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Impact on Environment and Society
Transport and Mobility

The Impact of Climate Change on the Road Infrastructure in Austria

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The interdisciplinary COIN project evaluates the economic impact of climate change on the Austrian road infrastructure based on precipitation-induced damage.

Main findings

- Precipitation-induced damages to the Austrian road network already cause total annual costs of € 18 million (mn).
- All investigated combinations of climate change scenarios (no or moderate climate change) and socio-economic scenarios (no, moderate, or significant extension of the road network) lead to additional future costs in the area of road maintenance and repair.
- Moderate climatic change combined with a moderate extension of the road network would result in annual climate-induced damages of approx. € 30 mn (€ 40 mn) over the 2016–2045 (2036–2065) period. However, the greater part of the expected cost increase will not be due to a growing number of damage-causing extreme weather events, but due to a denser, and thus more vulnerable, road network.
- The macroeconomic costs of damages to transport infrastructure exceed the additional weather- and climate-induced costs for road maintenance by the factor of three.

To cope with increasing transport volumes, the Austrian road infrastructure has been continuously expanded over the past decades. The freeway and motorway networks alone were extended by more than 250 kilometres between 1990 and 2010 – an increase of 10 % (BMVIT, 2010). The regular extension of the road network causes increasing costs for road maintenance and repair. Currently already 30–50 % of the European road infrastructure maintenance expenditure is caused by extreme weather events, such as floods and mass movements (i.e. land- or mudslides) (Nemry and Demirel, 2012). The estimated weather-induced damages to the Austrian road network amount to an annual average of approx. € 18 mn (for the 1981–2010 period)[1]. As further extensions to the transport network can be expected for the coming years, road maintenance expenditure may increase even without changes in the climatic conditions.

Project info box

The interdisciplinary COIN (Cost of Inaction – Assessing Costs of Climate Change for Austria) project evaluates economic impacts of climate change in Austria. For this purpose, a scenario-based analysis of and across twelve key sectors is conducted, which assesses the possible impact of climatic change in combination with socioeconomic developments. The main scenario assumes a temperature rise within the two degrees Celsius margin for the period up to 2050. This assumption presupposes stronger climate policies than the ones currently in place. The analyses presented here only show that part of all potential impacts which has already been quantified and takes into consideration individual adjustments made.

What has been analysed?

In order to estimate the financial impact of climate change on the Austrian transport sector, the COIN project has investigated the central damage-inducing impact chains. The pivotal influencing factor in this context is precipitation, especially heavy rainfall, which causes floods, land- and mudslides. The latter are responsible for 80–90 % of the relevant road damage in Europe (Enei et al., 2010). According to the analysis of damage-related data from various Austrian provinces, similar numbers also hold true for Austria. Due to a lack of data from other traffic carriers, the project could only quantify data relating to road infrastructure damage, and not to effects on the transport volume or on rail, air and water transport. Likewise, it has not been possible to evaluate the effects caused by interruptions of traffic, production, and business, or the loss of time for individuals in quantitative or monetary terms.

1 Extrapolation of the documented damages to federal and national roads in Styria (2007–2010) to the entire Austrian road network (local, federal, national roads, freeways and motorways).

What impacts are to be expected?

The current study shows that under moderate climate change[2] and under a moderate extension of the road network[3] there would be annual weather- and climate-induced damages of approx. € 27 mn over the 2016–2045 period (see Table 1). The 2036–2065 period would face average damages of € 38 mn per year. Thus, the amount of damages will double as compared to the estimated annual amount for 1981–2010 (€ 18 mn). However, the larger part of additional costs is not due to climate change, but to an increase in exposed values – according to the study, more than 95 % of the additional weather-induced damage arises from a denser, and hence more vulnerable, road network and from higher repair costs per damage event.

Table 1: Average annual weather- and climate-induced economic effects on traffic infrastructure, based on climate change and socio-economic developments (in million €).

Future economic impact*			Climate change	
			no climate change	moderate
Ø 2016-2045	Socio-economic development (sensitivity**)	low	-25	-25
		medium	-27	-27
		high	-28	-28
Ø 2036-2065		low	-34	-34
		medium	-38	-38
		high	-42	-42

* Future economic impact: negative numbers indicate net losses, positive numbers indicate net gains.
**Result sensitivity with respect to socio-economic development parameters.

Do alternative projections for the future change the results?

Road network extension has a strong influence on the sector's sensitivity to climatic changes. To illustrate existing uncertainties, different scenarios of road network extension have been analysed. In a moderate climate change scenario, a higher sensitivity[4] of the transport sector results in average annual costs of € 28 mn (€ 42 mn) over the 2016–2045 (2036–2065) period. Given a less sensitive transport sector, the moderate climate change scenario generates average annual costs of approx. € 25 mn (2016–2045) and € 34 mn (2036–2065).

2 The moderate climate change scenario assumes a mean temperature rise of +1.0 °C (+2.0 °C), an annual precipitation change of +1.4 % (-2.3 %), and a change in the number of days with precipitation of +2.1 % (3.5 %), comparing the reference period (1981–2010) to the first (second) scenario period of 2016–2045 (2036–2065).

3 The moderate socio-economic developments scenario assumes that by 2030 (2050) the entire road network will have been extended by 6 % (12 %) as compared to 2010 (i.e., only half of annual expansion during 1990–2010 period).

4 The effects of climate change on the direct costs for infrastructure will be higher when the road network is extended. Higher sensitivity: assumption that the road network is extended by 12 % (24 %) by 2030 (2050) (the annual extension corresponds to that of the 1990–2010 period); lower sensitivity: assumption that the road networks of 2030 and 2050 correspond to that of 2010 (no increase).

5 The result is based on comparing the individual climate scenarios to a baseline scenario (which interprets socio-economic developments with no climate change at a medium sensitivity level of the transport sector).

What impacts on the Austrian national economy can be expected?

The current results do not yet take into consideration the transport sector's interrelation with other sectors. Construction industry will benefit from additional road maintenance required. However, this will also lead to slight price increases and will reduce the spending power of individual households, causing some sectors to be negatively affected – e.g., the retail and trade as well as the real estate sector. Taking into account these reverse effects, the study shows an average annual decrease[5] in welfare and in the gross domestic product (GPD) of approx. € 640,000 (€ 170,000) for the 2016–2045 (2036–2065) period. Hence, the macroeconomic costs exceed the additional costs for road maintenance due to weather- and climate-induced damage events by the factor of three.

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