UN environment programme

University of Natural Resources and Life Sciences, Vienna

WITH FUNDING FROM AUSTRIAN DEVELOPMENT COOPERATION

Training Material on

Nature based solutions for climate proofing in transport planning and relevant EU regulations

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1. Integrative approaches – (large-scale) project level

Options for climate proofing through Environmental Impact Assessment (EIA)

The Environmental Impact Assessment (EIA) considers environmental impacts of transport infrastructure projects on a variety of environmental issues including amongst others "soil", "water", "human health/natural hazards" which inherently include thematic links to climate proofing challenges (e.g. flooding, land slides,...).

With the amendment of the EIA Directive (2014/52/EC), consideration of climate change impacts – especially of potential climate change-related accidents and catastrophes impacting projects subject to EIA – became mandatory at project level in the European Union. The guideline from the European Commission (EC 2013a) outlined already before the most important thematic entry points for the integration of climate proofing in the EIA (see figure 1). Recent literature and guidance (IEMA 2015, Jiricka-Pürrer et al. 2016 and 2018) underlined, however, the need to look also at the amplification of negative environmental impacts of the projects in context of climate change impacts. These topics can involve not only increasing risks for e.g. soil erosion or the stability of slopes but also impacts on water quality or biodiversity (e.g. through contamination of drinking water resources or negative impacts on wildlife corridors).

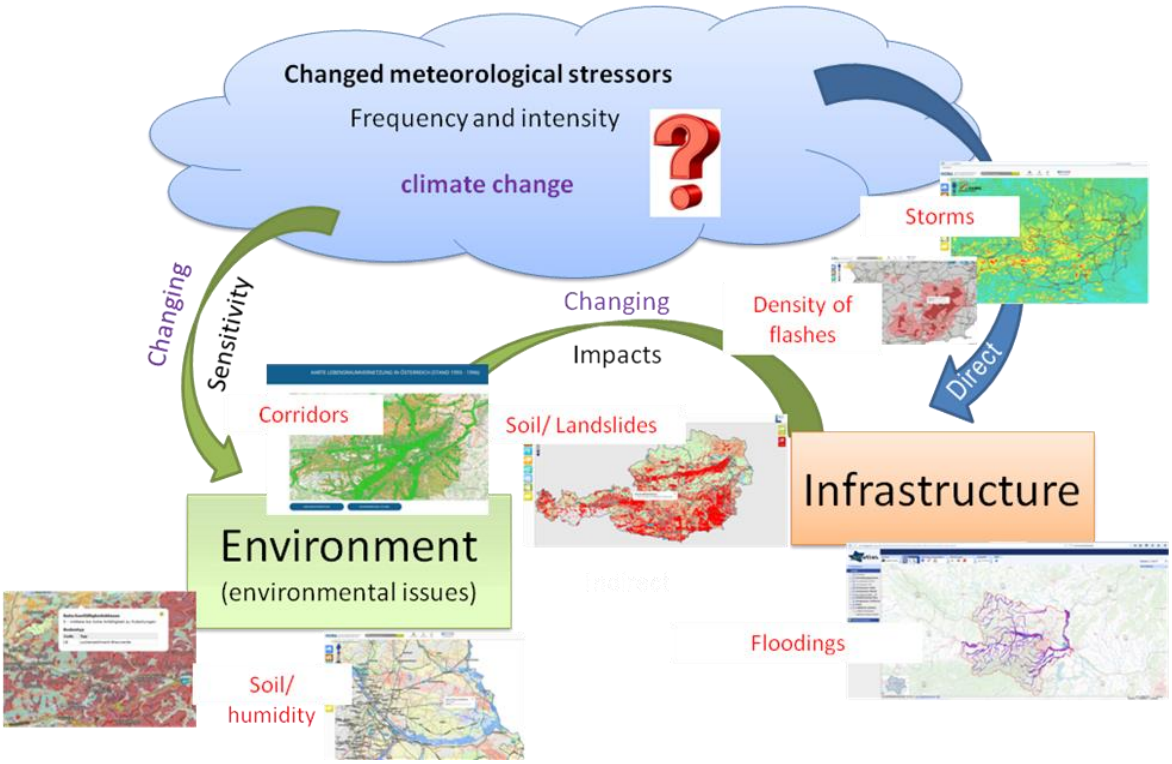

Figure 1: Direct and indirect impacts by climate change on transport infrastructure with examples for thematic entry points.

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In the following, table 1 illustrates exemplarily the differences between direct impacts on the infrastructure and those impacts related to the project's environment.

Example	Indirect effects	Direct effects
Storms	• **Infrastructure damages** (e.g. to power lines)	• **Storm damage due to windthraw of** trees and related obstruction of railways, roads, power lines
Heavy rainfall	• **Obstruction** of railways and roads through strong snowfall and damages to infrastructure through wet snow	• **Increased soil erosion** and risk of landslides

Table 1: Direct and indirect effects on infrastructure projects

In hilly to mountainous areas, indirect effects of intense localised rainfall can include landslides, mudslides and unstable slopes (Stoffel and Huggel, 2012). These, in turn, can lead to considerable costs due to reconstruction measures, blockage of strategically important routes, network failures or even physical injury to persons (Haurie et al., 2009; Altvater et al., 2011; Birkmann et al., 2010).

Furthermore, in lower and mid-range altitudes, a rise in winter temperatures could lead to an increase in precipitation on unfrozen ground. This, in turn, can increase the risk of unstable slopes and landslides. Increased soil sensitivity should therefore be taken into account in project planning, including issues such as site selection, depth of foundations, and slope stability.

A rise in the frequency of fires on embankments and in nearby (protective) forests (Leidinger et al., 2013; Birkmann et al., 2010) could also arise as an indirect effect on projects. These are only some of the key issues related to the project's environment which could be considered throughout an EIA.

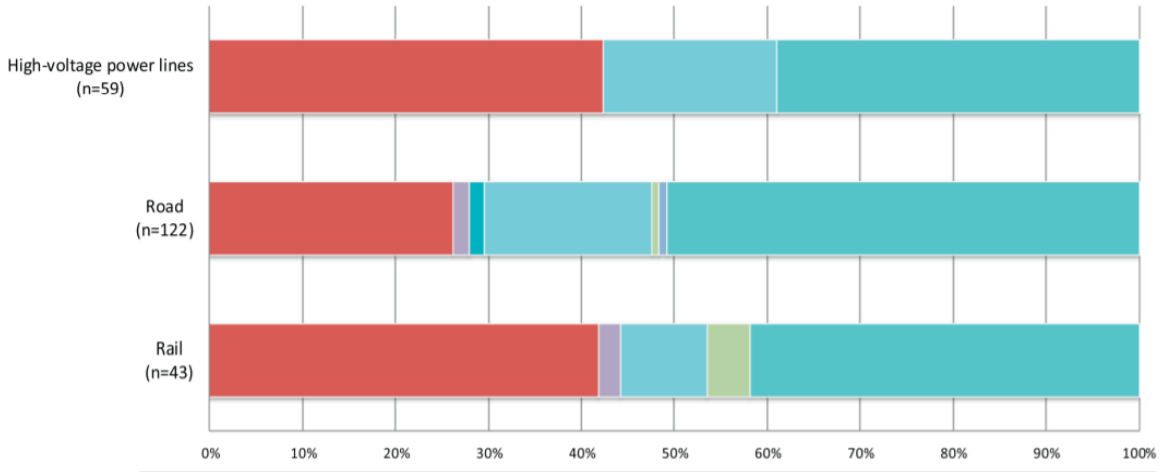
Scientific studies such as Hands and Hudson (2016) underlined the relevance of considering climate change adaptation and mitigation in transport planning EIA. Among others the "EU Guidance on integrating Climate change and Biodiversity in Environmental Impact Assessment" (EC 2013a) can provide more detailed information on thematic and methodological integration of climate proofing in EIA.

Thematic entry points for the consideration of climate proofing options through EIA in transport planning – examples from Germany

SPECIFIC (funded under the Austrian Climate Research Programme) was a pioneer project on the consideration of climate change impacts in EIA both methodologically and thematically. For Austria and Germany a high number of EIA reports and all related documents were examined in order to find out about the most relevant thematic entry points. These reports pertained to three categories of large-scale linear infrastructure, two of them major transport infrastructure (railway corridors and highways). Out of the climate change stressors and related impacts "flooding", "erosion" and "heavy rainfall" alone made up about 82% of all relevant hits in the German documents (see figure 2). In road and rail projects, "heavy rainfall" is most significant, making up almost 100% for the former, and over 80% for the latter (Jiricka-Pürrer et al. 2018).

Potential climate change impacts mentioned in connection with the different project types

(results from 28 evaluated German EIA projects; n=224)



	Rail (n=43)	Road (n=122)	High-voltage power lines (n=59)
Erosion	18	32	25
Wind erosion	1	2	
Low water level		2	
Wind throw	4	22	11
Icing	2	1	
Storm damages		1	
Flooding	18	62	23

Figure 2: Climate change impacts treated within EIA between 2005-2015 (examination of 28 EIA projects in Germany, Jiricka-Pürrer et al. 2018)

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2. Integrative approaches - strategic level (planning)

Consideration of climate change impacts through Strategic Environmental Assessment

Climate change, along with its impacts and difficulties in adapting to them, constitutes a complex challenge in transport planning, which can be partly only solved at a more strategic level than the single project. Particularly the Strategic Environmental Assessment (SEA) offers a great opportunity to consider long-term changes and options for climate proofing at an early stage but also, additionally, to create framework conditions for climate-friendly and also low-conflict development of transport infrastructure.

Key benefits for the consideration of climate change impacts through SEA involve the following methodological steps of the SEA process:

- Clarification of data, key objectives and planning alternatives during **scoping**
- Balancing **key targets for climate change mitigation** and **adaptation** with **environmental objectives**
- Examination of **diverse types of alternatives** – conceptional, locational, dimensional, technical
- Integration of climate-proofing **into mitigation measures**
- **Discovering uncertainties** to be examined in further detail at project level
- **Adaptive monitoring** – observing uncertainties and the usefullness of measures for climate proofing (as part of the compensation or mitigaiton measures for environmental impacts)

In 2013, the European Commission (EC 2013b) outlined as well the challenges and chances to consider climate change in Strategic Environmental Assessment. First national guidance, such as EPA Ireland (2015) followed, outlining also the variety of thematic aspects according to the multiple sectoral applications of the SEA as well as the diverse planning scopes and scales.

Due to the complexity of interrelationships between impacts on various environmental issues, the need for a precautionary consideration of climate change impacts in environmental planning became more and more evident (Agrawala et al. 2010, Byer et al. 2012). In this context, the SEA can support balancing the needs of other EU Directives (see next sub-sections).

The examination of alternatives to start the consideration of the mitigation hierarchy, in particular, is one of the SEA's strengths in contributing to conflict prevention.

→Aside from the examination of alternatives and the options along the mitigation-hierarchy to balance interests with other EU-Directives and avoid conflicts related to climate , co-benefits for sustainable, climate-friendly planning (e.g. to enhance/ preserve carbon sinks) can also be identified during the design of mitigation and compensation measures.

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Reducing the risk and damage of floods according to the Flood Directive

Climate change can lead to a change of the frequency and intensity of meteorological phenomena (EC — European Commission, 2013a,b and d). Among others floodings are those extreme events, in particular, are of high relevance for large-scale infrastructure projects (Altvater et al., 2011). Various authors (e.g. Haurie et al., 2009; Peterson et al., 2008, and Swart and Biesbroek, 2008) have looked at the consequences of extreme rainfall, including e.g. overloaded drainage systems and floods. Since 2007 the European Commission introduced a systematic approach to assess the risks of flooding and adopt management plans for rivers and their systems. Figure 3 summarizes some of the main targets of the Flood Directive and also the need to consider the entire river systems, which the Directive points out along with the need to foster cooperation across borders if necessary.

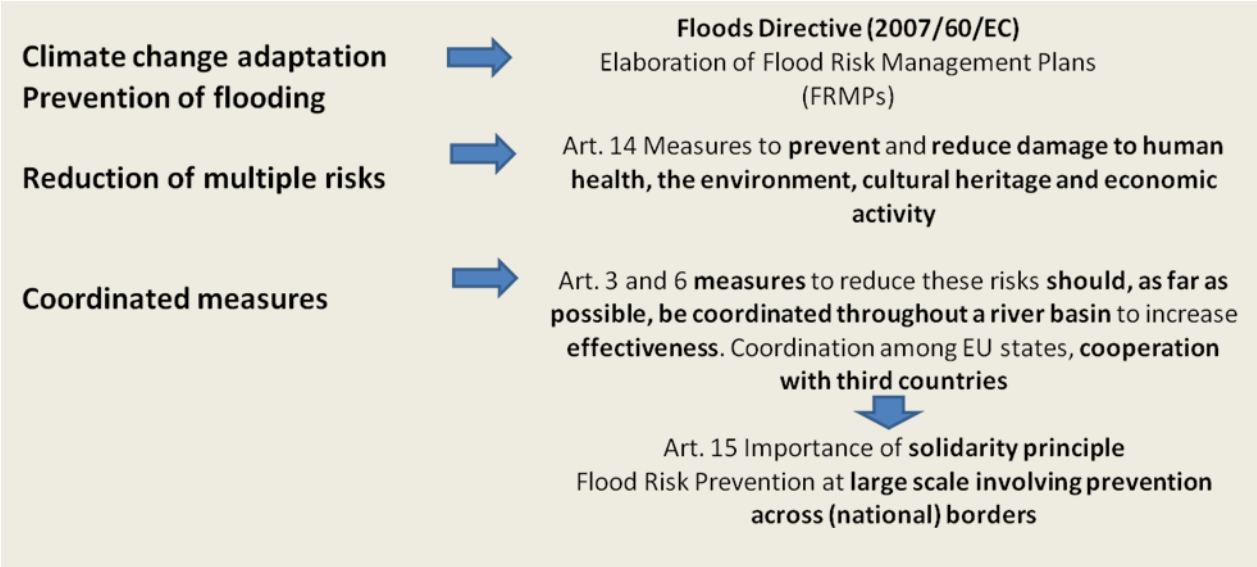

Figure 3: Core purpose of the Floods Directive (2007/60/EC) and need for cooperation

Balancing the targets of the related EU Directives

The **Article 9 of the Flood Directive** implies the need for coordination between the application of the **Flood Directive** and the **Water Framework Directive** (**WFD).** The measures of the Flood Directive should be in line with the goals of the WFD for surface waters, groundwater, coastal and estuarine water resources and their associated habitats and species, including fisheries. Management plans according to the Flood Directive need also to be **in line with the targets of the Habitats Directive and where appropriate, EIA Directive.**

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As mentioned before, the SEA can due to its variety of environmental issues and obligation to assess interrelationships between them serve as tool of coordination between the targets of the diverse EU-Directives. Targets of the Habitat Directive can be, for instance, considered in course of the assessment of the environmental issues in „Flora/Fauna/Biodiversity". Objectives of the Water Framework Directive are to be reflected in „Water" (Surface and Groundwater resources) and "Flora/fauna/biodiversity" (Water Ecology).

The following quote, a statement by the Environmental Protection Agency of Ireland (EPA Ireland 2016), in course of an SEA for River Management Plans emphasizes this need: "*The Plans, and any subsequent project level assessment(s), should examine the interrelationships between the proposed flood risk management measures and the WFD Programmes of Measures for individual water bodies which may be impacted during implementation of the Plan. Implementation related and project specific environmental monitoring will allow any adverse impacts on water bodies to be identified and, where necessary, suitable remedial action to be taken.*" (EPA Ireland 2016, p. 4)

The LIFE project IRIS (https://life-iris.at/) demonstrates approaches for ccoordination and cooperation of spatial planning, construction law, disaster control, nature conservation and other technical departments in order to allow an integrative application of the Water Framework Directive together with other EU-Directives. Consideration of objectives of **nature conservation according to the Habitat Directive**, targets of the **Water Framework Directive** and **recreational needs** are considered along with **Flood Protection measures through a "River Development and Risk Management Concept/ Gewässerentwicklungs- und Risikomanagementkonzept" (GE-MR)**. These integrative management concepts are elaborated exemplarily for several pilot areas including **e.g. the German and Austrian Danube area.**

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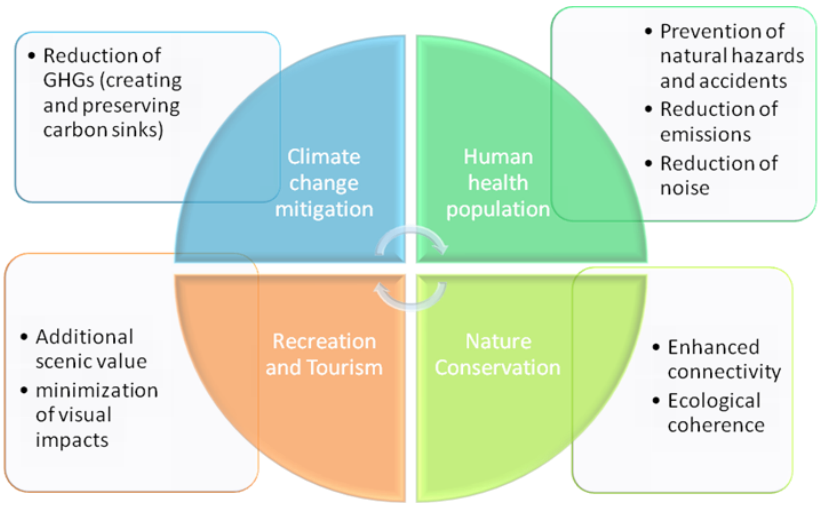
3. The role of nature based solutions for tackling climate change impacts

Key benefits of nature base d solutions for climate proofing of transport infrastructure

The European Commission forced the concept of Green Infrastructure in a Strategy of 2013 (EC 2013c) as a policy instrument for connectivity of habitats creating also multiple other benefits for other sectors outside nature conservation. Following the primary target of the enhancement Green and Blue Infrastructure, the EC encourages also 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).

To achieve the goals of climate proofing, nature based solutions can fulfil core targets for conservation and enhancement of biodiversity but also serve as tools to foster positive impacts on human health such as the reduction of emissions or improve the scenery of landscapes for touristic purposes as figure 4 summarizes.



" *Combining Green Infrastructure with permeable pavements may further reduce storm management costs and environmental pollution*." (EC s.a. "Green Infrastructure and the Transport Sector"p.2)

Figure 4: Key benefits of Green Infrastrucuture in transport planning for diverse sectors

Nature based solutions can serve in particular to reduce the impacts of heavy rain falls on traffic infrastructure, minimize impacts of wind and storm events to a certain extent, and, additionally, contribute to coping with the impacts of heat and drought for nearby areas (settlements) to support aims for the preservation of e.g. (drinking) water resources (see figure 5). For further information links to websites and projects funded by the European Commission – with detailed overviews of relevant measures – are included at the reference section.

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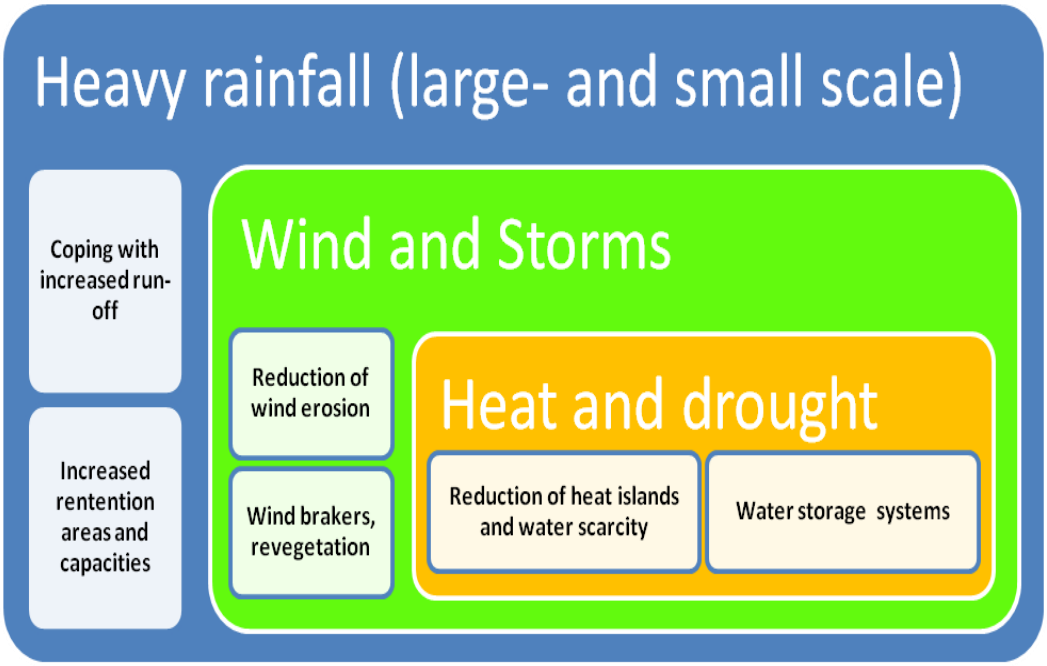

Figure 5: Options to cope with climatic stressors and their impacts on transport infrastructure through the application of Green Infrastructure

Options for Green Infrastructure in transport planning context comprise primarily the following ones:

- Green Bridges
- Water storage systems and retention areas
- Filtration stripes
- Re-vegetation of slopes
- Protection forests
- Wind breakers

Additionally, adequate selection of species e.g. for re-vetegation or re-forestation is essential in order to reduce the susceptibility to drought, pests and wind throw. Further information can be found on the website of the European Commission informing on Green Infrastructure and their fields of application (see references, important weblinks, p.12).

"Restoring floodplain forests is often cheaper in terms of maintenance costs than purely technical solutions such as building dams and floodplain reservoirs. Green Infrastructure thus can deliver the same level of flood prevention as purely technical solutions, often at lower cost, while being more resilient, and additionally deliver further benefits (as compared to single-purpose technical solutions)." (EC s.a. Green Infrastructure and the Transport Sector, p. 2)

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EC – European Commission (2013c): Communication from the Commission: Green Infrastructure; COM (2013) 249 final.

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Important Weblinks for further information:

Climate change adaptation

https://climate-adapt.eea.europa.eu/

https://ec.europa.eu/clima/sites/clima/files/docs/eu_strategy_en.pdf

The consideration of climate change in SEA and EIA

https://ec.europa.eu/environment/eia/pdf/EIA%20Guidance.pdf

https://ec.europa.eu/environment/eia/pdf/SEA%20Guidance.pdf

http://www.epa.ie/pubs/advice/ea/

www.iema.net

Green Infrastructure

https://ec.europa.eu/environment/nature/ecosystems/index_en.htm

http://nwrm.eu/concept/3835