps, Map 18.

Regarding mammals, there are about 80 species whereas most of them are shrews, mice, voles or bats (WWF 2004). Still, the most iconic species for the Alps are large mammals such as the chamois, ibex (Figure 14), black grouse or the marmot. In the last decades, a lot of effort has been undertaken to reintroduce large carnivores such as the wolf (*Canis lupus*), the brown bear (*Ursus arctos*) or the lynx (*Lynx lynx*). Also, the EC defined key actions to assist in establishing and preserving their populations in coexistence with humans in Europe (Boitani et al. 2015) as the acceptance of large carnivores is highly debated in society.

Unique Flora of the alpine region

According to WWF (2006) the Alpine region inhabits more than 5.000 fungus species and ca. 8.000 other plant species. About 4.500 of these are vascular plants representing 40% of the complete European flora. According to Universität Innsbruck (The flora in the Alps; viewed: 29.08.2019), about 200 species and subspecies are considered to be extinct or lost as no habitats are known. Ca. 350 species are endemic, only occurring in the Alpine region and nowhere else. Particularly at higher altitudes, plants with restricted distributions can be found adapted to the harsh environmental conditions they live with (EEA 2012, Nagy et al. 2003 etc.). The families of bell flowers (Campanulaceae) and saxifrages (Saxifragaceae) have a particularly high amount of endemites, the latter family show even 28 endemic species in the Alps. Other important endemites are Devil's Claw (*Physoplexis comosa*) or Cotton Thistle (*Berardia subacaulis*) (The flora in the Alps, Universität Innsbruck, viewed: 29.08.2019).

Biodiversity of the alpine region

The highly diverse climatic and geomorphological conditions offer home to more than 43.000 animal and plant species and diverse landscapes and is recognised as one of 238 priority ecoregions of global importance in the world through the Global200 initiative and are thus the finest example of a given major habitat type (WWF 2006). Of great importance for the biodiversity in alpine regions are not only large wilderness areas but also human-related species which can be kept only by cultivation f.ex. mountain meadows and alpine pastures below the climatic tree line. Phytosociological investigations clearly show the link between land-use and vegetation (Cernusca, Tappeiner, Bayfield 1999). More species can be found in extensively used alpine agricultural lands than in intensively used agricultural lands. Low-extensive use over the last centuries allowed the development of valuable phytocoenoses of which some are even protected by Natura2000 and dependent on the correct management (European Commission 2018, Umweltbüro Klagenfurt 2007) such as “Species-rich *Nardus* grassland, on siliceous substrates in mountain areas” or “Alpine and subalpine calcareous grasslands”. In these habitats, too frequent mowing inhibits the natural regeneration process, whereas a certain number of swaths (in general one or two swaths per year) are necessary in order to maintain the diversity of species. The cut leads to a dense vegetation cover, which ensures the water retaining capacity and improves the resistance of soil so as to prevent natural hazards (Schindelegger 2019). As far as pasture is concerned, neither too many nor too few animals should be kept in alpine areas. In particular cows can cause severe injuries to the vegetation cover (Government of the Fürstentum Liechtenstein 2011, Jessel 2010, Hofer et al. 2010).

Threats / pressures on flora, fauna and biodiversity

The IPBES (2018) presented an elaborated assessment report on the state of biodiversity and ecosystems. There, land-use changes (intensification, urbanisation and abandonment) are regarded as the most direct driver for biodiversity loss in Europe and Asia. Furthermore, climate change and natural resource extraction, pollution and invasive alien species are accounted for declines in biodiversity according to the IPBES.

(I) Land-use changes

For the Alpine region, the European Environmental Agency (EEA 2016) also lists the loss or destruction of habitats as the most direct threat to biodiversity. Intensification of agricultural practices, especially at the bottom of the valleys on the one hand, and land abandonment in the mountains on the other lead to a reduction of species (Batzing 2003, Hofer et al. 2010). According to Batzing 2003, species of the traditional agricultural land cultivation are most endangered.

Other challenges pose the fragmentation of landscapes and habitats as a result of growing urbanisation and increasing infrastructure as part of land-use changes. This fragmentation is leading to increased isolation of ecosystem patches thus breaking structural connections and decreasing resilience and ability of habitats to provide various ecosystem services (EEA 2016). Fragmentation also influences human communities, agriculture, recreation and overall quality of life.

The European Environmental Agency provides an indicator for landscape fragmentation (EEA 2016b) measured by the "Effective Mesh Density" (Jäger 2000): the higher the effective mesh density hence the higher the fragmentation. Especially, the valley bottoms and lower altitudes are highly fragmented, whereas higher altitudes seem to provide better connected patches (Figure 15).

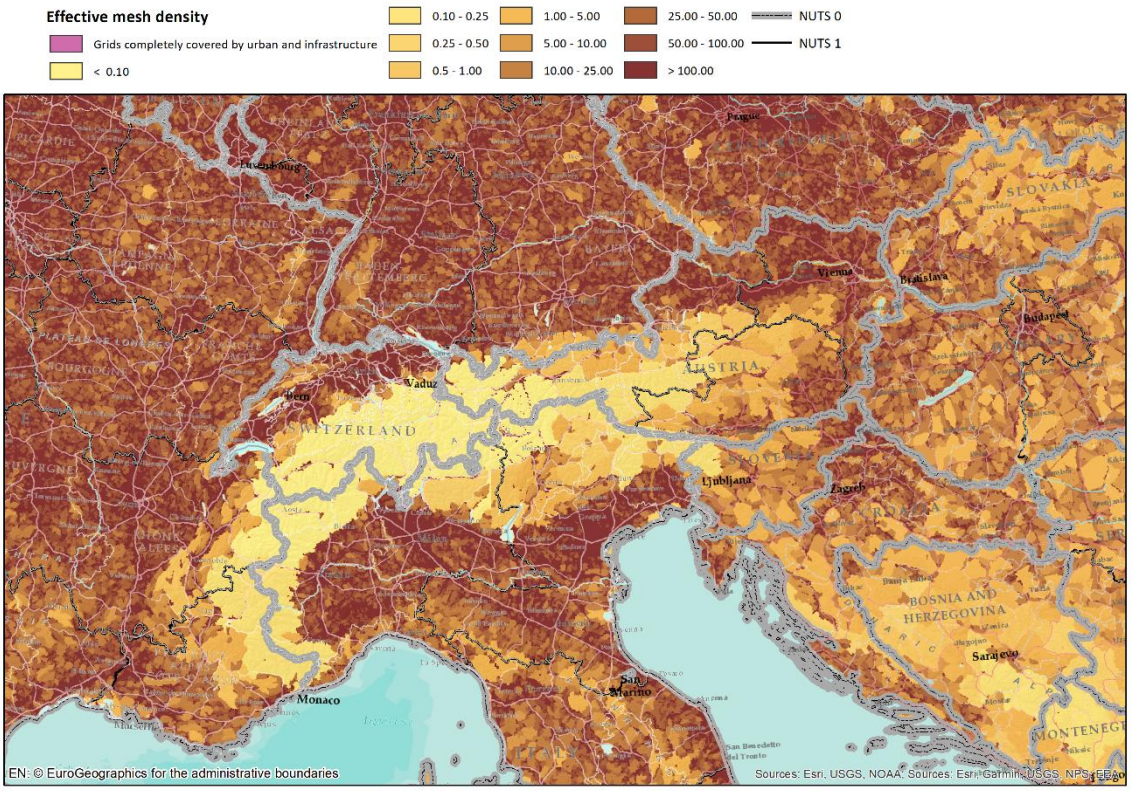

Figure 15: Effective mesh density as measure for landscape fragmentation in Alpine countries (EEA 2016b).

To mitigate this development, one major key is "Green Infrastructure", also fostered by an EU-directive (European Commission 2013) dedicated to this topic. All landscapes independently from altitude (alpine as well as lowland landscapes) would profit from establishing connected habitats in fragmented, agricultural and urban areas.

Alpine tourism and especially skiing have shown to have a major impact on biodiversity in the mountains. Sato et al. (2013) conducted a meta-analysis on the impacts of winter recreation which was concluded to be most often negative for fauna. They found that richness, abundance and diversity of birds especially (to a lesser extent mammals and arthropods) were lower in areas affected by winter recreation when compared with undisturbed areas despite the fauna's capacity to partly adapt to the infrastructure and its utilization. At the moment, the Austrian Alpine Association lists ten highly controversial ski-region expansions in the Austrian Alps, where untouched natural areas or even protected areas are threatened by new infrastructure expansion (Skigebietserschließungen Alpenverein, 30.8.2019). Also, in other parts of the Alps, winter mass tourism is in dispute with nature conservation, f.ex. in the Vanoise National Park (Mauz, 2014). This poses an enormous pressure on biodiversity and the landscape (Alparc, http://www.alparc.org/the-alps/a-sensitive-area). Research shows that the most disturbed plant communities can be found in sites between 1400 and 1600 meters altitude, where human activities are most intense in most alpine regions (Tappeiner et al. 1998, Tappeiner et al. 2006). In particular new sport activities such as rafting, free climbing, "*canyoning*", etc. pose severe problems, as the athletes expand into hitherto unused areas (Batzing 2003) (e.g. disturbance of birds during their breeding period or of the sensitive Alpine fauna during the winter skiing season). The overlapping of different usages (skiing, pasture, hiking, etc.) poses additional stress on the vegetation cover.

(II) Climate change:

Global climate change is an additional threat to biodiversity. Bellard et al. (2012) regarded climate change as the major driver of biodiversity decline. The risk of total extinction of species with specific habitat needs is also emphasized among others by Lambers (2015). Since the late 19th century, temperature has increased about 2°C in the Alps (Permanent Secretariat of the Alpine Convention 2017). For Austria, detailed records confirm this trend (Auer et al. 2007, http://www.zamg.ac.at/histalp/). A warming of 3°C could ultimately cause distribution limits to shift by 500 m (Körner 2012) resulting in the loss of the alpine zone of many mountain ranges. On the global level, a temperature increase of 2.2°C was estimated to leading to a loss of ~24% of lower alpine areas and of ~55% of upper alpine to nival areas (Körner 2012). The Secretariat of the Alpine Convention (2017) also counts with the loss of 31-51% of alpine plants and 80% of their habitats. Especially cold-adapted species will be affected whereas warm-adapted species are likely to profit – a process named "thermophilisation" (Gottfried et al. 2012 a.o.). The first pan-European GLORIA resurvey study showed a widespread thermophilisation process in alpine vegetation (i.e., declines of cold-adapted and/or a concurrent expansion of more warmth-demanding species) already after a period of only seven years (Gottfried et al. 2012). These observations strongly suggest that alpine vegetation and the distribution limits of its species do respond rather rapidly to climate change despite the long-lived and slow-growing nature of most alpine plants.

The up-ward shift of the treeline consequently also impacts on the available habitats of mountain-dwelling bird species. Ferrarini et al. (2017) showed for the Italian Alps, that the suitable habitat for

the rock ptarmigan (*Lagopus muta*) will decrease by 28% until 2039 and more than 49% by the end of the century. Winkler (2019) also points out the large impact of climate change on arthropod communities with large variation of reaction by taxonomic order.

There are several possibilities for species to survive the climate change (Bellard et al. 2012): (i) either they migrate to follow the climatic conditions they are adapted to (under precondition they have the necessary corridors and enough space to migrate to!), (ii) species change their phenology / seasonal behaviour or (iii) species adapt their physiology or to the new climatic conditions. For example, Netherer and Schopf (2010) summarized in their review that the "*Alps are likely to be affected most by an increase in stability and population density of certain pest species, such as defoliating insects or bark beetles*". For Switzerland, an increasing number of generations over the whole elevational gradient was predicted, more pronounced at low elevations. The maximum elevation where a whole yearly generation is possible will shift upwards (Jakoby et al. 2019).

Also, other processes induced by the changing climate pose challenges for alpine biodiversity and refugia: Increasing temperatures, glacial retreat, reduction of permafrost, upward shift of treelines and sub-alpine species, invasive species, change in phenology cycle (Gentili et al. 2015). The responses of plants and animals to the changing climate are manifold and not all are fully understood yet (Winkler 2019).

(III) Alien Species

Another threat to Alpine's biodiversity listed by the IPBES is the invasion of neobiota. It is well-known that invasive alien plants can significantly threaten the structure, function and productivity of natural ecosystems, and are generally associated with declines in diversity and fitness of resident biota (Ehrenfeld 2010, Pyšek et al. 2012). Particularly in the European Alps, most of the alien plant species occur only at low elevations and none are known to threaten biodiversity at high elevations yet (Kueffer 2010, Alexander et al. 2016).

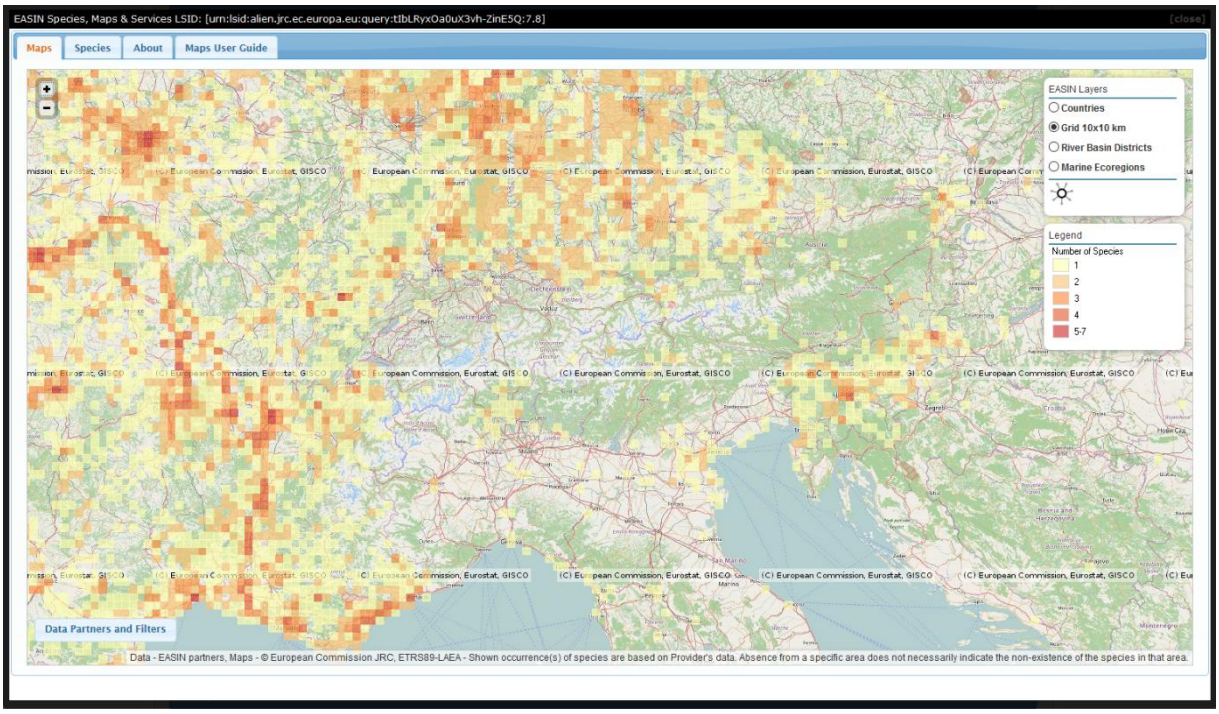

Figure 16: Map provided by the Joint Research Center from the European Alien Species Information Network - Species Mapper (http://alien.jrc.ec.europa.eu/SpeciesMapper viewed 30.08.2019) showing the number of neophytes of union concern (Commission Implementing Regulation (EU) 2016/1141) covering the Alpine region.

Alexander et al. (2016) find a combination of low propagule availability and low invasibility of undisturbed native alpine vegetation as reason for only little occurrence of alien species with the constraint that these limitations could be relaxed in the future, due to increasing anthropogenic pressures and climate change. At lower altitudes the invasion by non-residential species is more problematic. Especially in semi-natural and natural areas such as alluvial forests, riparian shrub stands and pioneer habitats, some alien plant species are known to reduce residential floristic diversity such as black locust (*Robinia pseudacacia*), Tree-of-heaven (*Ailanthus alitissima*), Indian balsam (*Impatiens glandulifera*) or Canadian goldenrod (*Solidago candensis*).

The Joint Research Center (JRC) hosts a large database where records of European Alien Species of Union Concern (36 plant species) are collected. Figure 16**Fehler! Verweisquelle konnte nicht gefunden werden.** shows only low numbers for the Alpine region, which can also mean, that not many records have been reported to the JRC at the moment.

Protection efforts for biodiversity

Efforts to maintain the ecological status and safeguard biodiversity exist on different organisational and spatial levels. Here, we focus on protected areas, ecological networks (mainly Natura2000) and green infrastructure (GI).

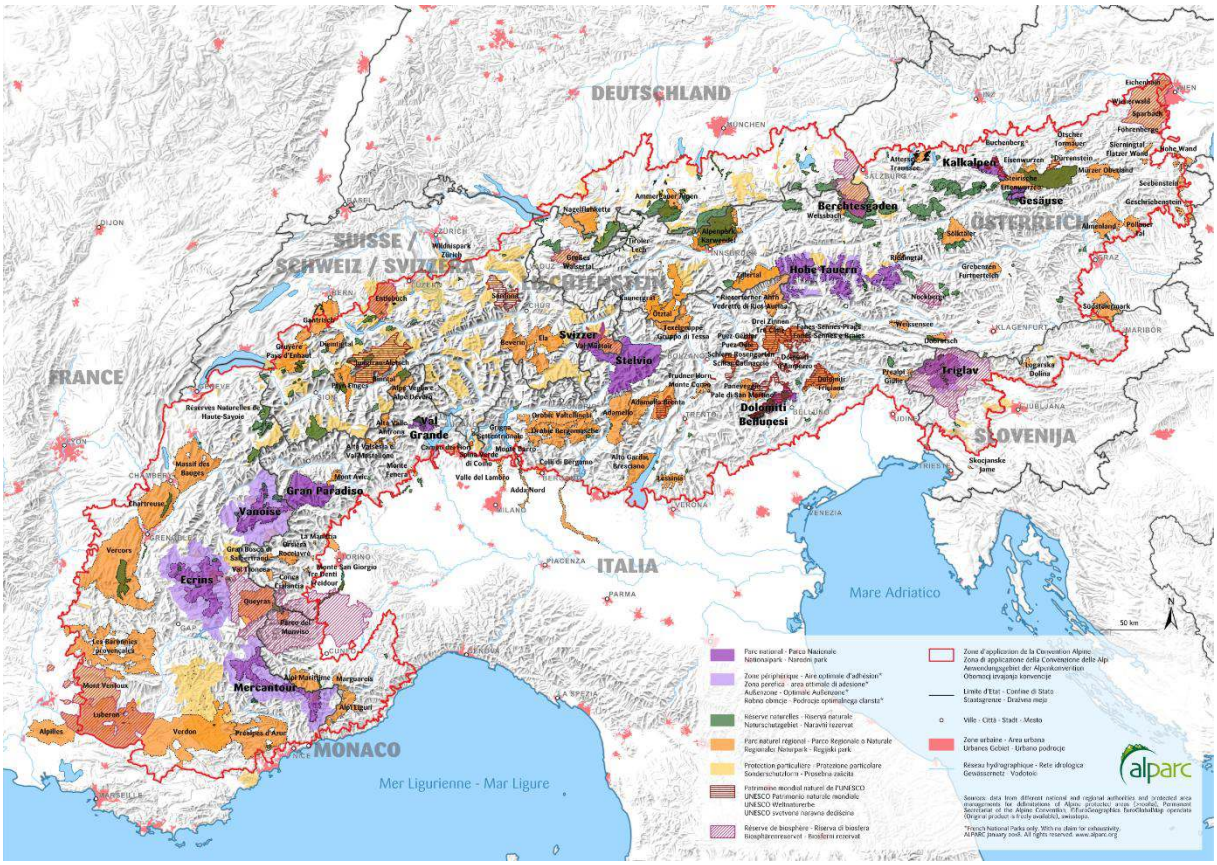

Figure 17: Alpine protected areas 2017. Source: http://www.alparc.org/the-protected-areas/discover-the-apa

The great importance of the region for biodiversity is acknowledged by a large network on protected areas throughout the alpine countries (Figure 17). The Alpine Network of Protected Areas counts more than 400 protected areas (among the most important categories) over 100 ha in 2013 among them 13 national parks and 13 biosphere reserves (Alparc 2013).

Protected areas not only play an important role for conservation strategies (nature, expertise, heritage, culture) but also to manage certain activities that are essential to modern-day mountain life (tourism, mountain farming, alpine grazing, forestry, eco-building, etc.) (http://www.alparc.org/the-protected-areas).

Based on the reported data on conservation status of habitat types and species (Article 17, Habitats Directive 92/43/EEC), the EEA published in 2016 their status showing that more than 56 % of the Alpine habitats have a declining or stable unfavourable status.

One prominent example are species-rich Nardus grassland on siliceous substrates in mountain areas with a high number of species if not overgrazed. The conservation status in the Alpine region is unfavourable-bad and deteriorating (Table 5) given to diverse pressures as already mentioned above.

The country reports of the Environmental Implementation Review of 2019 for Austria, Germany, France, Italy and Slovenia all mention the declining and / or unfavourable conservation status of many habitats and species, although some efforts are taken by the individual countries to counteract this development. Especially agricultural practices lead to the deterioration of many Natura 2000 sites (European Commission 2019 b, c, d, e, f).

Table 5: Conservation Status of Nardus grassland as example for an Alpine habitat under FFH-protection. Source: https://nature-art17.eionet.europa.eu/article17/reports2012/habitat/summary/?period=3andgroup=Grasslandsandsubject=6230andregion=ALP

Current selection: 2007-2012, Grasslands, 6230 Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe), Alpine. Show all Grasslands

Treated data from Member States reports

MS	Range (km²)				Area				Struct & func.	Future prosp.	Overall asses.				Areas from gridded maps(km²)			
	Surface	% MS	Trend	Ref.	Surface	% MS	Trend	Ref.			Curr. CS	Qualifier	Prev. CS	Nat. of ch.	Range	% MS	Distrib.	% MS
AT	51300	23.4	0	≈51300	355	8.2	-	>355	FV	FV	U1	=	U1	nc	46900	23.9	36400	25.9
BG	14300	6.5	x	14300	386.49	8.9	x	386.49	U1	U1	U1	=	N/A		11900	6.1	9700	6.9
DE	4108.27	1.9	0	4108.27	1.30	0	-	1.35	U1	U1	U1	-	U1	a	4500	2.3	4000	2.8
ES	3101	1.4	0	≈3101	64	1.5	0	≈64	XX	XX	XX		XX		1800	0.9	1900	1.4
FR	39200	17.9	0	≈39200	550	12.6	0	≈550	FV	FV	FV		U1	c1	30900	15.7	20700	14.7
IT	53000	24.1	-	>53000	516.46	11.9	-	>516.46	U2	U2	U2	-	FV	c1	46200	23.5	32800	23.3
PL	5616	2.6	x	≈5616	5	0.1	-	≈5	U2	U2	U2	-	U2	nc	5900	3	2600	1.8
RO	4200	1.9	0	≈4200	2200	50.6	0	≈2200	FV	FV	FV		N/A		4200	2.1	2200	1.6
SE	20400	9.3	0	20400	1	0	0	1	U2	U2	U2	-	U2-		17600	9	3900	2.8
SI	3936	1.8	0	≈3936	72.65	1.7	-	≈72.65	U1	U1	U1	-	U1	a	5300	2.7	4800	3.4
SK	20362.15	9.3	0	≈20362.15	199	4.6	-	≈199	U1	U1	U1	-	U1	b1	21100	10.7	21600	15.4

Although protected areas, including Natura 2000 sites, cover almost 30 % of the Alpine Convention territory, the EEA (2016) stresses the point that protected areas themselves are not enough to guarantee the sustainable conservation of biodiversity. The need for setting up an Alpine ecological network, which aims to conserve and recreate ecological connectivity between ecosystems, is strongly enforced. Three closely linked initiatives are working together on the Alpine ecological network, the Ecological Continuum Initiative (https://www.alpine-ecological-network.org/about-us/ecological-continuum-initiative), the Platform Ecological Network of the Alpine Convention (https://www.alpine-ecological-network.org/about-us/platform-ecological-network), and the ECONNECT project (http://www.econnectproject.eu/cms/). Especially large mammals like wolf, brown bear, lynx and red dear need large undisturbed migrating routes.

The Alpine Convention also stresses the need for ecological connectivity by establishing its own "Platform Ecological Network" in 2007. This platform not only enhances the connectivity between protected areas but also stresses the need for improving the permeability of the landscape matrix in order to provide suitable migration routes to species sensitive to climate change as a key element to climate change adaptation (BMUB 2016).

In their vision of "Climate-neutral and Climate-resilient Alps 2050", the Alpine Convention (2019) formulates several targets also concerning ecosystems and biodiversity: (i) preserved ecosystems and biodiversity, (ii) Alpine-wide system of protected areas, (iii) maintained and restored Alpine ecosystem services and (iv) Alpine ecological connectivity between and beyond protected areas.

On the European level, already in 1995, the establishment of the Pan-European-Ecological-Network was one of the priorities of European nature conservation under the original Pan-European Biological and Landscape Diversity Strategy (PEBLDS). Today, ecological connectivity remains a priority for international biodiversity conservation policy, formulated also in the Aichi Biodiversity Target (Secretariat of the Convention on Biological Diversity 2010). In response to that, the European Commission forced the concept of Green Infrastructure Strategy (European Commission 2013) as a policy instrument for connectivity. The EC encourages the inclusion of ecological connectivity into the

biodiversity policies of the member states and also reports on them in their annual implementation review (EC 2019).

TREND (ZERO VARIANT)

Current pressures on fauna, flora and biodiversity, in particular **land-use changes**, climate change and neobiota, as also defined by the IPBES (2018) are highly likely to continue. Therefore, there is the strong need to strengthen efforts for mitigation and adaption to these developments.

Ongoing polarisation between urban and rural areas will put pressure on alpine biodiversity in two ways: (i) intensification of land use activities like agriculture in suitable areas (especially valley bottoms) and (ii) abandonment of low-intensity agricultural activities (and thus woody succession) will both lead to a reduction on habitats which are dependent on this extensive dynamic. Many habitats protected by Natura2000 are affected by this development such as alpine meadows (European Commission 2018).

On the other hand, the rewilding of **abandoned landscapes** allows some animal species such as bears, wolves or lynx the comeback into the Alpine areas as already happened; with establishment of viable populations in areas with low human disturbances on the long run (Boitani and Linell 2015). The return of large carnivores poses challenges in the human-wildlife-coexistence, where they prey on domestic animals, and people are afraid of attacks (Boitani and Linell 2015).

Intensification of touristic infrastructure, inadequately managed settlement policy as well as the increased renewable energy production can lead to significant impacts on alpine flora and fauna as well as its biodiversity. The pressure on protected areas and special habitats is likely to increase (BMUB 2016). The Austrian Alpine Association lists ten highly controversial ski-region expansions in the Austrian Alps, where untouched natural areas or even protected areas are threatened by new infrastructure expansion (Skigebietserschließungen Alpenverein, 30.8.2019). One example is the fusion of the two glacier ski-regions Pitztal and Ötztal for establishing Europe's largest glacier ski-region. Also, in other parts of the Alps, winter mass tourism is in dispute with nature conservation, f.ex. in the Vanoise National Park (Mauz 2014). Competition of key economic sectors (agriculture, forestry, fisheries, energy, transport, building/housing and tourism) with nature conservation targets will continue due increasing land-scarcity. Climate change is one of the major reasons for these exacerbated conflicts between nature conservation and other competing land-use activities such as transport infrastructure or renewable energy (BMUB 2016). Adequate measures are needed to fulfil/maintain biodiversity targets.

Climate change impacts on flora, fauna and biodiversity as such will gain importance. Some aspects are already rather clear like up-ward shift of treeline to 2120 - 2820m by the end of the 21st century (Rubel et al. 2017) and population ranges of birds and plants (Gottfried et al. 2012 a.o.) or the probable increase of canopy mortality due to alien pests (Seidl et al. 2018). The Secretariat of the Alpine Convention (2017) also counts with the loss of 31-51% of alpine plants and 80% of their habitats by 2050. Schwager and Berg (2019) predict an enormous loss of calcareous and siliceous alpine grassland in the Eastern Alps of 50-90% by the middle of the century even though the loss of habitats will be less inside protected areas than outside.

The up-ward shift of the treeline consequently also impacts on the available habitats of mountain-dwelling bird species. Ferrarini et al. (2017) showed for the Italian Alps, that the suitable habitat for

the rock ptarmigan (*Lagopus muta*) will decrease by 28% until 2039 and more than 49% by the end of the century.

Other consequences still remain under discussion (e.g. compositional shifts of plant communities, changes in species interactions like competition). Overall, the limitations and changing habitat conditions, in particular for species of wetland areas and higher alpine habitats will increase and demand strong attention.

Without taking any action, also the establishment of **alien species (neobiota)** will proceed – maybe even in a higher pace due to warming temperatures. Alien plant species migrate to higher altitudes, but as they are normally generalist species, the impact on native communities is yet rather low (Alexander et al. 2016). The valley bottoms on the other hand provide suitable habitats and pathways for a long list of neobiota (Pergl et al. 2017). Early detection and warning system will be needed as they are the most effective way of limiting the spread of neobiota, especially to control newly spreading invasive species (BMUB 2016).

Conservation efforts must aim at preserving a permeable landscape matrix, mitigating fragmentation processes and allowing species to migrate across the entire Alpine region (BMUB 2016).

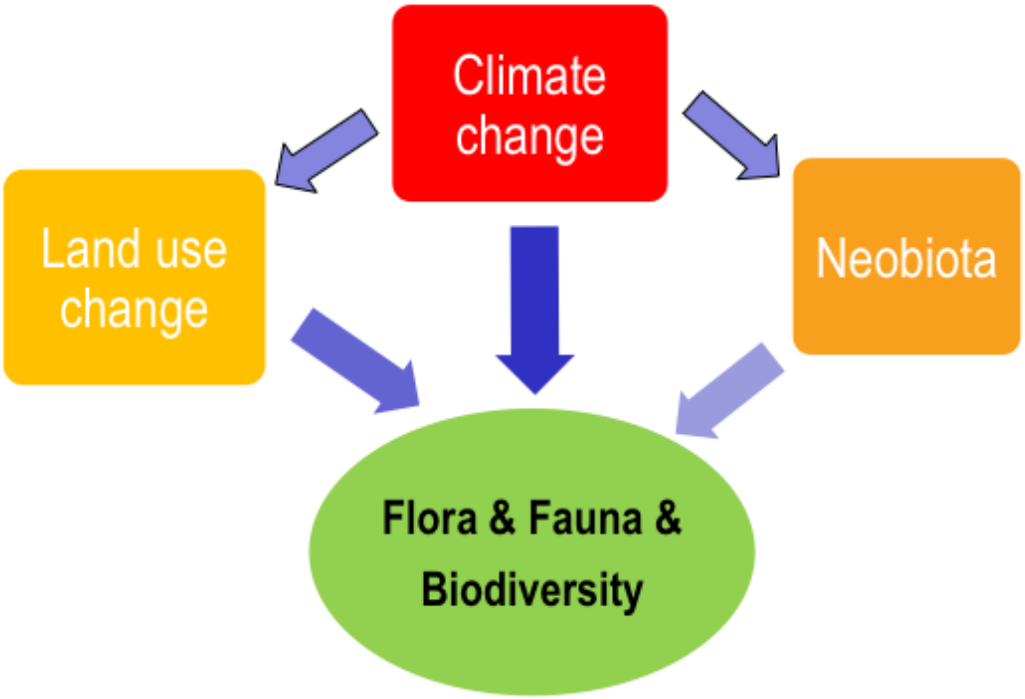

Figure 18: Key challenges for flora, fauna, biodiversity

KEY ENVIRONMENTAL OBJECTIVES "FLORA, FAUNA, BIODVERSITY":

- Stop the loss of biodiversity through land take, contamination, blockage of corridors and deterioration of habitats (EC biodiversity strategy, UN Convention on Biological Diversity)
- Foster the continuation of the Natura-2000-network and preserve protected areas
- Enhance the Ecological Connectivity by Green Infrastructure (EC GI)

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e. Landscape

STATE OF THE ENVIRONMENT

Traditional agricultural and pastoral activities have shaped the farmed landscapes in large sections of the Alps for over a thousand years and are a significant factor in maintaining biodiversity. Livestock grazing is common in many Alpine Environments around the globe (Nagy and Grabherr 2009). Centuries of human activity have created a diverse patchwork of small-scale landscape elements providing a large number of transitional spaces and ecological niches (Müller 2012). Bender and Haller (2017) have looked at the historical development over the last 1500 years and found different historical settlement and socio-demographic systems have evolved in the Alps as a result of various cultural traditions of the local population.

These cultural differences are still reflected in different developments of agriculture and tourism. Nevertheless, there are tendencies of polarization between prosperous areas (alpine cities, conurbations and major tourist areas) and less favoured areas (peri-urban and peripheral areas) over the last 30 years as described by Pfefferkorn et al. (2005).

The loss of cultural landscapes goes hand in hand with biodiversity loss (Müller 2012). Müller also stresses the point, that safeguarding man-made landscapes are also worth protecting because of their regional and identity-creating significance. Only recently, Bätzing (2018) confirms the continuing loss of traditional landscapes by the processes of rural depopulation and urban sprawl. The remnants barely exhibit commonalities with alpine specific living and economic conditions.

At the moment, forests and semirural areas cover about 77% of the Alpine area (Permanent Secretariat of the Alpine Convention 2018). Artificial surfaces are concentrated in the valley bottoms and at the Alpine borders (Figure 19). While the valleys are comparably densely populated, the steeper areas and more alpine landscapes as well as the heads of the valleys comprise of landscape with less land use (EEA 2012).

This typical landscape is a major important resource especially for touristic alpine areas. In particular summer tourists – yet to a lower degree also winter tourists – rank the factor “landscape” above all other criteria when coming to alpine regions (PSAC 2013, Jiricka et al. 2013a Jiricka et al. 2013b etc.). Tourism in the Alps has been estimated to account for 95 million overnight visits and 60 million day trip visitors per year and contributes notably to the economy of Alpine countries (50 billion euro yearly) (PSAC 2013).

On the one hand, the touristic exploitation poses pressures on the landscape (“overtourism”) because of increased land consumption (such as hotels, gastronomy, transport infrastructure, leisure areas, sport infrastructure) but on the other hand, generates opportunities for safeguarding cultural landscapes (BMUB 2016). One example for this is the “Bergsteigerdörfer” initiative (https://www.bergsteigerdoerfer.org/, viewed: 17.09.2019) launched in 2008 by the Austrian Alpine Association.

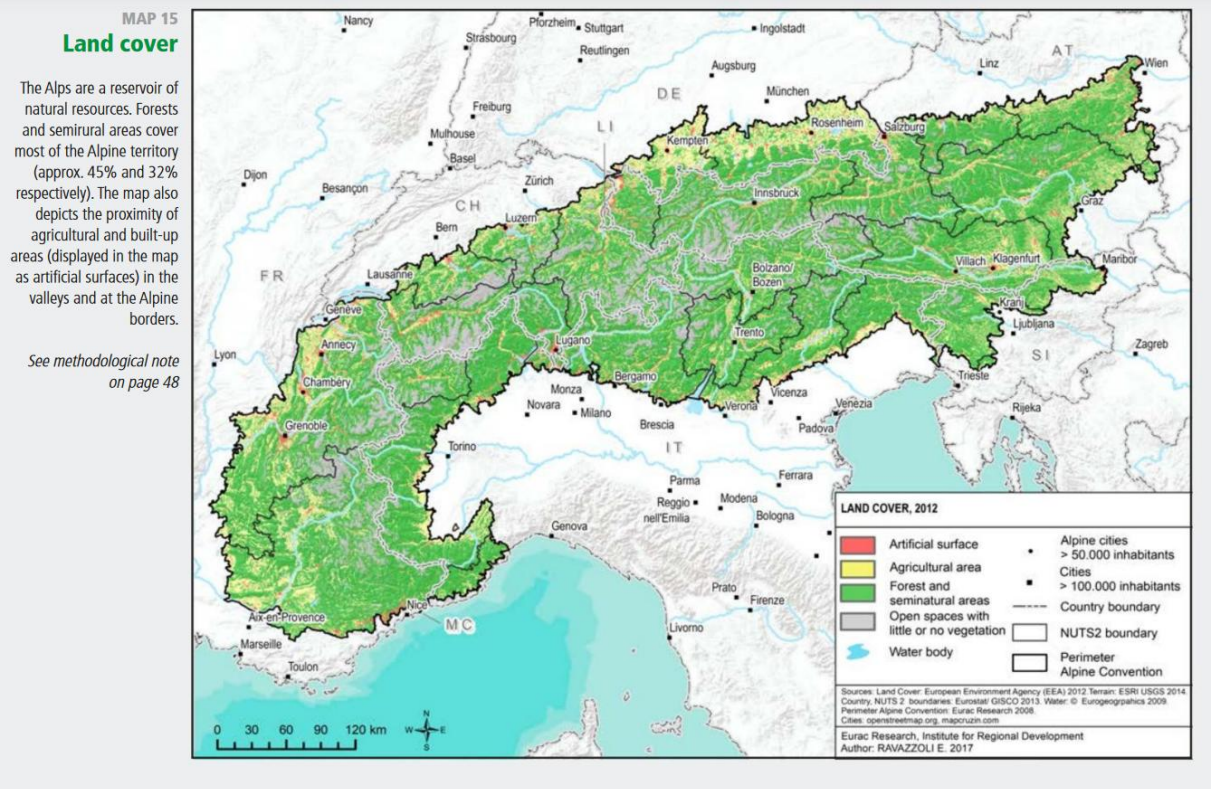

Figure 19: Land cover in the Alpine region. Source: Permanent Secretariat of the Alpine Convention (2018): The Alps in 25 maps; Map 15.

The future development of Alpine landscapes will also be largely dependent on climate change impacts and the related mitigation measures. According to Gobiet et al. (2014) that besides Alpine temperatures, also precipitation, global radiation, relative humidity, and closely related impacts like floods, droughts, snow cover, and natural hazards will be affected by global warming with large impacts on Alpine landscapes and society.

Forest landscapes, on the other hand, are likely to increase according to the Alpine Convention (2007) despite, or especially because of, global warming which may cause a change in the composition and structure of the woodlands (Thom et al. 2017). Winkler (2019) pointed out, that livestock grazing also influences the alpine-species responses to climate change indicating at for example declining vegetation productivity and forage quality.

Of the different types of landscape concerned, wild fluvial landscapes are the most endangered. The WWF (s.a.) states that for example only around 33 % of Austria's natural river landscapes are still ecologically untouched. According to Tockner et al. (2009), almost all European river basins are heavily affected by human activities, in the Alpine region, hydropower production and flood protection pose the strongest pressure on the river landscapes. The Alpine Space project SPARE (https://www.alpine-space.eu/projects/spare/en/home; viewed: 26.09.2019) addresses the challenge to harmonise data on the ecological status of Alpine rivers and to present clear priorities for future restoration and adequate protection measures by providing guidelines for successful and sustainable integrated water management.

Hydropower is only one way of renewable energy production. Other forms of renewable production technologies are used in the Alps and will become more important in the future such as bioenergy, wind power, solar energy and geothermal energy. Their further establishment will increase conflicts

with existing land use activities and might even further increase landscape fragmentation (BMUB 2016). Assessing the sustainability of different production technologies on the three sustainability pillars in the Alps, Grilli et al. (2017) found that forest biomass and hydropower will be more favourable solutions compared to ground solar photovoltaic and wind power due to their high impacts on land use. This increasing demand of land will force conflicts of different land use activities and needs solutions of multi-functional land uses.

One of several important solutions for mitigating these climate change impacts affecting the Alpine landscapes is the provision of a functioning ecological network (BMUB 2016). The ongoing fragmentation with all the implications already mentioned above (see chapter Flora, Fauna, Biodiversity) poses severe challenges to Alpine landscapes. A landscape matrix dedicated solely to agriculture, energy production of tourism prevents the movement of species in the landscape. A sustainable spatial development needs a balance of social, economic, ecological and also legal aspects. Solutions regarding a sustainable multifunctional trans-sectoral spatial planning need to be enforced in order to allow Alpine landscapes to evolve without losing identity, integrity and uniqueness. Even though the European Landscape Convention dates back to the year 2000 (Council of Europe, 2000), its main aims are more prominent than ever, namely ensuring the quality of landscape protection, management and planning and covering the entire territory.

TREND (ZERO VARIANT)

Many authors agree that the Alpine landscapes face large challenges in the next decades: The population will become more and more concentrated in the valleys which as a consequence become more urban and fragmented. On the other hand, some areas experience **depopulation** – young people migrate to urban areas leaving behind empty villages and the landscapes overgrown with bushes.

Flury et al. (2013) summarized in their study the past and future trends of mountain agriculture in the Alps depending strongly on overall **economic and social developments**. Depending on the scenarios applied, the future of agriculture in the Alps, in three of four scenarios (Globalisation and little regulation, Continental markets, Global co-operation, Regional communities) the abandonment of utilised land will continue to be the predominant change in land-use in Europe. Other studies even pointed out *…"that land-use changes that already occurred during the last decades are responsible for the main future LULC changes (by secondary succession). Only an extreme land abandonment scenario and extreme climate scenarios (5 K temperature increase) would bring about similar changes in LULC distribution and expansion of the forested areas."…* (Tasser et al. 2017). This expansion of forest cover will also impact the provision of multiple ecosystem services (Mina et al. 2017). They found, that protection services, carbon stock and deadwood abundance will benefit from no management in all regions with little negative effect of climate change. Schirpke et al. (2017) applied three socio-economic scenarios (positive, trend and negative) for 2050 and confirmed with their study the greatest changes in ecosystem services will be related to the natural reforestation of abandoned grassland, causing a shift from grassland to forest services.

Climate change with its associated fluctuations in precipitation and temperature regimes are expected to have partly large consequences for Alpine landscapes (Permanent Secretariat of the Alpine Convention 2017). Solutions regarding a sustainable multifunctional trans-sectoral spatial planning need to be enforced in order to allow Alpine landscapes to evolve without losing identity, integrity and uniqueness. Particularly increasing production of renewable energy contributing to climate change mitigation will impact Alpine landscapes. EUSALP Action Group 9 as well as BMUB (2016) sees the expansion of smaller and decentralized hydropower plants as well as other energy producing technologies like bioenergy, wind power, solar and geothermal energy as a way forward to a more sustainable energy production. Assessing the sustainability of different production technologies on the three sustainability pillars in the Alps, Grilli et al. (2017) found that forest biomass and hydropower will be more favourable solutions compared to ground solar photovoltaic and wind power due to their high impacts on land use. On the contrary, these approaches of renewable energy production impair partly strong impacts on animals and plants as well as the biodiversity. This increasing demand of land will force conflicts of different land use activities and needs solutions of multi-functional land uses.

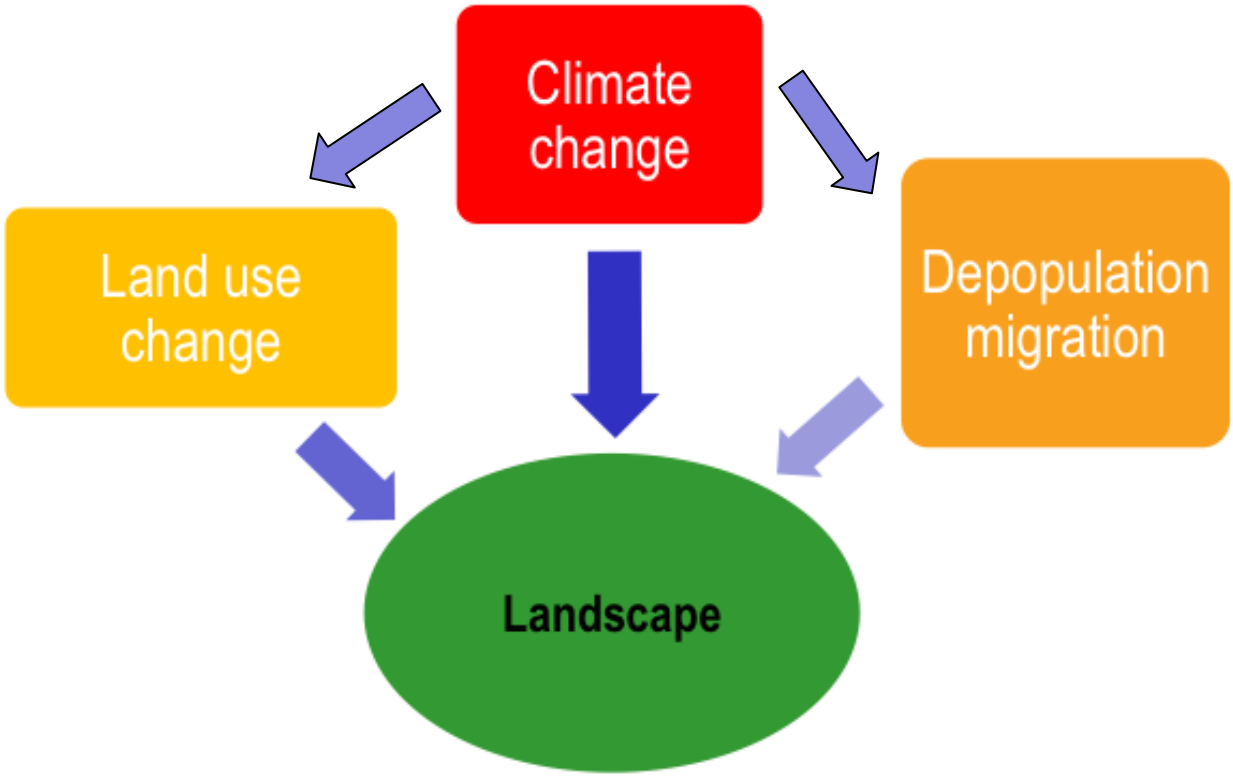

Figure 20: Key challenges "landscape"

KEY ENVIRONMENTAL OBJECTIVES "LANDSCAPE":

- Conserve the variety, uniqueness and beauty of landscape
- Maintain a mutually appreciated landscape development in the light of changes
- Balance multi-functional utilization of landscape

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f. Human Health, Population

STATE OF THE ENVIRONMENT

Emission related diseases

The population of the Alps is changing. The Permanent Secretariat of the Alpine Convention (2018) indicates that that there is a general population growth in the Western and central alps with declining population in the East (Figure 21). Not only are the Alps home to roughly 14 Million, but they also welcome to around 120 million tourists every year (Permanent Secretariat of the Alpine Convention 2018).

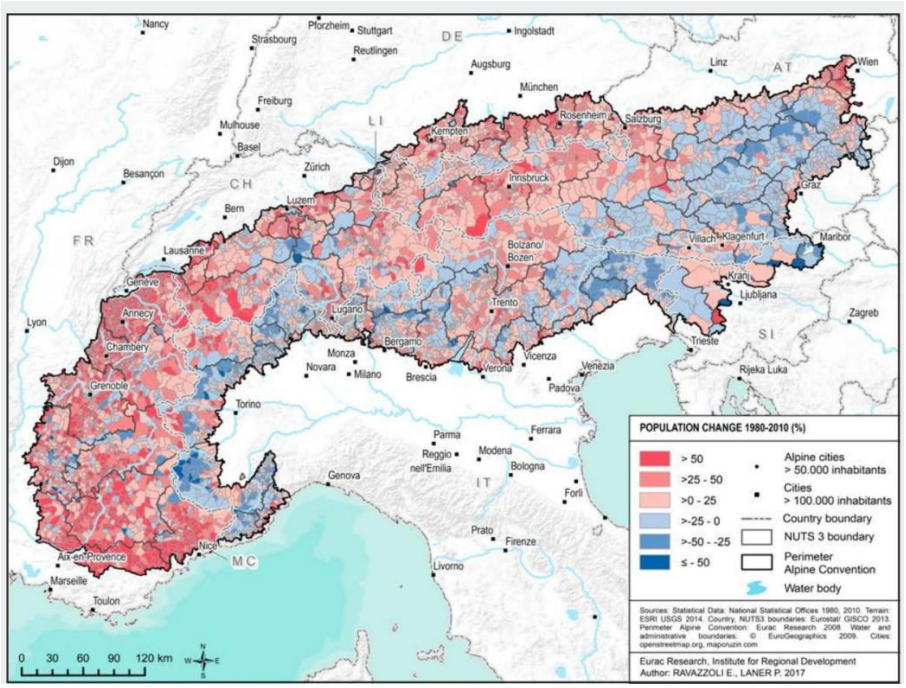

Figure 21: Population change 1980 – 2010. Source: Permanent Secretariat of the Alpine Convention (2018)

This means people and goods are beings transported across the region causing different types of emissions. Most influential for the local populations are noise and air pollutants caused by transport. Due to the transport corridors being limited to certain routes or valleys, these routes are especially hard hit with NOx pollution, a pollutant which is predominantly caused by combustion engines (Dumolard 2009). Figure 22 shows the current levels of nitrogen dioxide over Europe.

Transport is a major source of emissions in the Alps and the cause of 24.3% of GHG emissions (EEA 2016). While transport serves a purpose for inhabitants to in their daily lives, it also serves freight and tourism. Concerning the freight transport across this region, the European Commission (2018) has found, that there is an increasing amount of goods being transported, with an expectation of further increase in coming years. BAFU (2016) also recognizes the effects freight transport is having on the alpine space. Additionally, it was found that while Switzerland has a high modal share in favor of rail (69.9% of freight is transported by rail), Austria and France for example have much larger road

percentages (70.2% and 92.3% respectively). The overall modal split for transport across the Alps in Germany, Austria and Italy is dominated by road traffic (Tuszynska 2016).

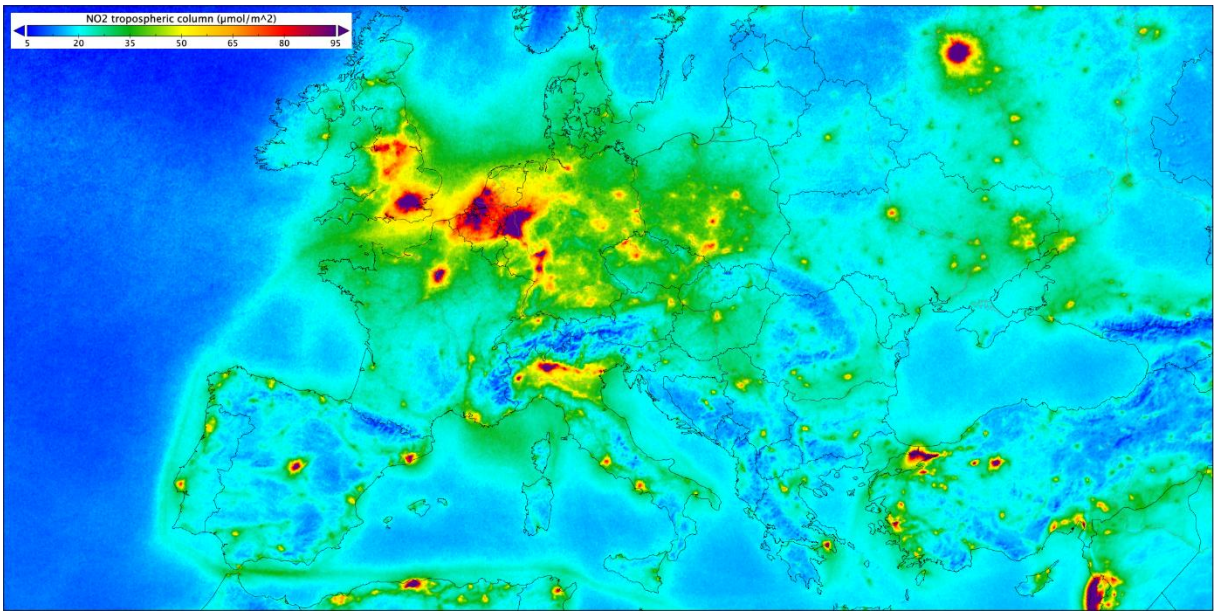

Figure 22: Nitrogen dioxide over Europe. Source: EESA modified Copernicus data (2018)

The population is left noise and air pollution causing negative effects on human health (BAFU 2018, 2014, BMNT 2018). The World Health Organization (WHO 2019) links excessive noise to cardiovascular disease, psychological effects including effects on concentration and annoyance. Even limited exposure over a longer course of time to air pollution can also cause cardiovascular disease (EEA 2013).

Moving away from human influences, the Alps also offer positive effects on human health. Research suggests that there are physical and mental benefits from spending time outdoors which can be found across all age groups (Mutz and Müller 2016, Arneberger et al. 2018, Gatterer et al. 2015). For recreation purposes the Alpine areas offer a diverse repertoire of activities that stimulate physical health and mental rejuvenation.

Natural hazards

Due to its geomorphology and topography, natural hazards are an inherent challenge in many parts of the Alpine Space territory leading to diverse impacts on human health/population. The risk of impacts on human health/population increases particularly in hillside areas, higher alpine territories and near rivers/brooks, in case inhabited areas are nearby. Over the past decades the magnitude and frequency of extreme events increased. Many studies as well as reports such as IPPC (2019) and Alpine Convention (2019) relate these dynamics to climate change.

Climate change can cause meteorological phenomena to change in frequency or intensity. Extreme events are particularly relevant for major infrastructure and settlements (Altvater et al., 2011). The effects of heavy precipitation and its consequences, such as drainage system overburdening and

flooding, were already ten years ago the subject of studies such as Haurie et al. (2009) or Swart and Bisesbroek (2008).

In the alpine area, indirect consequences of small-scale precipitation events are mainly landslides, debris flows and creeping slopes (Stoffel and Huggel 2012). These in turn lead to considerable costs through reconstruction measures, blockades of strategically important routes, power failures or even personal injury (Altvater et al. 2011, Birkmann et al. 2010). A decline in permafrost also played already a role and can lead to increased occurrence of soil instability and thus erosion. Further instability of very high transport infrastructure, railways etc. (Gruber and Haeberli 2007, Jochem and Schade 2009,). These effects are rarely impacting larger settlements however.

Altered temperature conditions, especially heat waves and freeze-thaw cycles, challenge the material of infrastructure, such as electronic line infrastructure (Jayant et al. 2013, Eskeland et al. 2008), or pavements (Harvey 2004, Enei et al. 2011). An increase in forest fires was partly observed due to longer periods of heat waves and drought (Vacik and Müller 2013).

Large storm events occurred over the past ten years which affected enormous forest areas, particularly in Northern Italy. Apart from economic impacts these large events of windfall also increased the likelihood of negative consequences for human health/population in particular close to settlements and in case protection forests were affected.

TREND (ZERO VARIANT)

Overall, the population of the alps is aging. The Italian and German Alps, where 1 out of 5 citizens are over 65, are seeing that more so than the French and Swiss Alps (Permanent Secretariat to the Alpine Convention 2018). The Alpine Convention (2018) also illustrates that the overall population growth is around 0,6%; with the strongest growth rates occurring in France, and the strongest decrease found in Austria. This shift in age is also accompanied by increasing polarization as indicated in Figure 21. In parallel migration to and within the alpine area is likely to continue.

Emission related diseases

Following the trends of reduction in **pollutants** discussed in the section on climate and air, it is to be expected that the correlating influenced on human health will also be reduced. In Germany, this trend was identified in the reduction years lost due to NOx exposure (Umweltbundesamt 2018). In the study, Umweltbundesamt identified that number of premature deaths was reduced from 7.832 in 2007 to 5.966 in 2014. Years of life lost fell from 69.244 down to 49.726. Although there are not many studies specifically covering the Alps, the trends indicate that the cases of cardiovascular disease, psychological effects or strokes related to the exposure to pollutants and causing premature death will decline as emissions decline. BAFU (2014) also calls for stronger collaborative work on reduction of pollution, as the movement of particles is not hindered by boarders. Climate change could partly reverse positive trends in summer times during heath waves and drought, in particular for ozone induced diseases (BAFU 2019).

On the topic of noise, the Environmental Implementation Reviews of 2019 (EC 2019 a – e) indicate differing trends across the nations. Slovenia and Austria appear to be doing well in upkeep of data, mapping and action plans. Switzerland (BAFU 2016) has also been able to report in a success in noise reduction with a continuous positive trend expected for noise from both road and rail. Italy has improved their approach to noise mitigation and has caught up on missing reports and plans concerning noise. Germany has ample sources of data, but is currently lacking action plans for future development. Lagging behind is France, where performance on noise mitigation continues to be low and action plans are missing. Through the Environmental Noise Directive (Directive 2002/49EC), the foundation for future improvements have been laid. Should the action plans be implemented, noise should be able to be reduced or kept low. Indications show that noise reduction continues to be sought mainly along roads through reduction of numbers, speed limit and noise barriers (BMVIT 2018). Switzerland is also giving significant attention to reduction of noise along rail axis (BAFU 2016). Recognizing noise as a continuous cause of cardiovascular disease, sleep disturbance, annoyance, loss of concentration and cognitive abilities, Swiss plans seek to reduce the source of noise and also promote quiet relaxation and in residential areas (BFU 2018).

Natural hazards

Particular attention needs to be paid to settlement structures on slopes, in the vicinity of streams, on respectively near the banks of rivers and - depending on the forest management (species, open clearing areas, etc.) – also in proximity to forests. Endangerment of people and houses in the vicinity of these natural elements is expected to increase because of climate change, in particular over the

long-term beyond 2050 (Alpine Convention 2019, Permanent Secretariat of the Alpine Convention 2019).

Changes in the precipitation regime need to be taken into account in planning in alpine space territories with proximity to surface water bodies, since otherwise a re-dimensioning of planning elements such as drainage basins, drainage or retention areas may be necessary at higher costs/ with limited options (BAFU 2014, Bayrisches Staatsministerium für Umwelt und Verbraucherschutz 2017, BMNT 2012a and b, BMNT 2017, BMU 2011). Demand for new retention areas, conversion (rezoning) of building land to retention areas might cause conflicts in land use and can particularly affect settlement structures (Hohenwallner et al. 2015, p. 130 and 168). Overall, the new demand of for space for active and passive hazard prevention might aggravate existing conflicts of land scarcity (e.g. Land Steiermark 2017, p. 45, Land Vorarlberg 2015, p. 57, see also interrelationships with the environmental issue "Soil"). Synergies between water retention and the reduction of heat islands through the increased development of Green Infrastructure (European Commission 2013) can help to minimize conflicts. First applications of multifunctional use of space were analysed e.g. in larger alpine cities such as Munich and Vienna (Back and Kleidorfer 2019 as well as Pucher et al. 2018). Similarly, synergies can be reached through stabilization of soils in order to prevent erosion and debris flows. The project Links4Soils covered this preventative approach, which will gain further importance in the future. Moreover, protection to natural hazards will be dependent to a large extent on the condition of mountain forests. Sebald et al. (2019) emphasize the role of mountain forests as important green infrastructure, efficiently reducing the probability of torrential hazards in the Eastern Alps. Impacts of climate change on the protective role of forests will be highly different based on local site conditions (Mina et al. 2017). As such, the choice of management regimes should be adapted to site conditions, whereas in some cases the absence of management might be the best solution for protection services (Mina et al. 2017).

Interrelationships, in terms of positive co-benefits, can occur for the prevention of risks due to green infrastructure between the environmental issues "Soil", "Water", "Flora/Fauna/Biodiversity" and "Climate/Air" thereby. Overall, spatial planning will bear major responsibility in coordinating and managing risk prevention regarding new settlements and protection of existing structures in combination with instruments for hazard prevention at local level (Permanent Secretariat of the Alpine Convention 2019).

Another impact of climate change that could lead more frequently to indirect damage to infrastructure and settlements will be the increase in forest fires. In case protective forests will be affected those climate change impacts pose a particularly high risk in combination with other follow-up extreme events (Leidinger et al. 2013, Vacik and Müller 2013). Forest fires are particularly likely to originate from embankment fires (e.g. railway tracks). Consequently, preventative measures need to be taken into account in forest management. At the same time the reduction of conflicts with nature conservation targets needs to be kept in mind (see interrelationships with Flora/Fauna/Biodiversity).

Additionally, an increased occurrence of windfall, especially at endangered locations (e.g. forest edges, wind-exposed slopes) is likely to occur more frequently and with a larger scope. Wet snow aggravates the conditions in particular in the Southern part of the Alpine territory. Snow pressure is also likely to affect settlement structures more frequently (depending on material and structure of roofs and other settlement infrastructure).

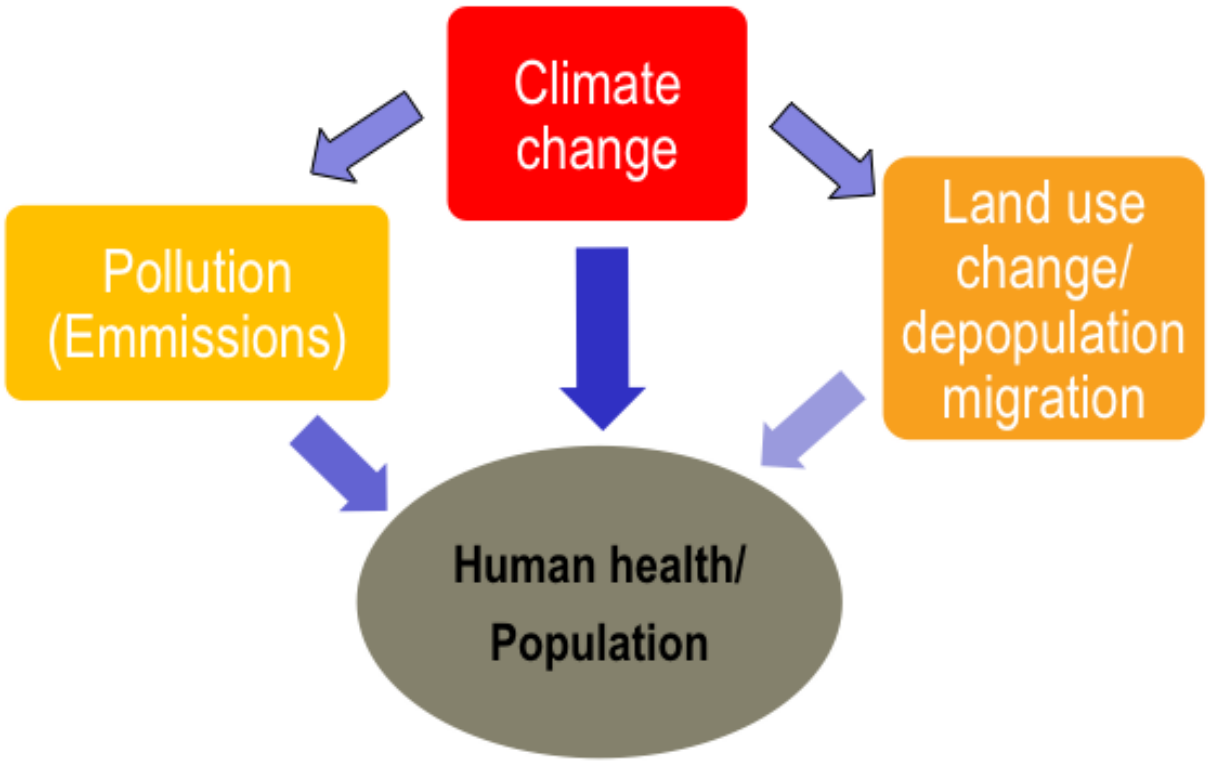

Figure 23: Key challenges "human health/population"

KEY ENVIRONMENTAL OBJECTIVES "HUMAN HEALTH / POPULATION":

- Reduce the high load of pollution – particularly PM10 and finer matter – in alpine valleys to prevent emission related diseases
- Reduce the noise pressure, particularly in alpine valleys
- Prevent and minimize risks of extreme events and related natural hazards for settlements

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g. Material assets and cultural heritage

STATE OF THE ENVIRONMENT

The Alpine region is characterized both in cultural heritage and material assets through long traditions in agriculture, architecture, cuisine, art and craftsmanship that have shaped the cultural landscape of this mountain range. Under the declaration on "Population and Culture" (Alpine Convention 2006), the great cultural diversity is recognized for its influence on quality of life, settlement structures, tangible and intangible cultural heritage. A quick look at the Map of Heritage Sites (Figure 24; Permanent Secretariat of the Alpine Convention 2018) illustrates just how many sites of cultural value are scattered throughout the region. There are 17 UNESCO World Heritage sites considered to be in the Alps and spread between Austria, Germany, Italy and Switzerland. Of these, four are Natural Heritage Sites while remaining 13 are all Cultural Heritage Sites (UNESCO 2019).

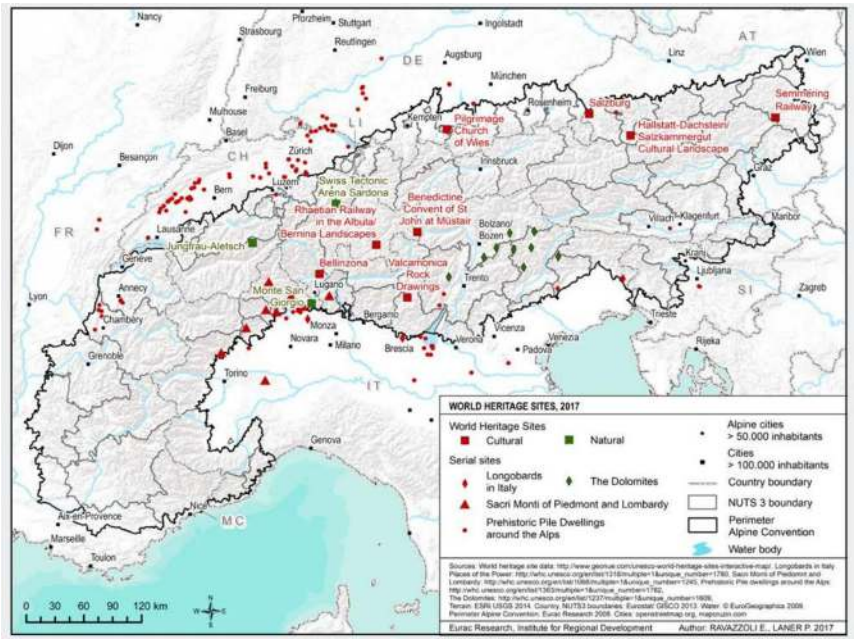

Figure 24: Map of Heritage Sites, Source: Permanent Secretariat of the Alpine Convention (2018)

Two main economic activities shape the cultural heritage in this region: agriculture and tourism. While agriculture has far less importance employment wise than tourism for the local populations for example (Permanent Secretariat of the Alpine Convention 2018), it carries great importance for the maintenance of the cultural landscape. Furthermore, the immaterial heritage carries great potential for tourism, yet it is often a fine line between tradition and staged enactment that is criticized in this regard (Luger and Wöhler 2015). Excessive tourism and the commodification of tradition could be seen as a threat to cultural heritage (Pasikowska-Schnass 2018). Festivals, oral traditions, music and language are all immaterial aspects that are found to be diverse and unique in the Alpine region contribute, to this day, to a fascinating immaterial cultural landscape. The beneficial effects of such rich cultural heritage is seen to be the ability to increase quality of life, enhance uniqueness,

contribute to job creation, ignite sustainable regeneration, contribute to identity building and incorporate climate change adaptations into renovations (CHCfE Consortium 2015).

Architecture and traditional constructions remain significant material assets. Traditional architecture can be a draw both for heritage tourism but also as a means of education for tourists and locals alike (Hmood and Jumaliy 2018). With traditional architecture come questions of restoration, preservation and maintenance which can be very costly in both time and financial investments. This becomes a more pressing issue when threats from climate change and natural disasters (Pasikowska-Schnass 2018) are considered. Going beyond the touristic value, it can be argued that built heritage is profitable as a soft factor in local economy and that historic building stock carries a very specific attraction to investors due to their unique historic characteristics (Haspel 2011). Two projects, CLISP and ATLAS, have worked with regions in the past to address adaptation to climate change in both spatial planning and restoration and maintenance of historic buildings in a manner which follows sound social, ecological and economic sense. Architecture and traditional constructions are seen to be central for the preservation of cultural heritage in the Alps, an attitude that can also be recognized in the various conservation policies of the alpine nations.

TREND (ZERO VARIANT)

The trends concerning cultural heritage and material assets will need to address three main future issues: the consequences of **climate change**, the **maintenance of cultural landscape** and the **maintenance of historic building stock**.

Cultural heritage and material assets are well established but not untouched by **climate change**. Landscape and man-made structures are not immune to the risks of erosion, landslides and other natural hazards. These occurrences can change the landscape and its stability, influencing the security of structures (JRC 2015). In particular the growing transport and tourism infrastructure in the Alps will be exposed to more natural hazards, such as rockfall, avalanches, and torrential hazards, events which are likely to increase in the future due to climate change (Einhorn et al., 2015). In this publication, the authors summarize findings of many studies dealing with the occurrence of natural hazards in the future decades and their impact on the Alpine environment: increasing frequency or volume of rockfalls, significant increase in the occurrence of debris flow probability, decline of 20-30 % in avalanche activity for the 21st century. Furthermore, impacts of climate change can also remove and re-deposit archeological artifacts (JRC 2015). It is of importance to recognize these risks in spatial planning approaches and adapt accordingly.

Maintaining cultural landscape, often linked to agriculture, will become more difficult as the demographics continue to age and outward migration effects regions (see chapter “Human health, Population”). Even if the industries that formed the landscape such as agriculture and mining have changed, upkeep of traditional trade and handicrafts continue to be a central part of maintaining the cultural landscape and identity, often branching out into the tourism sector (Schermer 2016, Bätzing 2015, Bender 2010). In order to promote sustainable development of the cultural landscape, regionally specific ecological and social aspects must be considered in spatial planning and landscape management.

Additionally, the cultural difference across the Alps also influences how heritage and material assets are perceived and managed. The Alps continue to be very culturally diverse. This diversity will influence organization, maintenance and subsidies individuals may be interested in regionally (Bender and Haller 2016, Bätzing 2016). Trends in landscape management approaches will be equally diverse.

When it comes to the **maintenance of building stock**, the project ATLAS identified that up to 60% of building in rural areas can be considered historic. However, these structures are usually outdated. Recognizing this as an opportunity, ATLAS engaged in retrofitting historic buildings and illustrated, that there are current shortcomings in financial support and policy frameworks to assist investors and owners. With the trend working against retrofitting and the use of existing infrastructure, it becomes clear that to protect material assets and increase resource efficiency, stronger policy and financing mechanisms need to be developed.

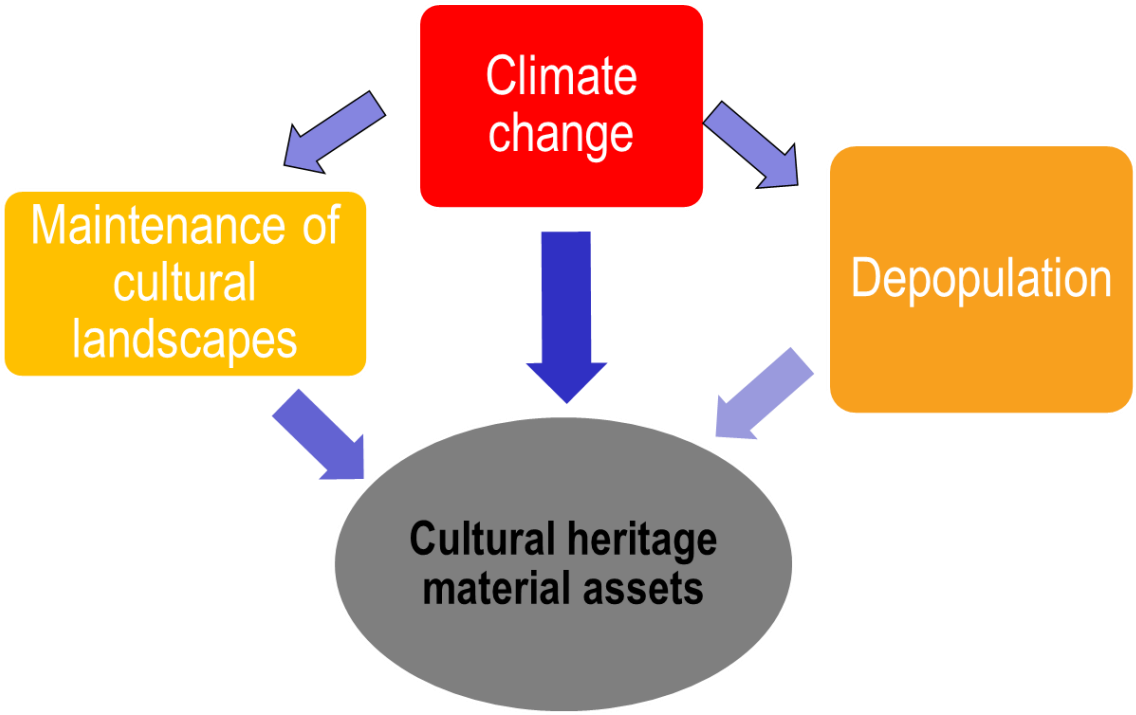

Figure 25: Key challenges "material assets/ cultural heritage"

KEY ENVIRONMENTAL OBJECTIVES "CULTURAL HERITAGE / MATERIAL ASSETS":

- Enhance the protection/preservation and renovation – Consider resource consumption, resilience and coping mechanisms
- Integrate renewable energy production and supply carefully

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4. Core environmental objectives across all environmental issues

Due to the highly interconnected nature of the different environmental issues, overarching goals can be formulated enabling positive synergies for several environmental issues or speaking in terms of the SEA to enhance positive interrelationships.

Improve ecological condition and connectivity: As outlined in Chapter 3.d. fragmentation is a major pressure on biodiversity. The enhancement of connectivity e.g. through strategic Green Infrastructure planning does not only foster the environmental objectives for "flora/fauna/biodiversity" but also provides co-benefits for climate regulation and indirectly for "human health/ population" (Honeck et al. 2020, Monteiro et al. 2020). Additionally, these approaches can support climate change mitigation but also adaptation to climate change impacts: green spaces retain water; provide shaded / cooler locations for animals and people and a range of other ecosystem services (European Commission 2013). Similarly improvement in the connectivity of water ecosystems can imply several other positive effects e.g. for climate change adaptation purposes.

As mentioned in the previous section three, pollution is still a serious challenge, particularly for "water", "air" and "soil" but also "human health" and indirectly for "flora/fauna/biodiversity" and in some cases even "cultural heritage" in the alpine territories. One strong polluter is still to some extent, next to traffic, the more industrialized agriculture. Reduction of negative impacts in this field can support reduction of negative environmental impacts significantly and contribute also to reintroducing biodiversity in some areas. While regional initiatives can support climate change mitigation, the additional valuation of sustainable production conditions support the overall environmental ambitions. Organic farming, for example, can significantly improve ecological condition and **decrease pollution** since it abstains from agrochemicals; by low input of chemical compounds, water systems and soil profit (e.g. Williams et al., 2017), as well as fauna & flora (Fuller et al., 2005; Hole et al., 2005). Additionally, products of organic farming seems to promote a positive human health status (Hurtado-Barroso et al., 2019). The Alpine Space programme is as well supposed to continue its initiatives in reducing emissions (GHG, PM, and other pollutants) of traffic, communities and industries, which again does not only support objectives for clean air and human health, but also healthy ecosystems and thus biodiversity. Energy efficiency but also **reducing consumption of natural resources** offers possibilities for a more sustainable development in all its dimensions. Particularly, in light of climate change mitigation but also due to climate stressors making climate change adaptation necessary, new strategies towards sufficiency and multiple, combined usage of space are essential.

To sum up the core environmental objectives, Figure 26 summarizes the key needs to enhance positive impacts across all environmental issues. Climate change adaptation and mitigation targets are strongly related to these four principle goals as well. The concrete contributions of the specific objectives to the environmental objectives identified for each environmental issue will also be transparently subsidized at the end of section five (Detailed overview of likely contributions to environmental goals by each specific objective, p. 116).

Figure 26: Summary of key goals to preserve the Alpine Space' environment and enhance its condition in light of the future development

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5. Assessment of likely significant environmental impacts

a. Priority 1 - Climate resilient and green Alpine region

S.O. iv. Promoting climate change adaptation, risk prevention and disaster resilience

Background

Primarily the actions under this specific objective strongly relate to protection of natural hazards. In the past funding period projects, like Links4Soils or RockTheAlps, focused strongly on one environmental issue – e.g. soils or protective mountain forests – for the purpose of hazard prevention and/or reduction. Looking on the outcomes of Links4Soils, a wide range of topics was treated and best-practice examples were presented linking the main focus on the intelligent and careful use of the resource soil to the broader context of soil protection in forestry, spatial planning, agriculture, tourism and natural hazards prevention. RockTheAlps focused on rock fall events in the Alps and in the way protective forest can help in their prevention. Advantages of an intact and sustainably managed forest ecosystem could have more actively been addressed. Thus integrative nature-based solutions viewing also co-benefits for other environmental issues could be exploited further in the next programming period. Some sectors and impacts are mentioned exemplarily in the new programme, such as settlement areas and impacts by heat waves. Herewith the strong connection to S.O. vii seems highly evident. Not only can green and blue infrastructure foster climate change adaptation needs, partly also co-benefits for climate change mitigation can be created. In this case, even significant positive impacts might result for "climate/air" and also "flora/fauna/biodiversity". A cross-sector perspective could also support the prevention conflicting interests e.g. fostering multiple-land use and prevent contradicting goals of nature conservation. The final version of the programme explicitly underlines this approach: "*It should be pointed out, that actions supported within this SO should have an integrated character, foster co-benefits for mitigation and avoid lock-in-effects by adaptation*." (ASP 2021+, final programme, p. 21).

Altogether, the SEA monitoring for the funding period 2014-20 could not identify any significant negative environmental impacts resulting from projects in the area of climate change adaptation and particularly the prevention and reduction of natural hazards. Some projects such as SPARE, HyMoCARES and Eco-AlpsWater attempted even to ameliorate the conditions of surface water bodies and could be considered as mitigation for negative impacts of regulation for hazard prevention and or negative impacts of energy production (e.g. they could contribute to minimize impacts of hydropower utilization).

Also for the future funding period, continuation of the focus on nature-based solutions in prevention and reduction is highly recommended. The planned actions indicate that the programme is following this principle: *"Developing solutions and pilot activities to set up coordination structures for the sustainable management of multifunctional protective forests and the establishment of Nature Based Solutions, taking into account Green and Blue infrastructure, water-management and ecosystem services (ASP 2021+, final programme, p. 23)".* Strong synergies can therefore occur in connection with the activities and targets of S.O. vii "*Enhancing biodiversity, green infrastructure in the urban environment, and reducing pollution*". Against this background also from actions such as "*Developing*

solutions and pilot activities for different types of territories in highly affected and exposed regions (e.g. high altitude environment with glacial mass reduction, permafrost degradation or regions specifically hit by draught)" (ASP 2021+, final programme, p. 23) no negative environmental impacts are expected. These territories and their flora/fauna/habitats will be impacted strongly by climate change. Project selection, implementation and monitoring therefore needs to pay special attention not deteriorate or negatively impact habitat conditions.

Provided the joint efforts of these two objectives under this priority, significant negative environmental impacts are excluded by the SEA and even positive environmental impacts are likely to result from projects funded under this priority and special objective, in particular for "Soil", "Human health and population" as well as "material assets and cultural heritage".

The likelihood of significant positive impact increases also due to the planned activities in prevention and integrative spatial planning, which is indicated e.g. by the following actions "*Setting-up of preventive planning measures in the fields of spatial planning and risk management through the joint development of tools, interoperable databases; disaster monitoring-, warning- and response- systems at different territorial levels concerning all kind of natural hazards."* Communication actions such as "*Developing integrated and participatory concepts and implementing pilot projects in risk management as well as communication measures aiming at raising awareness and preparedness among policy makers at different policy levels as well as among citizens*" are likely to increase the positive impacts on "human health/population" in terms of prevention of natural hazards. Data monitoring and improved methodologies and tools (link to priority 3) which will look at climate change impacts and particularly natural hazards can be beneficial too.

Assessment of the Specific Objective iv.

Overview on the assessment results of Priority Axis 1 "Climate resilient and green Alpine region" **S.O. iv. Promoting climate change adaptation, risk prevention and disaster resilience**		
Environmental Issues	**Assessment results**	**Explanation**
Soil	Significant positive impacts likely	Depending on whether nature-based solutions to stabilize soils and prevent erosion are chosen (see SEA monitoring)
Water	No significant impacts to positive impacts	Focus on nature-based solutions and retention recommended – if this happens even positive impacts are likely; otherwise also negative impacts might result; monitoring results of the previous programme suggest however, not to suspect these negative effects.
Climate/Air	No significant impacts to positive impacts	In case maladaptation is prevented no significant environmental impacts are expected, in case the projects funded under this S.O. foster co-benefits for climate change mitigation even significant positive impacts are likely
Fauna, Vegetation, Biodiversity	No significant impacts to positive impacts	Even positive impacts are likely in case the focus is on nature-based solutions; no significant impacts to be expected, in case the focus is on measuring, monitoring, knowledge exchange; overall, negative impacts are possible but unlikely according to SEA monitoring results of the previous programme. Actions also address higher alpine areas. These territories and their flora/fauna/habitats will be impacted strongly by climate change. Project selection, implementation and monitoring therefore needs to pay special attention not deteriorate or negatively impact habitat conditions.
Landscape	No significant impacts to positive impacts	No significant impacts to be expected, in case the focus is on measuring, monitoring, knowledge exchange; overall, negative impacts are possible but unlikely according to SEA monitoring results of the previous programme and in case the focus is on nature-based solutions and knowledge building/ exchange.
Human health, Population	Significant positive impacts	Efforts to reduce risks also on human settlements and infrastructure will lead to significant positive impacts.

Material assets and cultural heritage	Significant positive impacts	Significant positive impacts are likely due to risk reduction; negative impacts are possible e.g. visual impacts (see also landscape) Negative impacts are possible (e.g. visual impacts) but are unlikely - see also landscape

Interrelationships and cumulative impacts

Positive interrelationships are likely within this specific objective in case nature-based solutions contribute not only to prevention of soil erosion, stabilization of slopes/ hilly/ mountainous territories and retention capacity but also to benefits for flora/fauna/biodiversity (such as e.g. the sustainable management of protection forests). Additionally, positive interrelationships are likely with “climate/air” in this context as carbon sinks can be preserved or (re-)established. Positive synergies can occur with targets promoted under S.O. vii and under the specific objectives of Priority 2 as also mentioned in the final programming document.

S.O. vii. Enhancing biodiversity, green infrastructure in the urban environment, and reducing pollution

Background

The ASP defined one of the main joint challenges for the Alpine region the pressure on Alpine Biodiversity: "*Alpine biodiversity and ecological connectivity has been under pressure for many decades especially since the second half of the 20th century. Intensive exploitation of natural resources and the use of land for various purposes like settlements, transport, energy and touristic infrastructure as well as for agriculture and forestry have caused high losses in biodiversity and the fragmentation of ecosystems in the Alpine area. In addition, the rich natural and cultural heritage of the Alps is more and more endangered. Climate change is a new threat for Alpine biodiversity*." (ASP 2021+, final programme, p.5)

The Specific Objective 3.2 *"Enhance the protection, the conservation and the ecological connectivity of Alpine Space ecosystems"* of the last funding period had partially many overlaps to the currently planned S.O.vii. The importance of ecological connectivity in the Alpine region is stressed also under the light of European policies. The funded projects (f.ex. ALPBIONET2030, Eco-AlpsWater, SPARE and HyMoCARES) showed positive impacts especially on "flora, fauna and biodiversity", as well as "water" and indirect positive impacts for "landscape". Consequently, a wide array of benefits was possible and positive contribution to several dimensions of ecosystem services (regulating services, cultural services, provisioning services ...). Projects like SPARE and HyMoCARES very clearly indicated the positive indirect impacts on other environmental issues and ecosystem services resulting from improved surface water quality. From this point of view, the involvement also of Blue Infrastructure into the current S.O. seems logic and valuable and could already be implemented in the name of the S.O.

Surprisingly, the influence of climate change as additional stressor on the connectivity of several species was only marginally tackled in the projects during the last period. The current description of the S.O. and its actions actively address the topic of a changing climate now: *"c) Supporting transnational cooperation, knowledge-exchange and reinforced research on the concrete impacts of climate change on Alpine biodiversity as well as the impacts of mitigation and adaptation measures for different types of territories, as well as in and for urban regions (e.g. to fight urban heat islands,…);"* (ASP 2021+, final programme, p.26) Thus, it is expected that projects funded under this S.O. vii will contribute to a better knowledge of impacts on biodiversity and mitigation through GBI.

Even looking at climate regulation functions of GBI, the suburban network needs to be considered as it is also argued on p. 18 (ASP 2021+, final programme): *"Furthermore, Green and Blue Infrastructure can ensure a better functionality of Alpine cultural landscapes and local economy activities (tourism, agriculture,…) and can improve connection between rural and urban areas."*. It is widely known that not only urbanised but also very intensive agricultural landscape suffer enormously from biodiversity decline. Similarly climate change affects (higher) alpine habitats. Particularly in these areas GBI can contribute to climate regulation and reduction of natural hazards and provides possible synergies with S.O. iv. Connecting green and blue infrastructure would make sense, particularly also for climate regulation and fostering biodiversity.

Reinforced research on concrete impacts of climate change on Alpine biodiversity could be combined with S.O. iv to address the issue of the impacts of mitigation and adaptation measures on Alpine biodiversity (as addressed on p. 18; ASP 2021+, final programme).

Another interrelationship with S.O. iv is the provision of a wide array of ecosystem services by GBI such as natural flood prevention, biodiversity and soil protection, especially when focusing on Nature Based Solutions (NBS) and sustainable management, as stated also on p. 26 (ASP 2021+, final programme): *"a) Implementing pilot projects that support Green and Blue infrastructure-networks ("TEN-G"), Nature Based Solutions (NBS) and innovative planning methodologies in order to strengthen Alpine biodiversity and ecosystem services, taking into account their contribution towards the social, cultural and economic systems (e.g. "One-health-approach"; integrated and sustainable approaches of system integration and valuation)"*

Reduction of pollution, as mentioned in the name of S.O.vii, indirectly addressed as a positive impact of GBI by combining with climate change-adaptation when attempting a strategic approach of GI from small to larger scale (considering also e.g. fresh air corridors in urban-suburban relationships as well as in alpine valleys and other relevant topographical structures).

The focus on urban areas as suggested by the title of S.O.vii seems too narrow in the view of the SEA. Strategic planning and linking diverse structures offer benefits also in other areas particularly when attempting to enhance and preserve biodiversity and enhance climate regulation capacity. In the description of the SO in the final programme document, the urban focus is widened to other landscape types and their interlinkages (connectivity).

Overall, **only significant positive impacts** seem likely with the current planned activities. Maximization of **co-benefits** is likely especially when considering synergies with activities of other Specific Objectives. Recommendations to include Blue Infrastructure were up taken finally and should be consider not only for urban landscapes.

Assessment of the Specific Objective

Overview on the assessment results of Priority Axis 1" Climate resilient and green Alpine region" S.O. vii. Enhancing biodiversity, green infrastructure in the urban environment, and reducing pollution		
Environmental Issues	**Assessment results**	**Explanation**
Soil	Significant positive impacts likely	Directly addressed in action b)
Water	Significant positive impacts likely	Network-solutions and strategic blue infrastructure planning highly recommended
Climate/Air	Significant positive impacts likely	GBI has a regulating effect on the local climate (e.g. help fighting urban heat island) and acts as a filter of pollutants considerably enhancing air quality
Fauna, Vegetation, Biodiversity	Significant positive impacts likely	Network-solutions and strategic GI planning also comprising sub-urban and rural areas highly recommended
Landscape	Significant positive impacts likely	Structured landscapes rich on biodiversity can provide a high value of landscape aesthetics and recreation potential
Human health, Population	Significant positive impacts likely	network-solutions and strategic GI planning highly recommended to maximize positive benefits for climate regulation capacity
Material assets and cultural heritage	Significant positive impacts likely	Given the wide array of ecosystem service GBI provides, the safeguarding of material assets against natural hazard would profit

Interrelationships and cumulative impacts

The positive effect of a widespread and functioning GBI concerns all environmental issues, interrelationships among them seem likely, particularly between flora/vegetation/biodiversity, landscape and human health as well as between soil, water and fauna/vegetation/biodiversity.

b. Priority 2 - Carbon neutral & resource sensitive Alpine region

S.O. i Promoting energy efficiency measures

Background

In order to reach climate mitigation targets approaches fostering efficiency and if possible sufficiency are key goals which are urgently needed. Overall, the communication and awareness-raising for energy efficiency and saving turned out to be the key opportunity but also challenge for several projects funded under similar specific objective(s) in the previous funding period. Actions "*Supporting knowledge transfer as well as communication measures in order to raise awareness among different policy levels and the citizens/consumers using approaches like behaviour economics and political framing in order to foster the paradigm shift towards sufficiency- and post-carbon approaches*" (ASP 2021+, final programme, p. 29) will positively continue this process. The link to life-style and economic impacts will create positive impulses herewith.

Projects surveyed under the SEA monitoring of the previous Alpine Space Programme, such as THE4BEES attempted to create some long –term positive impacts also beyond the project-lifetimes. Others such as IMEAS, mainstreaming climate mitigation and low carbon energy planning, contributed useful tools to facilitate this process and identify and involve suitable stakeholders for transformative processes to institutionalize climate change mitigation at various levels.

According to the core focus of the specific objective, significant positive impacts on global climate change are likely. Similarly, positive impacts can result from the reduction of emissions as a side-effect of an energy-efficient and climate friendly building and transport sector. Significant positive impacts can herewith result from integrative approaches in land use planning, particularly for the action *"Supporting innovative solutions as well as concrete pilot actions that foster sufficiency-oriented-post-carbon lifestyles as well as cross-sectorial approaches for different types of territories, e.g. in the planning/ building/ housing/ residential/ tourism /mobility & transport/ energy sector(s) that take into account the sustainable implementation of new energy-resources (e.g. GNV, hydrogen, bio GNV, electric mobility)"*. Such integrative approaches might also lead to indirect positive impact on "Soil" and "Land consumption".

Cross-sectoral conflicts could be solved throughout these processes of "*Supporting solutions, the exchange of knowledge, good practices and R&D activities focussing on the transition from energy efficiency to sufficiency-oriented approaches and to support the transition towards a post carbon economy and society in the Alpine region considering Multi-Energy-System-Integration and the sustainable use of renewables;"* (ASP 2021+, final programme, p. 29) and could also support co-benefits between adaptation and mitigation (S.O. iv and vii) as well as to achieve targets of circular economy as envisaged in S.O. vi. The final version of the

programme reflects these two suggestions as mentioned on page 28 of the final programming document.

Assessment of the Specific Objective

Overview on the assessment results of Priority Axis 2, "Carbon neutral & resource sensitive Alpine region" S.O. i Promoting energy efficiency measures		
Environmental Issues	**Assessment results**	**Explanation**
Soil	No significant to positive impacts likely	Precautionary concepts in spatial planning could involve a reduction of sealing
Water	No significant impacts likely	
Climate/Air	Significant positive impacts likely	Viewing the major goals of this S.O. positive impacts on the global climate are likely to a certain extent
Fauna, Vegetation, Biodiversity	No significant impacts likely	Negative environmental impacts, depending on energy-production are not likely viewing the planned activities and particularly the efficiency and sufficiency oriented approach s
Landscape	No significant impacts likely	Negative environmental impacts, depending on energy-production are not likely viewing the planned activities and particularly the efficiency and sufficiency oriented approach s
Human health, Population	Significant positive impacts likely	Viewing the major goals of this S.O. positive impacts on the global climate are likely to a certain extent
Material assets and cultural heritage	No significant impacts likely	

Interrelationships and cumulative impacts

Positive interrelationships between "climate/air" and "human health" are likely due to the reduction of GHGs and other emissions.

S.O. vi. Promoting the transition to a circular economy

Background

The SEA monitoring discovered some hidden chances during the last funding period to focus more on multi-dimensionally sustainable green economy with today's knowledge and in today's time of societal transformation. This Specific Objective creates the potential to investigate and develop profound strategies and solutions for a transnational enforcement and promotion of circular economy.

Already in the past programme projects such as AlpLinkBioEco or AlpBioEco showcased how sustainable economic development can be based on alpine core products. Exploring also by-products in order to exploit the full bio economic potential and create a high value chain was a particular strength of these projects. From an environmental point of view the integration of diverse sectors and the enhancement of innovative, sustainable product ideas, reflecting also climate change adaptation targets cross-sectorally, is highly recommended. When looking at agricultural and forestal resources in the alpine area, adaptation needs should be considered in an integral way in order to avoid negative side-effects e.g. for valuable resources such as water/drinking water (e.g. due to increasing irrigation) which will most probably run scarce in a larger part of the Alpine Space territory. Similarly resistance to pests, drought and (as far as possible) storm events need to be considered. Cross-sectoral exchange could be a major asset to achieve socially sustainable and climate-friendly solutions which contribute to biodiversity targets in the best case too.

Positively, projects under this S.O. review the energy and resource consumption in order to improve also positive environmental impacts on global climate change considering the production but also the whole lifespan of the products including the waste, after use and/or recycling phases. Enhancement of organic production/ sources of origin could be a surplus for future projects in the same field.

Viewing also the direct and indirect consequences of the Covid-19 pandemic and the response in the Alpine states that are yet to be fully understood, including significant economic and social impacts, it is particularly important to foster a sustainable recovery for the Alpine Space's economy and societies by taking the chance to contribute to climate change mitigation at the same time. This includes the necessity to strengthen the sustainable production, research and development in the alpine area by profiting from regional resources "*Fostering the use of high quality biological, indigenous and regional products*" ASP 2021+, final programme, p. 32) in a climate and environmentally friendly socio-economic development. One focus of the final version of the programme aims at supporting the tourism industry, a sector which was particularly affected by the pandemic. Many practitioners and academics pointed out the potential for reorientation of tourism destinations and businesses during and after this global crisis towards a more climate-friendly and sustainable practice. The actions envisaged by the Alpine Space programme namely "*reducing the total use and consumption of materials and resources in tourism and leisure time activities, including mobility*" (ASP 2021+, final programme, p. 32) can contribute positively to this development. In case synergies with S.O. (i) are created, novel approaches reflecting the (new) lifestyle of (future) target groups, could make a real impact and prepare tourism destinations and businesses for future demands. Processes of innovation but also reorganization after the crisis are the ideal point of time to question tourism strategies and regional development processes intrinsically looking beyond one

single sector. Waste recycling, which is also mentioned as core target under this S.O., will not only but also be very relevant for the tourism and leisure sector.

Assessment of the Specific Objective

Overview on the assessment results of Priority Axis 2, "Carbon neutral & resource sensitive Alpine region" S.O. vi. Promoting the transition to a circular economy		
Environmental Issues	**Assessment results**	**Explanation**
Soil	No significant to significant positive impacts likely	Significant positive impacts are possible, e.g. indirect positive impacts on the reduction of land consumption and/or brownfield development)
Water	No significant to significant positive impacts likely	Significant positive impacts are possible, unclear so far whether definitely to be expected – water consumption and/or indirect impacts on water resources are not explicitly mentioned but might result from the actions
Climate/Air	Significant positive impacts likely	Viewing the major goals of this S.O. positive impacts on the global climate are likely to a certain extent
Fauna, Vegetation, Biodiversity	No significant impacts likely	Positive side-effects could result if biodiversity/ nature conservation targets are considered aside of fostering alpine core products for bio economy purposes
Landscape	No significant impacts likely	
Human health, Population	Significant positive impacts likely	Significant positive impacts can result from reduction of emissions following also reduction of resource consumption
Material assets and cultural heritage	No significant impacts likely	

Interrelationships and cumulative impacts

Positive interrelationships are likely due to reduction of resource consumption but also depending strongly whether integral approaches are applied and synergies with S.O. (i) created.

c. Priority 3 - Innovation and digitalisation oriented green Alpine region

S.O. i Enhancing research and innovation capacities and the uptake of advanced technologies

Background

Projects funded in the last period under the S.O. "Improve the framework conditions for innovation in the Alpine Space" had no restriction for a "green" character, although already the last SEA formulated mitigation measures to absorb possible negative impacts. Even though there was no precondition for a "green" project, there were no negative impacts noticed in the monitoring report. For some projects, the formulation of objectives such as in the AF of SCALE(up)ALPS suggested a clear link to "green economy".

Whereas some of the projects recognized the potential of integrating environmental topics throughout the stakeholder involvement, others did not discover the hidden chances. In the interview interviewees partly stated that environmental topics did not play a role in their project – except for a very limited scope. One interviewee acknowledged that from today's perspective the consideration of environmental expertise might have been beneficial for some companies as these aspects. Most of the projects did not cover green-economy topics explicitly in the initial ideas, but did either include these thematic aspects due to stakeholder involvement or at least discovered some hidden potential during this SEA environmental monitoring.

Based on these experiences, the monitoring report recommended fostering the integration of adequate environmental expertise and institutional capacities in the projects. The new programme explicitly addresses the need for a "green" character of future projects by a **sustainability statement**: *"Project partners are strongly encouraged to consider expected and unexpected impacts of their projects on the environment and sustainability, to seek mitigation of possible adverse effects of the implementation of innovations and technologies, to strengthen any possible positive effects and, whenever possible, to incorporate mechanisms or practices that will unleash such positive effects."* (ASP 2021+, final programme, p. 36)

Also, activity a) iv. *"Supporting experimental models and "green" start-ups to better address innovation topics in the Alpine region, involving greening practices building upon the natural and cultural heritage and knowledge of the actors in the Alpine region;"* (ASP 2021+, final programme, p. 37) underpins this necessity.

If all future projects within this S.O.i follow the sustainability statement earnestly, **no significant negative impacts are to be expected**. On contrary, efficient implementation and use of new technologies offering new perspectives in rural areas (*"a) ii. Fostering the innovation capacities, addressing innovation gaps on a transnational level in non-urban areas, reinforcing urban-rural as well as rural-rural-linkages in the field of innovation, fostering access of rural businesses to the urban innovation support services and diffusion of innovation support services;"* ASP 2021+, final programme, p. 37) might have significant positive impacts due to less mobility / commuting necessities on "Climate/Air" and "Human health / Population".

Assessment of the Specific Objective

Overview on the assessment results of Priority Axis 3 "Innovation and digitalisation oriented green Alpine region" S.O. i Enhancing research and innovation capacities and the uptake of advanced technologies		
Environmental Issues	**Assessment results**	**Explanation**
Soil	No significant impacts likely	Considering the sustainability statement and the results of the SEA monitoring no significant environmental impacts are expected for this environmental issue.
Water	No significant impacts likely	Considering the sustainability statement and the results of the SEA monitoring no significant environmental impacts are expected for this environmental issue.
Climate/Air	No significant to positive impact	The use of new technologies might lead to less energy consumption and pollution.
Fauna, Vegetation, Biodiversity	No significant impacts likely	Considering the sustainability statement and the results of the SEA monitoring no significant environmental impacts are expected for these environmental issues.
Landscape	No significant impacts likely	Considering the sustainability statement and the results of the SEA monitoring no significant environmental impacts are expected for this environmental issue.
Human health, Population	Significant positive impacts likely	Improvements on human health and population are possible (e.g. in the area of decentralized job options).
Material assets and cultural heritage	No significant impacts likely	Considering the sustainability statement and the results of the SEA monitoring no significant environmental impacts are expected.

Interrelationships and cumulative impacts

Interrelationships between the reduction of emissions and human health are likely.

S.O. ii. Reaping the benefits of digitisation for citizens, companies and governments

Background

The experiences of governance and digitalisation projects of the last funding period leads to the conclusion that there are no impacts likely. In literature, different effects of digitalization on sustainability are discussed concluding that overall, digitalization increases energy consumption; but future developments could boost sustainability considering positive ecological economic effects (Lange et al., 2020). Provided that municipalities aim to use digital technologies to achieve environmental aims (Ringeson et al., 2018), benefits of digitalization can be considered predominantly neutral to environmental issues, but may indirectly lead to positive effects through digital innovation as already shown in the monitoring of projects such as SMART-SPACE or SMART-VILLAGES which could indirectly lead to slight positive impacts on "population and human health" as well as on "climate and air".

The potential of digitalization to contribute to social sustainability and social innovation, opportunities for new businesses through now working structures is described in the ASP 2021+ final programme, p. 40 and concludes: *"Digitalisation can contribute to finding solutions for more efficient, innovative and effective solutions that support a shift to climate resilience, carbon-neutrality, green and resource sensitivity "* presuming to *"**safeguarding that any activities have a positive environmental impact**"*. In the view of SEA this is an important preamble similarly to the sustainability statement in S.O.i.

Also, the descriptions of the planned activities underpin that the ASP strongly focuses on the environmental sustainability as the following exemplary quotes show (ASP 2021+, final programme, p. 41):

"Developing and testing solutions that better address the response to sustainable development efforts, and to contribute to solutions for climate resilience, resource sensitivity, green and carbon neutrality" – this might lead to positive impacts on the environmental issues to "climate/air", "soil" and "water" due to reduces use of resources and less GHG emissions

"Developing and testing solutions to support e-learning, new working structures (home-office and other forms of flexible working) in order to provide more attractive living possibilities in remote areas" – new working structures might lead to less commuting activities and thus less emissions, impacting positively on "climate/air" and "human health";

In principle, the issue of digitalisation has to be assessed rather neutral in regards to the single environmental issues, so no significant impacts are likely. As described above, benefits of digitalisation can lead indirectly to slight positive impacts having the postulated "environmental sustainability" in mind.

References:

Lange, S., Pohl, J., Santarius, T., (2020): Digitalization and energy consumption. Does ICT reduce energy demand?. Ecological Economics, 176, 106760, https://doi.org/10.1016/j.ecolecon.2020.106760

Ringenson, T.; Höjer, M.; Kramers, A.; Viggedal, A. (2018): "Digitalization and Environmental Aims in Municipalities". Sustainability, 10, 1278.

Assessment of the Specific Objective

Overview on the assessment results of Priority Axis 3 "Innovation and digitalisation oriented green Alpine region" S.O. ii. Reaping the benefits of digitisation for citizens, companies and governments		
Environmental Issues	**Assessment results**	**Explanation**
Soil	No significant impacts likely	Considering activity a) (ASP 2021 +: p. 40) no significant environmental impacts are expected.
Water	No significant impacts likely	Considering activity a) (ASP 2021 +: p. 40) no significant environmental impacts are expected.
Climate/Air	No significant to significant positive impacts likely	Significant positive impacts are possible through better air quality due to reduced transport, commuting etc., and considering the sustainability statement
Fauna, Vegetation, Biodiversity	No significant impacts likely	Considering the sustainability statement and the results of the SEA monitoring no significant environmental impacts are expected for these environmental issues.
Landscape	No significant impacts likely	Considering the sustainability statement and the results of the SEA monitoring no significant environmental impacts are expected for these environmental issues.
Human health, Population	No significant to significant positive impacts likely	Significant positive impacts are possible through better air quality due to reduced transport, commuting etc.
Material assets and cultural heritage	No significant impacts likely	Considering the sustainability statement and the results of the SEA monitoring no significant environmental impacts are expected for these environmental issues.

Interrelationships and cumulative impacts

Interrelationships between the reduction of emissions due to reduction of traffic and commuting and human health are likely.

d. Priority 4 – Cooperatively managed and developed Alpine region

Background

Based on the focus in supporting the overall goals of the other priorities through ameliorated governance throughout the Alpine Space' territory, no significant negative environmental impacts are to be expected. The experiences of the former Alpine Space programme regarding related projects in the area of governance support this expectation. Vice versa, enhancement of positive impacts are even possible to some extent.

Assessment of the Specific Objective

Overview on the assessment results of Priority Axis 4 "Cooperatively managed and developed Alpine region"		
Environmental Issues	**Assessment results**	**Explanation**
Soil	No significant impacts likely	The focus on governance reduces the likelihood of significant environmental impacts. Based on the SEA monitoring result of specific objectives with a similar target, no significant negative environmental impacts are expected. Significant positive environmental impacts due to enhancement of environmental goals related to other Priorities e.g. for "climate/air" and "human health" are likely.
Water	No significant impacts likely	
Climate/Air	No significant to positive impacts likely	
Fauna, Vegetation, Biodiversity	No significant impacts likely	
Landscape	No significant impacts likely	
Human health, Population	No significant to positive impacts likely	
Material assets and cultural heritage	No significant impacts likely	

Interrelationships and cumulative impacts

Interrelationships between the environmental issues are not expected.

e. Detailed overview of likely contributions to environmental goals by each specific objective

		P.A.1		P.A.2		P.A.3		P.A.4
Env. Issue	Environmental objective	S.O. iv.	S.O. vii.	S.O. i	S.O. vi.	S.O. i.	S.O. ii.	
Soil	Reduce sealing through improved spatial planning, strategic use of brownfields, protection of open space		(X)		(X)		(X)	
	Prevent erosion (adapt to climate change)	X	(X)					
	Enhance soil quality and retention capacity	X						
	Remediate contaminated soil		(X)					
	Control/ mitigate land degradation		(X)					
	Enhance soil biodiversity		(X)					
Water	Rational use of water resources to prevent/ tackle water scarcity related to drought	(X)			(X)			
	Monitor the water quality of (contaminated) water resources and maintenance of their chemical and ecological state (according to the WFD)							
	Foster integrative approaches for flood risk prevention in line with the Floods Directive	X						
	Enhance/maintain the biodiversity of water bodies		(X)					
	Improve drinking water quality according to the Directive on drinking water							
Climate/ Air	Improve Air quality reduce the seasonally very high load of pollution – particularly PM10 and finer matter (focus alpine valleys)			(X)			(X)	
	Mitigate climate change: Reduce Green House Gases (GHGs)		(X)	X	X			(X)
Flora/ Fauna/ Biodiversity	Stop the loss of biodiversity through land take, contamination, blockage of corridors and deterioration of habitats (EC biodiversity strategy, UN Convention on Biological Diversity)		X					
	Foster the continuation of the Natura-2000-network and preserve protected areas		(X)					
	Enhance the Ecological Connectivity by Green Infrastructure (EC GI)		X					
Landscape	Conserve the variety, uniqueness and beauty of landscape		(X)			(X)		
	Balance multi-functional utilization of landscape	(X)	X			(X)		
	Maintain a mutually appreciated landscape development in the light of changes according to the European Landscape Convention		(X)					
Human health/ population	Reduce the high load of pollution – particularly PM10 and finer matter – in alpine valleys to prevent emission related diseases		X	(X)	(X)		(X)	(X)
	Reduce the noise pressure, particularly in alpine valleys						(X)	
	Prevent and minimize risks of extreme events and related natural hazards for settlements (also according to the European Strategy on climate change adaptation)	X	(X)					(X)
Cultural heritage/ material assets	Enhance the protection/preservation and renovation – Consider resource consumption, resilience and coping mechanisms							
	Integrate renewable energy production and supply carefully with regard to visual esembles			(X)				

P.A.1 Priority Axis 1 "Climate resilient and green Alpine region"
S.O. iv. Promoting climate change adaptation, risk prevention and disaster resilience
S.O. vii. Enhancing biodiversity, green infrastructure in the urban environment, and reducing pollution
P.A.2 Priority Axis 2 “Carbon neutral & resource sensitive Alpine region”
S.O. i Promoting energy efficiency measures
S.O. vi. Promoting the transition to a circular economy
P.A.3 Priority Axis 3 “Innovation and digitalisation oriented green Alpine region”
S.O. i. Enhancing research and innovation capacities and the uptake of advanced technologies
S.O. ii. Reaping the benefits of digitisation for citizens, companies and governments
P.A.4 Priority Axis 4 “Cooperatively managed and developed Alpine region”
X: direct contribution possible
(x): indirect contribution possible

6. Assessment of alternatives

The SEA was iteratively integrated in the programme development process (see Figure 27 and Figure 28). Presentation of the scoping results including major environmental goals and challenges for each environmental issue and the Alpine Space territory overall were discussed with the entire Task Force and relevant institutions such as the JS and MA team, the programme drafting experts and the representative of the European Commission.

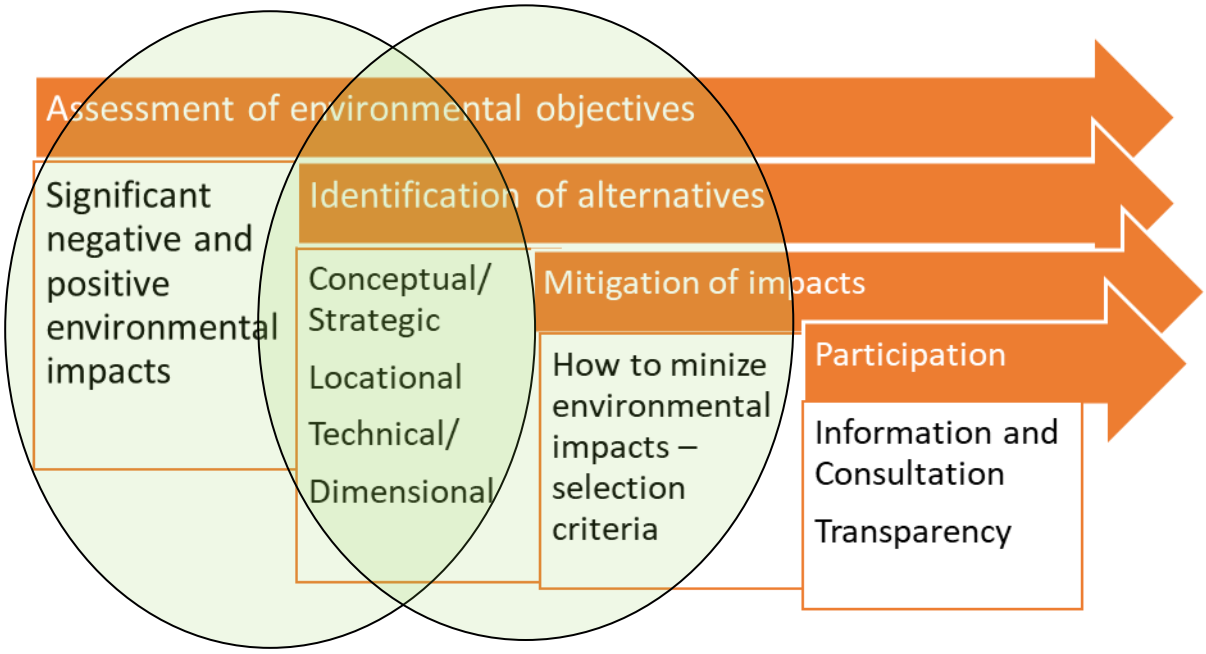


Figure 27: Summary of key goals to preserve the Alpine Space' environment and enhance its condition in light of the future development

During the programme drafting process also the monitoring results for the previous Alpine Space Programme were taken into consideration by the Task Force as well as possible implications for the upcoming programming period. Feedback loops (as displayed in Figure 28) occurred even more often in practice and particularly also in the finalization phase of the programme after the consultation period.

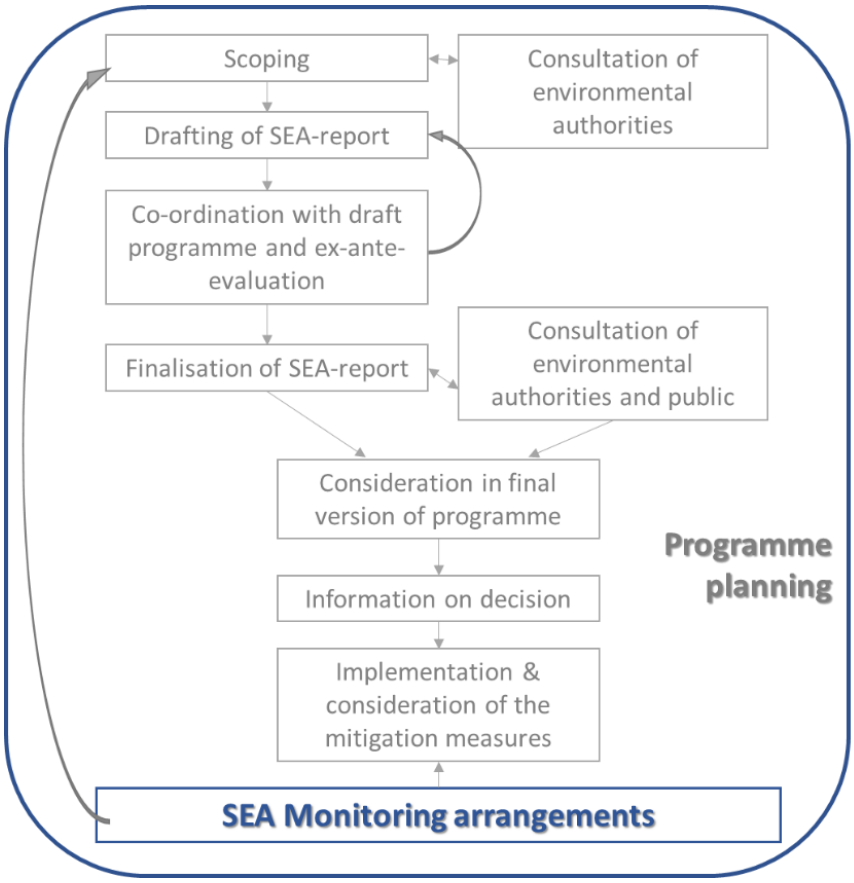


Figure 28: The role of the monitoring within the whole SEA process of programme planning

Therefore, the programme is strongly reflecting environmental aspects. Only one major alternative formulation was recommended for the specific objective vii. In this case the SEA suggested to amplify the territorial focus to urban and suburban areas and reflect this wider Green and Blue infrastructure network opportunities also within the wording of the specific objective. Due to specific framing conditions of EU Cohesion Funding these changes were not possible however. As the programme specifies its intention to also consider sub-urban to rural connectivity and amelioration of GI, there are no concerns left about this formulation of the specific objective.

7. Interrelationships and cumulative impacts

After the assessment of each specific objective interrelationships are discussed immediately. Due to its over-arching commitment of contributing to a sustainable development in the Alpine Space's territories also positive synergies in terms of co-benefits were discussed during programme development by the SEA team.

For this purpose SEA monitoring results were taken into account. One key benefit of the SEA monitoring of the Alpine Space programme 2014-20 was the identification of synergies between several projects. The SEA monitoring discovered that projects treated aspects/solutions which could be an important input to encourage the environmental sustainability of others. Similarly, interviewees (lead partners and partners of the previous funding period) actively stressed that providing information on environmental aspects would have helped to consider the environmental situation in the Alpine Space and co-benefits for environmental sustainability right from the application process.

Therefore, the SEA for the novel Alpine Space programme 2021+ has encouraged making possible thematic synergies transparent also in the upcoming calls. Networks established under the Alpine Space projects can help later on to encourage capacity building and sustain the importance of dedicating resources for these novel important topics. The monitoring team highly recommended encouraging these concrete exchanges of thematic capacities.

For the novel programme the SEA estimates even stronger synergies between the priorities and specific objectives, as also partly indicated within the programme itself. Figure 29 summarizes synergistic effects with regard to environmental impacts between priority one, two and three. The SEA does perceive priority four as neutral in this context and therefore it is not included in this figure.

Database harmonization/digitalisation overlapping priorities is also highly recommended to maximize positive impacts through monitoring of relevant indicators and joint utilization of data to identify e.g. climate change related challenges at diverse levels. The final version of the programme reflects this recommendation.

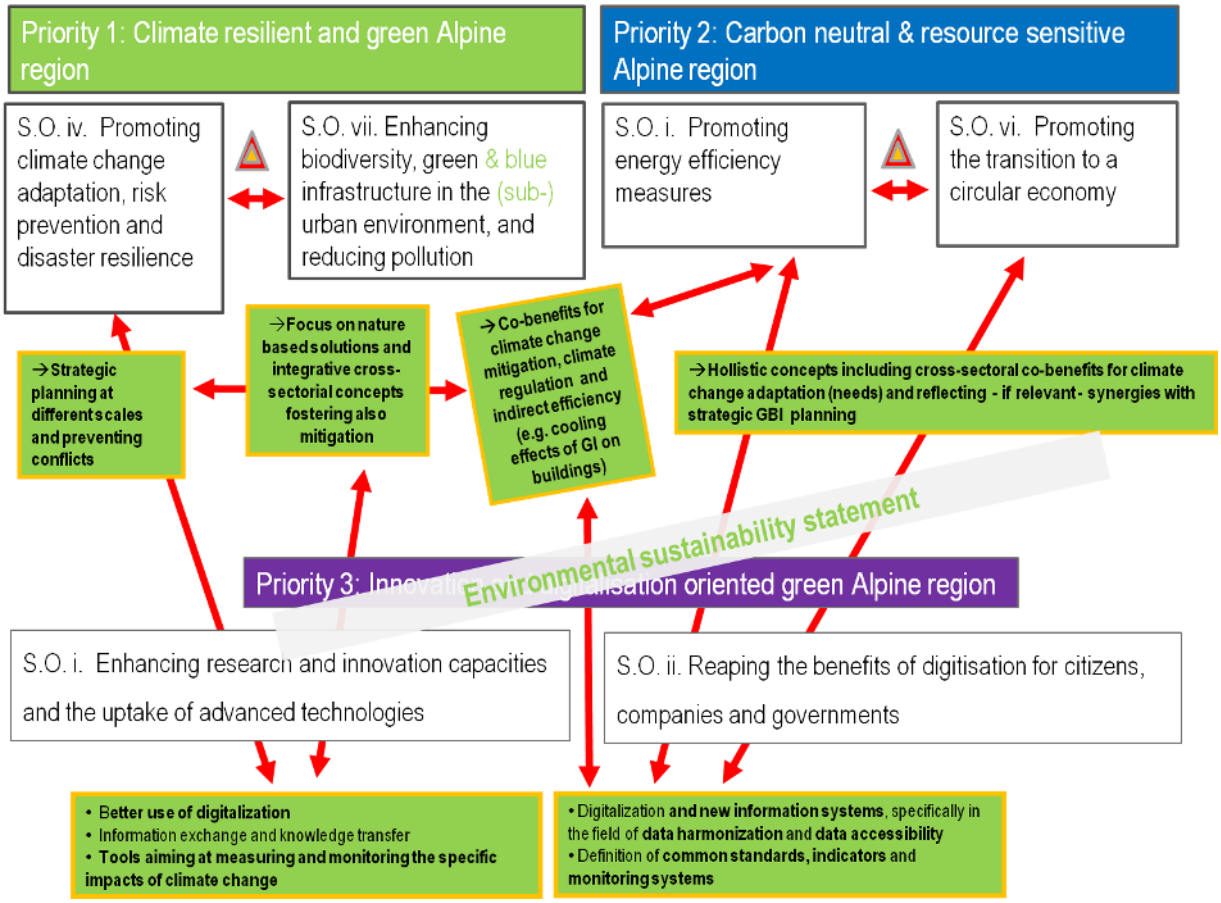


Figure 29: Overview of synergistic interrelationships between the specific objectives of priority one to three to enhance even more the positive environmental impacts of the Alpine Space Programme

Apart from the synergies within the Alpine Space Program, other funding and research programs at European and national level offer opportunities to join efforts and maximize positive outcomes in their foci. Given within the frame of the European Green Deal, European Structural and Investment Funds (especially European Regional Development Fund ERDF with all INTERREG programs and European Agricultural Fund for Rural Development EAFRD) and research programs (e.g. Horizon Europe) provide opportunities for collaboration among different stakeholder groups also in thematic fields contributing to the ones of this Alpine Space Program. Institutions like CIPRA and EUSALP can support this process.

8. Mitigation and compensation measures

The aim of mitigation and compensation is to reduce negative environmental impacts as far as possible. As no significant negative environmental impacts are likely to be caused by the implementation of the upcoming programme, provided the project selection will reflect environmental impacts accordingly, no concrete mitigation measures (and also no compensation measures) are relevant. To enhance positive impacts reflection of synergistic environmental goals (see section four) and options to foster positive thematic interrelationships between several specific objectives (see section seven) is strongly recommended.

No mitigation or compensation measures are required in case the **specific objective iv focuses** on **nature-based solutions and retention capacities**. Thereby, if synergies with S.O. vii are well used, it can even create positive co-benefits for other adaptation or mitigation targets or even flora/fauna/biodiversity conservation objectives. Actions also address **higher alpine areas**. These territories and their flora/fauna/habitats will be impacted strongly by climate change. Project selection, implementation and monitoring therefore needs to pay **special attention not deteriorate or negatively impact habitat conditions**. Also, **for S.O. i of priority 2** negative environmental impacts are unlikely **viewing the planned activities with focus on sufficiency and efficiency**. There are no infrastructure measures planned which might affect landscape, cultural heritage or flora/fauna/biodiversity. The SEA mid-monitoring could nevertheless survey that no activities which are harmful to flora/fauna/biodiversity or landscape are funded finally.

In the first draft of the environmental report the SEA encouraged applying the **sustainability statement** included in priority three for the entire programme. In the final version, the programme announces a clear commitment to amplify positive environmental impacts including strong efforts to mitigate climate change and also its impacts on the alpine territory. Early consideration of negative impacts and avoidance of any harm on the environmental issues is explicitly addressed as the following statement of the programmes' final draft announces (ASP 2021+, final programme, p. 15): *"To foster the "green and CO2-neutral approach" of the Alpine Space programme 2021-2027 even more, the programme invites all partners to consciously consider expected and unexpected impacts of their projects or actions on the environment, climate and sustainability, to seek mitigation of possible adverse effects, to strengthen any positive effects and, whenever possible, to incorporate mechanisms or practices that will unleash such positive effects (e.g. "green projects" considering environmental aspects right from the beginning)."*

As the past SEA monitoring showed, the integrative consideration of environmental impacts and positive synergies is highly dependent on the integration of environmental expertise right from the beginning. Information on environmental challenges and environmental goals can contribute already in the calls and application procedure to a more detailed reflection on multi-dimensional sustainability. Throughout the whole project lifetimes synergies with other projects can be established to maximize co-benefits. Therefore, to strengthen the likely significant positive impact of the programme the recommendations from the SEA monitoring are displayed in Figure 30.

Communicate environmental challenges and core environmental objectives of the Alpine Space territory

Foster the integration of adequate environmental expertise and institutional capacities

Consider environmental aspects right from the beginning – include environmental expertise in all stages

Improve the environmental sustainability of the Alpine Space Programme

Encourage to communicate the environmental achievements

Make the interim reports more informative

Encourage synergies – even beyond one Specific Objective to create (more) co-benefits for the environment

Source: Viktoria Kurpas/Shutterstock.com

Figure 30: Overview of recommendations to further enhance the environmental sustainability of the Alpine Space Programme (Jiricka-Pürrer et al. 2020, source of the graphics used Viktoria Kurpas/Shutterstock.com)

9. Monitoring

The following "Step by step – Approach" was developed for the first monitoring of the Alpine Space Programme 2014-20 and combined with the quality assurance process of the programme (see Figure 31 and Jiricka-Pürrer et al. 2021). It included the following steps:

- First step – Analysis of project objectives, overall outcomes envisaged and beneficiaries in the Application Form (AF)
- Second step – Detailed analysis of Application Form (AF) with regard to likely environmental impacts
- Third step – Analysis of interim reporting documents to JS with regard to likely environmental impacts
- Fourth step – Analysis of (first) project outcomes
- Fifth step – Interviews with selected project partners

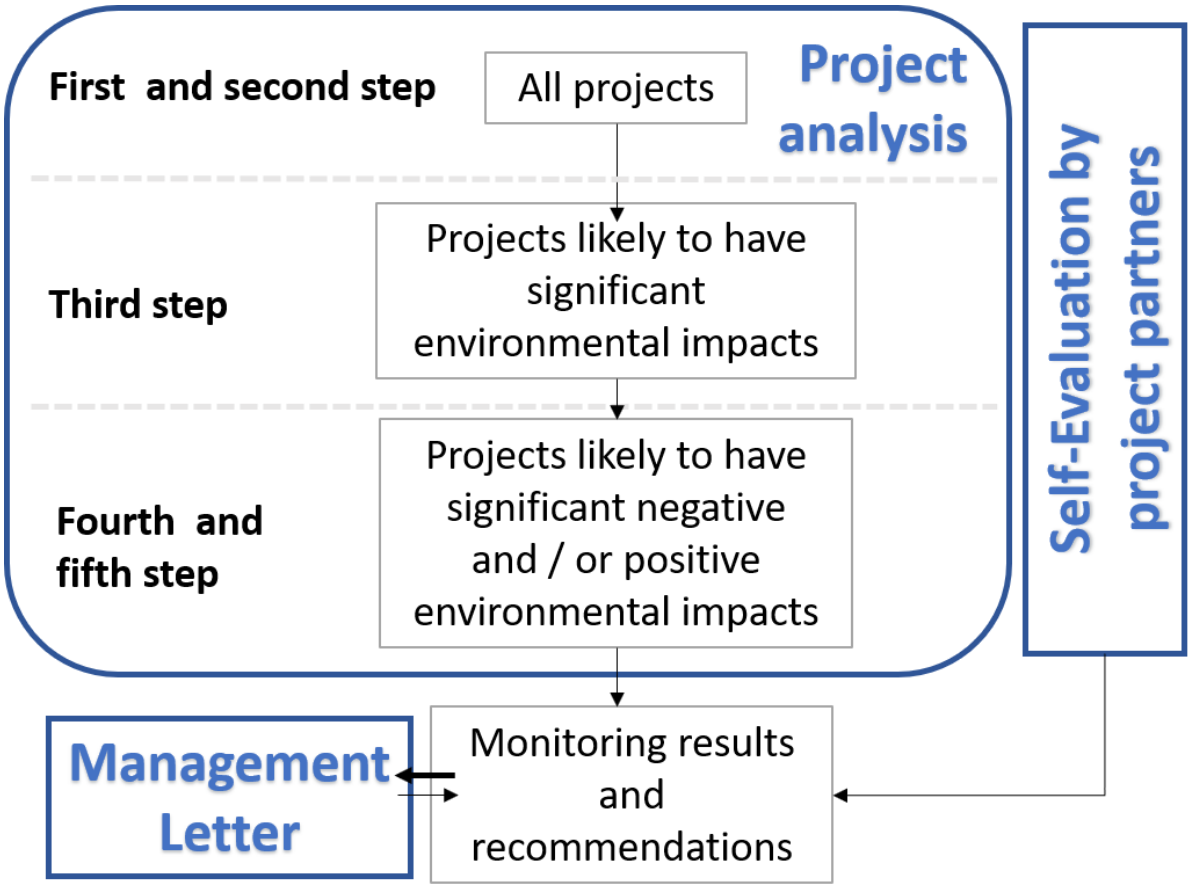


Figure 31: SEA Monitoring combined with quality assurance by the Alpine Space programme

Review of methodological approach

The exclusion of significant environmental impacts based on the application forms (step 1 objectives only and step 2 whole document) was not as efficient for the previous programming period due to the lack of concrete information on environmental impacts (both positive and negative).

→In the upcoming period integration of more specific information on the contribution to environmental sustainability and avoidance of harm to environmental issues would therefore be beneficial to allow a fast initial screening of the projects' likely impact on the environment.

Exact identification of environmental impacts was also to the majority difficult taking the interim and final reports into consideration as step three and four intended. Most of these documents focused on formalities providing an exact overview on the project performance without contributing in-depth thematic information on environmental aspects.

→Also for the interim and final reports a section focusing on environmental impacts and synergies to maximize positive environmental impacts would be highly recommended

Finally, a detailed monitoring could be supported by interviews again. For a smaller number of projects, the interviews were a feasible approach also for the first monitoring of the ASP 2014+. Given the limited information in the AFs and the reports, they turned out to be an important step and encouraged reflection also regarding thematic synergies.

Focus of the monitoring

SEA monitoring can on the one hand serve to, if necessary, take remedial action to improve the programs' environmental impacts if unexpected environmental effects should occur and on the other hand identify hidden chances and define space for improvement regarding the environmental sustainability. As the current Strategic Environmental Impact does not expect any significant negative impacts judging from the information available for the public consultation, we would not recommend a specific focus on one or more specific objectives but encourage carrying out a compact monitoring nevertheless to exclude unforeseen negative impacts and particularly to strengthen the multiple positive impacts including also surveying the positive interrelationships between the environmental issues (see recommendations in section four, seven and eight).

References:

Jiricka-Pürrer, A.; Wanner, A.; Hainz-Renetzeder, Ch. (2021): Who cares? Don't underestimate the values of SEA monitoring!, Environmental Impact Assessment Review, 90, 106610, https://doi.org/10.1016/j.eiar.2021.106610.

10.Non-technical summary

Overall, Alpine environmental issues are – despite past achievements in the Alpine Space territory – **continuously affected by land use change, climate change and related spread of neobiota**. Climate change itself but also response to it as well as mitigation efforts can imply also negative consequences and conflicts of objectives. **Resource scarcity** is very likely to increase in the Alpine Space territory due to a combination of drivers of land use change. Particularly, soil (land) and water capacities are affected.

In this context, the SEA highlights four significant goals to improve the condition of the environmental issues in the Alpine territory further:

- **To improve the ecological condition and connectivity**
- **Decrease pollution and deterioration of environmental issues**
- **Enhance multi-functional land-use to reduce conflicts and enhance co-benefits (e.g. for climate regulation, hazard protection, mitigation and nature conservation targets)**
- **Reduce resource consumption**

The final version of the Alpine Space Programme 2021+ is tackling several of these challenges and goals actively and contributing directly and indirectly to improvements of the environmental condition in the programming territory. The SEA was iteratively integrated in the programme development process. Presentation of the scoping results including major environmental goals and challenges for each environmental issue and the Alpine Space territory overall were discussed with the entire Task Force and relevant institutions such as the JS and MA team, the programme drafting experts and the representative of the European Commission. During the programme drafting process also the monitoring results for the previous Alpine Space Programme were taken into consideration by the Task Force as well as possible implications for the upcoming programming period. Therefore, the programme is strongly reflecting environmental aspects.

To sum up, the SEA did not identify any significant negative environmental impacts based on the final programme version from May 2021 which served as the basis for this environmental report, when considering the monitoring results of similar specific objectives (and over-arching priorities) of the past Alpine Space Programme (2014-20), viewing the actions planned and including the feedback of the iterative process with the programme drafting experts and responsible institutions.

Assessment results of the four priorities are summarized and displayed in Table 6. Detailed information on the assessment results for each environmental objective with specific explanation in context of the actions planned under this specific objective are provided in section 5 of this environmental report.

Table 6: Assessment tables summarizing the impact assessment for the different Specific Objectives

Priorities	Specific Objectives	Soil	Water	Climate/Air	Fauna, Vegetation, Biodiversity	Landscape	Human health, Population	Material assets and cultural heritage
Priority 1 "Climate resilient and green Alpine region"	*S.O. iv. Promoting climate change adaptation, risk prevention and disaster resilience*	Significant positive impacts likely	No significant impacts to positive impacts	No significant impacts to positive impacts	No significant impacts to positive impacts	No significant impacts to positive impacts	Significant positive impacts	Significant positive impacts
	S.O. vii. Enhancing biodiversity, green infrastructure in the urban environment, and reducing pollution	Significant positive impacts likely	Significant positive impacts likely	Significant positive impacts likely	Significant positive impacts likely	Significant positive impacts likely	Significant positive impacts likely	Significant positive impacts likely
Priority 2 "Carbon neutral & resource sensitive Alpine region"	*S.O. i Promoting energy efficiency measures*	No significant impacts to positive impacts	No significant impacts likely	Significant positive impacts likely	No significant impacts likely	No significant impacts likely	Significant positive impacts likely	No significant impacts likely
	S.O. vi. Promoting the transition to a circular economy	No significant to significant positive impacts likely	No significant to significant positive impacts likely	Significant positive impacts likely	No significant impacts likely	No significant impacts likely	Significant positive impacts likely	No significant impacts likely
Priority 3 "Innovation and digitalisation oriented green Alpine region"	*S.O. i Enhancing research and innovation capacities and the uptake of advanced technologies*	No significant impacts likely	No significant impacts likely	No significant to positive impact	No significant impacts likely	No significant impacts likely	Significant positive impacts likely	No significant impacts likely
	S.O. ii. Reaping the benefits of digitisation for citizens, companies and governments	No significant impacts likely	No significant impacts likely	No significant to positive impacts likely	No significant impacts likely	No significant impacts likely	Significant positive impacts likely	No significant impacts likely
Priority 4 "A better Interreg Governance"	*enhance institutional capacity of public authorities and stakeholders to implement macro-regional strategies and sea-basin strategies*	No significant impacts likely	No significant impacts likely	No significant impacts to positive impacts	No significant impacts likely	No significant impacts likely	No significant impacts to positive impacts	No significant impacts likely

As the past SEA monitoring showed, the integrative consideration of environmental impacts and positive synergies is highly dependent on the integration of environmental expertise right from the beginning. Information on environmental challenges and environmental goals (see also section three and four of the environmental report) can contribute already in the calls and application procedure to a more detailed reflection on multi-dimensional sustainability.

Throughout the whole project lifetimes synergies with other projects can be established to maximize co-benefits. For the novel programme, the SEA estimates synergies between several priorities and specific objectives, as also partly indicated within the programme itself. Figure 32 summarizes synergistic effects among priority one to three with regard to enhancement of positive environmental impacts. Positive interrelationships between several environmental issues are likely and can be exploited further through positive cumulative impacts with other specific objectives and even additional funding schemes and planning initiatives complementary to the Alpine Space Programme's activities. The SEA does perceive priority four as neutral in this context and therefore it is not included in this figure. Apart from the synergies within the Alpine Space Program, other funding and research programs at European and national level offer opportunities to join efforts and maximize positive outcomes in their foci.

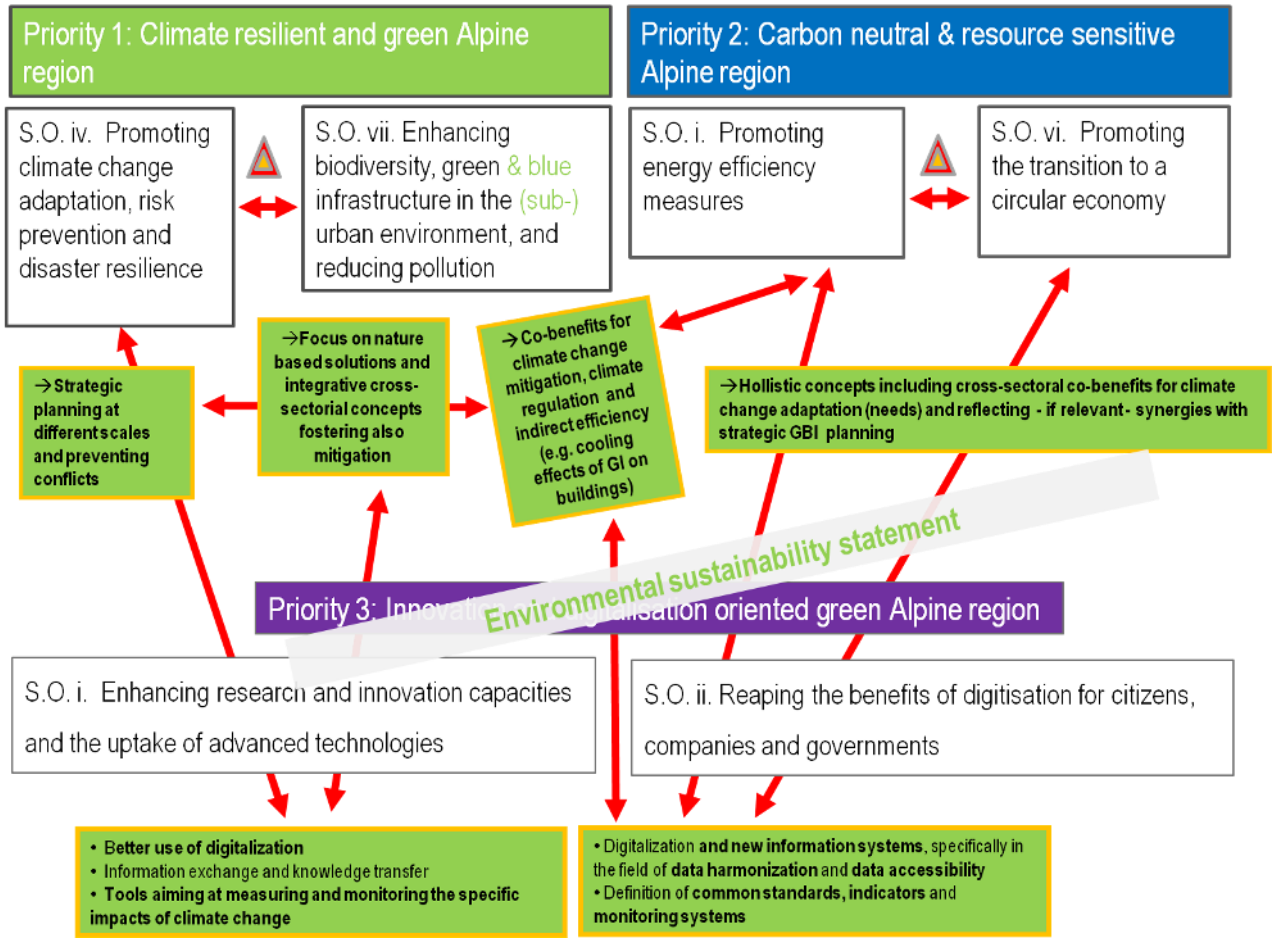


Figure 32: Overview of synergistic interrelationships between the specific objectives to enhance even more the positive environmental impacts of the Alpine Space Programme

No mitigation or compensation measures are required in case the specific objective iv focuses on nature-based solutions and retention capacities. Thereby, if synergies with S.O. vii are well used, it can even create positive co-benefits for other adaptation or mitigation targets or even flora/fauna/biodiversity conservation objectives. Actions also address higher alpine areas. These territories and their flora/fauna/habitats will be impacted strongly by climate change. Project selection, implementation and monitoring therefore needs to pay special attention not deteriorate or negatively impact habitat conditions. Also, for S.O. i of priority 2 negative environmental impacts are unlikely viewing the planned activities. Consequently, no specific mitigation measures (or selection criteria) are recommended. In the first draft of the environmental report the SEA encouraged applying the **sustainability statement** included in priority three for the entire programme. In the final version, the programme announces a clear commitment to amplify positive environmental impacts including strong efforts to mitigate climate change and also its impacts on the alpine territory. Early consideration of negative impacts and avoidance of any harm on the environmental issues is explicitly addressed as the following statement of the programmes' final draft announces (ASP 2021+, final programme, p. 15): *"To foster the "green and CO2-neutral approach" of the Alpine Space programme 2021-2027 even more, the programme invites all partners to consciously consider expected and unexpected impacts of their projects or actions on the environment, climate and sustainability, to seek mitigation of possible adverse effects, to strengthen any positive effects and, whenever possible, to incorporate mechanisms or practices that will unleash such positive effects (e.g. "green projects" considering environmental aspects right from the beginning)."*

Although not significant negative impacts are to be expected from the Alpine Space Programme 2021+, provided the project selection will reflect environmental impacts accordingly, monitoring of any unforeseen environmental impacts is recommended. Additionally, the SEA monitoring can survey synergistic effects to create significant positive environmental impacts and interrelationships between several environmental issues.

11. ANNEX – Documentation of the consultation (scoping and first version of the environmental report)

a. Consultation of environmental authorities and the public

During the **scoping** environmental authorities of the countries involved in the Alpine Space Programme were invited to provide feedback on

- the **methodological approach,**
- **relevant data sources,**
- **relevant national and international legislations** and
- core **environmental objectives**.

→For this purpose a scoping document was sent to the institutions by the JS

For **the consultation of the public** guiding questions were formulated in order to stipulate feedback according to the main tasks of the Strategic Environmental Assessment.

→Responses are displayed in the following **collection of powerpoint slides from Task Force Meetings** as well as the way the SEA team took these suggestions into consideration.

→ A detailed list with a suggested procedure to integrate each statement related to the SEA was submitted to the JS and MA after the consultation period.

→The Italian delegation submitted a late consultation feedback. Integration of these comments is also documented in a collection of presentation slides and a detailed list on the consideration of each statement was submitted to the JS and MA.

b. Environmental institutions highly relevant for the SEA process

European Institutions

- European Environment Agency (EEA): www.eea.europa.eu
- European Environment Information and Observation Network (EIONET): www.eionet.europa.eu

Institutions for the whole Alpine Space

- Commission Internationale pour la Protection des Alpes (CIPRA): www.cipra.org
- European Academy of Bozen/Bolzano (EURAC): www.eurac.edu, www.eurac.edu/Org/AlpineEnvironment/AlpineEnvironment
- Alpine Convention: www.alpconv.org/pages/default.aspx

AUSTRIA

- Bundesministerium für Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie: https://www.bmk.gv.at/
- Bundesministerium für Kunst, Kultur, öffentlichen Dienst und Sport https://www.bmkoes.gv.at/
- Bundesministerium für Landwirtschaft, Regionen und Tourismus https://www.bmlrt.gv.at/
- Amt der Niederösterreichischen Landesregierung (particularly the deparments *Naturschutz* and *Forstwirtschaft*) http://www.noe.gv.at/noe/Kontakt-Landesverwaltung/Alle_Gruppen-Abteilungen_h.html
- Amt der Tiroler Landesregierung (particularly deparments *Wasserwirtschaft, Gruppe Umwelt, Raumordnung und Verkehr, Gruppe Forst*) https://www.tirol.gv.at/ https://www.tirol.gv.at/umwelt/
- Amt der Steiermärkischen Landesregierung (particularly the departments *13, 14 and 15*) https://www.verwaltung.steiermark.at/
- Amt der Kärntner Landesregierung (particularly departments *8, 10 and 12*) https://www.ktn.gv.at/
- Amt der Vorarlberger Landesregierung(particularly the departments *Umwelt und Lebensmittelsicherheit (Umweltinstitut), Umwelt- und Klimaschutz*) https://vorarlberg.at/web/land-vorarlberg/home
- Amt der Salzburger Landesregierung(particularly the departments *5, 7 and 10*) https://www.salzburg.gv.at/dienststellen/abteilungen
- Amt der Oberösterreichischen Landesregierung (particularly the departments *Anlagen-, Umwelt- und Wasserrecht, Umweltschutz, Wasserwirtschaft*) https://www.land-oberoesterreich.gv.at/12735.htm
- Amt der Burgenländischen Landesregierung (particularly the department 4 *Ländliche Entwicklung, Agrarwesen und Naturschutz)* https://www.burgenland.at/
- Magistrat der Stadt Wien (particularly *MA 22, MA 18*) https://www.wien.gv.at/kontakte/ma.html
- Permanent Secretariat of the Alpine Convention https://www.alpconv.org/en/home/organization/permanent-secretariat/

FRANCE

- Ministère de la Transition écologique et solidaire: https://www.ecologique-solidaire.gouv.fr/
- Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail: https://www.anses.fr/fr
- Auvergne-Rhône-Alpes DREAL: http://www.auvergne-rhone-alpes.developpement-durable.gouv.fr/
- Provence Alpes-Cote D'Azur DREAL: www.paca.developpement-durable.gouv.fr
- Bourgogne-Franche-Comté DREAL: http://www.bourgogne-franche-comte.developpement-durable.gouv.fr/
- Grand Est DREAL: http://www.grand-est.developpement-durable.gouv.fr/
- Qualité de l'Air pour regions:
  - https://www.atmo-bfc.org/
  - https://www.atmosud.org/fiche-bilan/region-provence-alpes-cote-dazur
  - https://www.atmo-auvergnerhonealpes.fr/
- Agences de l'eau: www.lesagencesdeleau.fr
- Inventaire national de patrimoine naturel (INPN): https://inpn.mnhn.fr/accueil/index
- Centre d'échange français pour la convention sur la diversité biologique: http://biodiv.mnhn.fr/

GERMANY

- Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit: https://www.bmu.de/
- Umweltbundesamt: www.umweltbundesamt.de/
- Bayerisches Staatsministerium für Umwelt und Verbraucherschutz: http://www.stmug.bayern.de/umwelt/index.htm
- Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg: https://um.baden-wuerttemberg.de/de/startseite/
- Landesanstalt für Umwelt, Messungen und Naturschutz Baden-Württemberg (LUBW): http://www.lubw.baden-wuerttemberg.de/servlet/is/35855/
- Bayerisches Landesamt für Umwelt (LfU): https://www.lfu.bayern.de/index.htm

ITALY

- Ministero Dell'ambiente e della tutela del territorio e del mare: http://www.minambiente.it/home_it/menu.html?mp=/menu/menu_ministero/&m=Enti_ed_Organismi_Vigilanti.html
- South Tyrol:
  - Landesagentur für Umwelt: http://www.provinz.bz.it/umweltagentur/
  - Dachverband für Natur- und Umweltschutz: http://www.umwelt.bz.it/
- Trentino:
  - Agenzia Provinciale per la Protezione dell'Ambiente Trentino (APPA) www.appa.provincia.tn.it/
  - Provincia Autonoma di Trento: http://www.provincia.tn.it/
- Veneto:
  - Regione Veneto: http://www.regione.veneto.it/web/guest
  - Agenzia Regionale per la Protezione dell'Ambiente Veneto (ARPA): https://www.arpa.veneto.it/
- Friuli-Venezia Giulia:
  - Ambiente e Territorio and Water: www.regione.fvg.it/ambiente/ambiente.htm

  - Agenzia Regionale per la Protezione dell'Ambiente FVG (ARPA): www.arpa.fvg.it/
- Lombardia:
  - Regione Lombardia: www.regione.lombardia.it/
  - Agenzia Regionale per la Protezione dell'Ambiente Lombarida ARPA: www.arpa.lombardia.it/
- Piemonte:
  - Regione Piemonte:
  - Agenzia Regionale per la Protezione dell'Ambiente Piemonte ARPA www.arpa.piemonte.it/
- Val d'Aosta:
  - Regione Val d`Aosta:
  - Agenzia Regionale per la Protezione dell'Ambiente Val d'Aosta ARPA www.arpa.vda.it/
- Liguria:
  - Regione Liguria: https://www.regione.liguria.it/
  - Agenzia Regionale per la Protezione dell'Ambiente Liguria, ARPA https://www.arpal.liguria.it/homepage/meteo.html

LIECHTENSTEIN

- Amt für Umwelt https://www.llv.li/inhalt/12298/amtsstellen/amt-fur-umwelt

SLOVENIA

- Republic of Slovenia Ministry of the Environment and Spatial Planning: https://www.gov.si/en/state-authorities/ministries/ministry-of-the-environment-and-spatial-planning/
- Slovenian Environment Agency: http://www.arso.gov.si/en/

SCHWEIZ

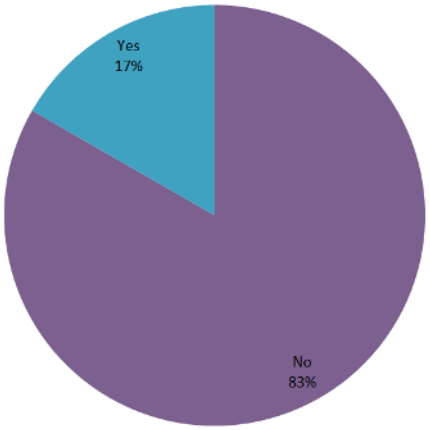
- Bundesamt für Umwelt (BAFU): https://www.bafu.admin.ch/bafu/de/home.html
- Bundesamt für Raumentwicklung (ARE): https://www.are.admin.ch/are/de/home.html

c. Documentation of the consideration of the statements received during the public consultation

Q1 – SEA report

University of Natural Resources and Applied Life Sciences Vienna
Department of Spatial-, Landscape- and Infrastructure Science

50. Would you suggest additional data sources and/or thematic aspects to be considered based on the state of the Alpine Space's environment and the likely future development without the programme?



SEA

Additional sources of information

University of Natural Resources and Applied Life Sciences Vienna
Department of Spatial-, Landscape- and Infrastructure Science

Only a few additional sources were suggested

- → **These data sources will be considered for the environmental report**
- → **Partly,** the sources were **already contained. W**e added information on the specific location in the environmental report in these cases.
- → we will **not consider regional/ federal state level documents** *(e.g. the Biodiversitätsprogramm Bayern)***,** however, in order to avoid an overload of references and information, as the program particularly refers to **transnational challenges and strategic environmental goals** (as explained in the introduction of the environmental report on page five)

SEA

Orientation in the report

University of Natural Resources and Applied Life Sciences Vienna
Department of Spatial-, Landscape- and Infrastructure Science

Some statements contained **recommendations on thematic issues to be included in the environmental report:** e.g.: *„Soil is, apart of air and water, the central component of terrestrial ecosystems. Soil provides the widest range of ecosystem services (=soil ecosystem services). Speaking about environment, soil must not be overlooked.*"

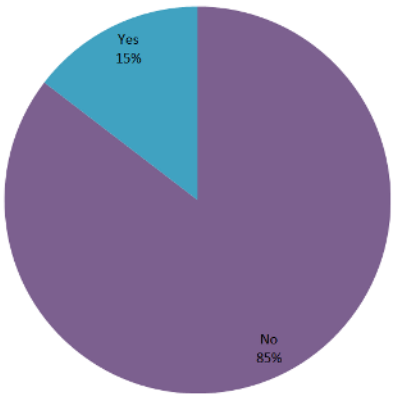
→ Almost all of the thematic aspects acknowledged in these statements **were already contained in the environmental report** → we **added detailed feedback with reference to the respective sub-sections in the report** (see table with detailed response on the consideration of the statements).

→ **We assume that partly those who were commenting did not study the environmental report** itself but maybe **only the "non technical-summary".**

Q2 – Significant environmental impacts

University of Natural Resources and Applied Life Sciences Vienna
Department of Spatial-, Landscape- and Infrastructure Science

52. Are there significant environmental impacts (positive or negative) not yet mentioned in the environmental report with relevance to the priorities and specific objectives subject to this SEA?



SEA

Specfic comments I

University of Natural Resources and Applied Life Sciences Vienna
Department of Spatial-, Landscape- and Infrastructure Science

Climate change adaptation and conflicting interests:

"Climate change adaptation measures could have adverse effects on soil, biodiversity and landscape if not designed in a sustainable way (e.g. built flood protection measures, increasing summer tourism etc.) - i.e. sustainability has to be a "must criterion". "

→ The **emphasis on nature-based solutions** as well as the focus on sustainability was **outlined in** the environmental **report section five** regarding **priority one and its potential to counteract possible negative effects of climate change adaptation measures** keeping both specific objectives and their activities in mind. We also addressed the need for a sustainable adaptation in the field of tourism and recreation (*see also link to next statement below*). **If needed, the value of NBS can be illustrated even more in detail.**

"Increasing tourism and leisure activities (hiking, mountain-biking, skitours, geocaching on-and off-trail) need to be properly regulated to avoid negative impacts on mountain farming and the whole environment"

→ Adressed in **the assesment of the environmental impacts** for the **Specific Objective vi**

SEA

Specific comments II

University of Natural Resources and Applied Life Sciences Vienna
Department of Spatial-, Landscape- and Infrastructure Science

Climate change mitigation – side effects/trade-off:

"Massive shifts to digitization could increase total energy consumption / GHG emissions, i.e. adverse effects on climate/air (problem: often geographically disconnected)."

→ The impact of digitization on global GHGs can not be neglected and effects should be minimized by **sufficient and efficient use of digital devices (sustainability statement)**. **Overall, positive impacts on climate/air as well as human health/population expected when looking at the effect of digitization for remote areas.**

"Effects on existing structural (hydromorphologic) deficits of Alpine waterbodies"

→ Mentioned in the state of the art and trend (zero variant) sub-sections for water (pages 40-46), we will reconsider whether to go more in detail about the hydromorphological deficits. In the current version, no Specific Objective is likely to harm the Alpine water bodies when keeping the monitoring results in mind.

Methodological feedback I

University of Natural Resources and Applied Life Sciences Vienna
Department of Spatial-, Landscape- and Infrastructure Science

Differentiating significant positive environmental impacts at multiple scales:

"*While the differentiation for negative impacts is very sophisticated (part. considering that the measure description is quite vague), only one option is available for positive ones."*

→ The **scale** was in accordance with the previous SEA of the Alpine Space Programme and the Task Force/MA/JS agreed on this suggestion. Of course, also positive differentiations exist for other environmental reports and this would also be **an option for a future SEA** for the Alpine Space. **In particular, as we see a stronger trend to focus on the positive impacts by the entire program.**

→ However, so far we also saw **some methodological deficiencies in the differentiation of positive impacts on multiple-scales** (weighing of certain environmental targets etc.) in other SEAs. Therefore, we kept our system this time as it was in the past.

→ We would acknowledge this suggestion in the methodological section, thought.

Methodological feedback II

University of Natural Resources and Applied Life Sciences Vienna
Department of Spatial-, Landscape- and Infrastructure Science

Integration of environmental goals in the assessment:

"[…] *Sometimes it seems like a scientific paper but does not clearly show the link between overall (and even too detailed) Policy Goals, planned ASP measures and their Impact based on clear indicators."*

→ We will **include an assessment of the actions against the background of the environmental goals** for the final environmental report.

→ A **good and feasible way to highlight positive impacts** but also point out which environmental targets are not (explicitly) covered with the final program draft.

Methodolgical approach was questioned:

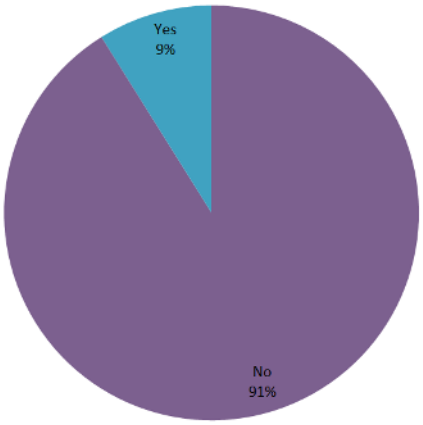
"*Please clearly state what kind of structured foresight approach was chosen, if any - otherwise please state expert judgement as such*"

→ **Likelihood approach** was explained in sub-section 2, partly **based also on the environmental monitoring**

Q3 – Alternative formulations

University of Natural Resources and Applied Life Sciences Vienna
Department of Spatial-, Landscape- and Infrastructure Science

54. Would you like to contribute alternative formulations or alternative wording/small-scale changes in thematic aspects regarding the actions of the programme with particular relevance for the environmental assessment?



Connection to the programme

University of Natural Resources and Applied Life Sciences Vienna
Department of Spatial-, Landscape- and Infrastructure Science

No explicit alternative formulations were suggested

One statement acknowledged the benefits of directly mentioning the programme activities also in the environmental report for better understanding:

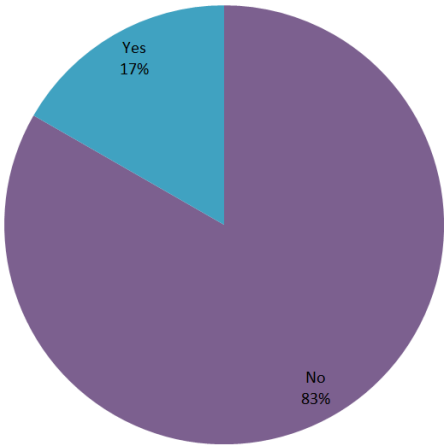
"A short description of the Programmes measures would improve readability"

- → We could reconsider citing the actions of each Specific objective at the beginning of the assessment of the relevant significant environmental impacts, when the actions are finally determined
- → At the moment they are only cited if relevant for the assessment of certain significant environmental impacts in the explanatory text to each Specific Objective

Q4 – Cumulative effects Synergies other funding

University of Natural Resources and Applied Life Sciences Vienna
Department of Spatial-, Landscape- and Infrastructure Science

56. Do you see any cumulative effects (both positive and negative) with other funding programmes and/or major strategies for the programme territory relevant for environmental issues worth mentioning in the SEA report?



SEA

Links to other funding programmes

University of Natural Resources and Applied Life Sciences Vienna
Department of Spatial-, Landscape- and Infrastructure Science

Links to some other European funding programmes and schemes were mentioned at a general level:

„ *E.g Horizon Europe, LIFE (likely positive) e.g. European funding shemes supporting agrigulture and infrastructure (likely negative) - e.g. European Agricultural Guarantee Fund (EAGF) support schemes, Agricultural Fund for Rural Development (EAFRD) EBRD funds/loans , EIB funds/loans,.... if applicable to the Alpine region*“

We appraciate the suggestions and comments

→ For the final environmental report, it is planned not only to **demonstrate the interrelationships between the environmental policy goals** and the planned priorities, specific objectives and their actions (see feedback to statements regarding Q2).

→ Additionally, if applicable, we could highlight **positive synergies with complementary funding programmes, if this is appreciated by the Task Force and MA/JS**

SEA

Ideas for greening the Management of the ASP

University of Natural Resources and Applied Life Sciences Vienna
Department of Spatial-, Landscape- and Infrastructure Science

Suggestions **for CO2-calcuation and offsetting of the programme's acitivities**

"*Interesting to have a CO2 calculator for the activities of the projects funded (at least the main activities-travels and events) and to pay for the CO2 (at project level or at prorgam level). People are travelling a lot."*

→ We will include this in the final **suggestions as recommendation for project management and procedural environmental issues** to be decided and established by the MA/JS

Impacts on environmental issues I

University of Natural Resources and Applied Life Sciences Vienna
Department of Spatial-, Landscape- and Infrastructure Science

- "***A number of measures*** *are recommended to avoid or minimize possible negative impacts, including measures to* ***reduce noise in general*** *and in particular to* ***preserve quiet areas in mountain regions (Directive 2002/49/EU****), and* ***regarding digitalization to avoid inducing further polarization and marginalization of the peripheral Alpine areas. As for energy efficiency,*** *it is recommended* ***to promote energy production systems with low impact on natural landscapes of value for tourism."***

→ Most of these aspects are treated already in the impact assessment we will add further aspects at suitable passages

SEA

Impacts on environmental issues II

University of Natural Resources and Applied Life Sciences Vienna
Department of Spatial-, Landscape- and Infrastructure Science

- "*For* ***Specific Objective VII****,[…],* ***it is suggested to consider the theme of ecosystem services produced in the Alpine Space****, evaluating their* ***functionality also in terms of support for more urbanized areas***."

→ We agree a lot of the aspects mentioned e.g. climate regulation function (of GI) matches with the concept of ecosystem services, which was already mentioned in the detailed assessment of this SO

- "As regards PO2-SO1 "Promoting energy efficiency measures", special attention is suggested to the protection of landscape, fauna vegetation and biodiversity, soil and water. ***It is strongly recommended that the protocols and declarations recognized in the Alpine Convention are considered in the actual design of the calls."***

→ We will mention the protocols also in the description of likely impacts if applicable

SEA

Formulation of environmental criteria

University of Natural Resources and Applied Life Sciences Vienna
Department of Spatial-, Landscape- and Infrastructure Science

- "*Regarding landscape, it is suggested to define actions and criteria for the selection of the projects. As for healthcare and population, it is suggested to insert criteria where needed to reward projects with no impact on health for harmful emissions or noise pollution.*"

→ In the past mitigation measures in terms of selection criteria were only formulated for S.O.s and actions likely to lead to significant negative environmental impacts

→ This will be continued

→ Keeping also the monitoring results in mind, we would also appreciate to formulate criteria to emphasize positive environmental impacts

SEA

Connection to the programme

University of Natural Resources and Applied Life Sciences Vienna
Department of Spatial-, Landscape- and Infrastructure Science

"*It is suggested that the Environmental Report emphasizes the added value of cooperation and describe in more detail POs,SOs, and actions.*"

→ At the moment all POs and SOs are described in the impact assessment, actions are only cited if relevant for the assessment of certain significant environmental impacts in the explanatory text to each Specific Objective

→ The added value is outlined in several parts of the ER, particularly when synergies between the POs, Sos and actions are addressed

SEA