

Together we are Stronger – Examining Thematic and Procedural Entry Points for Multidisciplinary, Integral Spatial Planning Approaches to Confront Climate Change

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1 ABSTRACT

Due to climate change, meteorological phenomena can occur with changing frequency and intensity. As a result of these changes, different thematic challenges arise, depending on the geographical location, topographical and climatic conditions, as well as other influencing factors such as land use. Spatial planning can contribute significantly to the prevention or mitigation of climate change-related risks through the creation of visions and integration of objectives, as well as through spatial research and the support of planning decisions (e.g. Hurlimann and March 2012).

Urban and in particular metropolitan areas and their surrounding sub-urban structures are particularly prone to climate change impacts, such as increasing and longer-lasting heat waves due to its high share of impervious surfaces (Morabito et al., 2021). Consequently, they need to urgently consider resource scarcity (e.g. related to droughts) and complex planning decisions caused by multiple land use changes and diverse pressures accumulating with intensifying climate change impacts. Among others, Matthews (2012) addresses the key role of metropolitan areas in coping with climate change as a “transformative stressor”. Besides these challenges, several authors highlight the multiple co-benefits (e.g. for health, recreation and/or nature conservation) that can result from a precautionary and proactive approach to climate change adaptation in urban and sub-urban areas (Floater et al. 2016; Raymond et al. 2017). Similarly, Biesbroek et al. (2009) already discussed the potential to combine adaptation and mitigation efforts to create joint benefits in planning.

To achieve these aims in adapting to climate change and creating positive synergies, horizontal cooperation across planning borders is often required. Such an approach allows for an early consideration of planning alternatives and enables planners to specifically and appropriately implement further climate proofing measures, all of which are considered essential steps in the climate proofing of spatial plans and programmes (Hurlimann and March 2012). To consider climate change along horizontal planning boundaries in an integrative manner, it can be highly relevant to consider information and planning objectives from adjacent or complementary sectoral instruments, as Matthews and Baker (2021) point out. Similarly, Widmer (2018) highlights the importance of addressing the „cross-cutting nature of adaptation” within integral planning processes.

This paper, based on a large case-study in the eastern part of Austria, funded by the “Planungsgemeinschaft Ost – PGO” (Planning Association East) and involving three different federal states – each with its own legal system – discusses specific entry points and barriers that need to be overcome in order to foster an integrative, multidisciplinary consideration of climate change in and around cities including also large metropolitan areas. Based on a theoretical framework (Jiricka-Pürner et al. 2020), which helps to approach the complex challenges of climate proofing in an integrative way across planning borders, the authors undertook a systematic review of the thematic and procedural entry points for cooperation across planning units. Nineteen expert interviews were carried out with spatial planning units, as well as departments of forestry, geology and water management across the three Federal states of Vienna, Lower Austria and Burgenland. They review, among other aspects, the cross-institutional communication and coordination of targets, as well as data-related challenges and measures for climate change adaptation. Additionally, opportunities to increase co-benefits for climate change mitigation, public health and nature conservation are discussed, particularly in the light of procedural entry points. The complex challenges of this case study area in Eastern Austria showcase the variety of options for integral planning and cooperation at various planning levels (federal, regional to local) and the need for multidisciplinary perspectives.

Keywords: cross-sector cooperation, cross-border cooperation, climate change adaptation, climate proofing, integral planning

2 INTRODUCTION

Growth of cities and suburbs is a European and world-wide phenomenon (UN 2019). Re-densification and the associated loss of urban green infrastructure (UGI) and unsealed soils accumulate with impacts of climate change such as heat waves, and droughts. Urban expansion and urban sprawl is a widely known phenomenon also in Austria, particularly concerning its capital Vienna and surrounding areas in Lower Austria and its neighbouring Federal state Burgenland. The Austrian Conference on Spatial Planning – ÖROK has forecasted a large population increase by 2040, especially in the outer districts and suburbs of Vienna and the neighbouring districts (ÖROK 2019). This entails the deterioration of relevant green infrastructure and consequently means that regulating ecosystem services are endangered in areas, where they are urgently needed. In addition, climate-induced stress and biological invasion, as results of global change, are intensifying the pressure on existing green spaces with their related biodiversity (Martinson and Raupp, 2013).

Efforts for climate change adaptation encounter partly opposed objectives for climate change mitigation related e.g. to densification. On the contrary, nature-based solutions for climate change adaptation can enhance multiple benefits for biodiversity, human health and partly also climate mitigation purposes (EC, 2015; Bush & Doyon, 2019; Raymond et al., 2017).

Spatial planning on its own has limited capacities for achieving these beneficial goals. Knowledge and data from other sectors, such as forestry, water management and geology are, in most cases, required to assess the upcoming cumulative impacts of climate change in combination with other drivers of change. Effects of land scarcity and pressures on the green areas/green belts of urban and peri-urban areas (thus the UGI) deserve long-term strategies to foster cross-sectoral adaptation and to maximise the potential for climate change mitigation at the same time. The actors-based interdisciplinary project CLIP-OST, funded by the “Planungsgemeinschaft Ost – PGO”, aims at identifying approaches for integral and strategic planning to confront climate change in the light of specific challenges in urban and sub-urban areas. Findings from the case study area in Eastern Austria are compared with international experiences. The project investigates opportunities for cross-sectoral cooperation based on expert interviews from spatial planning as well as other relevant sectoral planning institutions. Subsequently, we discuss the following thematic aspects in the context of the presented case study and compare the results with those of other international case studies:

- (1) thematic and procedural entry points for a multidisciplinary perspective to approaching climate change in spatial planning in the urban-sub-urban planning context
- (2) opportunities to foster integral approaches for climate change adaptation as to create positive synergies and minimise conflicts of interest
- (3) entry points for climate proofing and climate change adaptation across planning boundaries in metropolitan areas

3 PARTICULAR CHALLENGES OF CLIMATE CHANGE FOR URBAN AND SUB-URBAN AREAS

3.1 Challenges specific to densely populated areas affected by climate change

Urban and in particular metropolitan areas and their surrounding sub-urban structures are particularly prone to climate change impacts, such as increasing and longer-lasting heat waves (Morabito et al., 2021). The urban heat island effect (UHI) is amplified by the reduction and fragmentation of urban green space. Competition for land-uses like housing, transportation, energy conversion and the like, are also clearly associated with habitat fragmentation and isolation in urban areas (Gaston, 2012).

A key but increasingly scarce resource, not only but particularly in urban areas, is space. Climate change mitigation targets impose additional pressure in sub-urban areas, for example when planning to implement large-scale energy production. While climate change mitigation purposes foster the densification of settlement structures, awareness of essential areas (e.g. unsealed structures, small to large scale green structures,...) for climate regulation is a key asset at the same time.

For some metropolitan areas also water resources will become seriously endangered during periods of heat wave and drought. In this context, fostering nature-based solutions for climate change adaptation can be

limited in case this effect is not recognised at the initial planning phase and during the development of measures which involve water storage for instance.

Urban areas and their related sub-urban surroundings, consequently, need to urgently consider resource scarcity and complex problems caused by multiple land use changes and diverse pressures accumulating with climate change impacts. While spatial planning strategies, programmes and plans normally involve a review on the natural assets in a planning area, this assessment in the regular spatial planning procedures does, in most cases, not consider future trends and implications for these natural resources so far. Accompanying instruments of environmental planning such as the Strategic Environmental Assessment (SEA) are discussed as relevant to integrate these perspectives into spatial planning processes. Often, this potential is, however, counteracted by the late or limited application of this instrument (Posas et al. 2013). Some countries, such as Germany, established instruments of landscape planning, which are supposed to deliver essential information to tackle climate change (Heiland et al. 2008, Heiland et al. 2016). In Austria, efforts to implement, respectively strengthen these instruments remained rather unsuccessful.

3.2 Urban-suburban cooperation – enhancing opportunities for strategic climate proofing

Besides the challenges mentioned in the previous sub-section, several authors highlight the opportunities to create multiple co-benefits (e.g. for health, recreation and/ or nature conservation) that can result from a precautionary and proactive approach to climate change adaptation in urban and sub-urban areas (Floater et al. 2016; Raymond et al. 2017). Biesbroek et al. (2009) already outlined the potential to combine adaptation and mitigation efforts to create joint benefits in planning. Among others, Matthews (2012) addresses the key role of metropolitan areas in coping with climate change as a “transformative stressor” (see also Yiannakou & Salata, 2017). Parker and Simpson (2018) highlight the benefits of green infrastructure to enhance the quality of living in urban areas based on an extensive literature review.

Green areas, especially trees, provide cooling through evapotranspiration and shading effects keep surfaces cool (e.g., Akbari et al. 2001, Gill et al., 2007, Morabito et al., 2021). Semi-natural structures and connected urban green spaces, cannot only allow coping with climate change impacts but also provide a highly functional habitat network, when an optimal spatial configuration can be achieved (Venn et al., 2013). Honeck et al. (2020) elaborated a first multi-functional GI modelling approach for Geneva and its surrounding areas, through dynamic response to emerging and aggravating challenge.

To date, several studies exist on the effects of enhancement of strategic planning of nature-based solutions in urban-sub-urban planning context (Garmendia et al. 2016, Pauleit et al. 2017 or Mayrand and Clergeau 2018). However, the opportunities but also barriers for implementing novel and holistic concepts through a cross-sectoral integral planning approach are rarely investigated so far, especially for the context of urban-sub-urban cooperation in spatial planning.

Monteiro et al. (2020) outline important principles for the enhancement of green infrastructure with the main motivation to foster consideration of them in spatial planning. The analysis of about one hundred studies identified multifunctionality and multi-scale planning, among others, as key principles. Achieving multifunctionality in planning is necessarily dependent on multiple cross-sectoral perspectives to obtain knowledge on joint goals, enable practical implementation and management of the development/ measures but also to create awareness for hindering factors to overcome right from the beginning of the planning process. Multi-scale planning in terms of vertical cooperation and tiering is often discussed in the context of identifying planning alternatives as well as exploiting the mitigation hierarchy, but also in the light of achieving climate change adaptation and mitigation purposes. Complementary consideration of connectivity of UGI deserves consideration of efforts to minimise negative impacts of climate change along the mitigation hierarchy but also across planning boundaries (horizontal cooperation).

Monteiro et al. (2020) also confirm in their study that the transfer of these overarching goals, also reflecting the European Commission’s strategy (e.g. EC 2013), into spatial planning practice is very limited. Similarly to Lennon and Scott (2017), they summarise that the procedural consideration of cross-sectional planning objectives is rare.

Against this background, this study examines the state of the art of cooperation across sectors as well as barriers and opportunities for future integral planning in a large metropolitan area prone to severe impacts of climate change.

4 METHODOLOGICAL APPROACH

The authors undertook a systematic review of the thematic and procedural entry points for cooperation across diverse sectoral planning units, thereby applying a multi-disciplinary approach as outlined in the following sub-sections.

4.1 Description of the case study area

The paper is based on a case study in the eastern part of Austria. The case study area includes three federal states - Vienna, Lower Austria and Burgenland - with around 3.9 million inhabitants in a total of 745 municipalities. The Planungsgemeinschaft Ost (Planning Association East, PGO), which was founded in 1978, is responsible for the coordination of spatially-relevant activities in the three federal states. The case study area is an area of the larger metropolitan area of Vienna, the so called Stadtregion+ (City region+), which includes Vienna with its 23 districts, 205 Lower Austrian and 63 Burgenland municipalities with a total of 2.8 m inhabitants. The urban region of Vienna is characterised by strong commuter links and many additional functional relationships between the core city and the surrounding area (PGO 2011).

The complex challenges of this case study area showcase the variety of options for integral planning and cooperation at various planning levels (federal, regional to local) and need for multi-disciplinary perspectives. A central challenge are the diverse federal laws on spatial planning and the planning monopoly at the municipal level, which is relevant to determine land use and construction permissions. Different conceptual planning instruments – which are not legally-binding (e.g. strategy concepts, sectoral concepts) – are used by federal states, regions or municipalities for their spatial development. The supervisory authorities for municipalities are the offices of the state government, which have to review and approve planning acts. In some federal states, additional regional planning levels exist, including conceptual or binding concepts, plans and programmes for supra-local and sectoral planning.

Regarding the climatic situation the eastern part of Austria is the region with the lowest rainfall in Austria (Reniu 2017). Dry periods are an actual challenge since they can cause problems to the water supply needed for the vegetation, and also to the drinking water supply. Climate change will exacerbate this situation in the future, although there will be no significant decrease in precipitation on an annual basis, but the forecasts predict a strong increase in evapotranspiration due to warming and in particularly occurrence of heat waves. The Eastern region and especially the lowlands are also among the warmest regions in Austria. Therefore, especially urban regions are confronted with an increasing urban heat island phenomenon (MA 22 2018). Up to now, topics such as population development, settlement development, mobility or nature conservation dominated the work of the urban region+. Climate change adaptation has only recently been considered as a novel challenge.

For the analysis of entry points for integral planning strategies in the Viennese larger metropolitan area the following instruments were analysed regarding their suitability for cross-regional and inter-sectoral cooperation:

- cross-sectoral strategies at state level that deal with climate change mitigation and adaptation,
- federal state development programmes,
- regional development concepts or programmes,
- local development concepts,
- legally non-binding concepts and master plans,
- land use plan, as well as
- construction development plans.

4.2 Analysis of international case studies regarding entry points for cross-regional and inter-sectoral cooperation

While literature dealing with urban-sub-urban challenges for climate proofing is still scarce (Haaren & Moss, 2011; Van Eerd et al., 2014), international pilot projects have already dedicated their efforts to urban-suburban contexts for about fifteen years. A desk research and analysis of a selected number of international case studies was conducted to compare the findings of the presented case study (Vienna and larger Viennese

area involving parts of Burgenland and Lower Austria) with other territories. The case studies show how cross-sectoral cooperation in the coordination of climate change adaptation between urban and sub-urban areas can be organised and supported by regional planning and other forms of cooperation across planning areas.

The following case studies were analysed, two of them are discussed in more detail in this article:

- Stuttgart and the Greater Stuttgart Region
- Zurich and the surrounding area
- Hannover and the Region Hannover
- Hamburg and the Hamburg Metropolitan Region
- Karlsruhe and the Karlsruhe area

International literature identifies barriers and opportunities for cooperation across sectors and planning regions (e.g. Ledda et. al. 2020; Wachsmuth 2014; Serrao-Neumann et. al. 2014). The following categories will be used as the basis for the analysis of the international case studies and the expert interviews:

- Communication and coordination of targets for climate proofing from multi-sectoral perspectives
- Data availability and knowledge of climate change impacts
- Procedural entry points for cross-sectoral cooperation to confront climate change
- Opportunities to increase co-benefits for climate change mitigation, public health and nature conservation

4.3 Expert interviews

Nineteen expert interviews were carried out with spatial planning units, forestry, geology and water management departments in three Federal states of Vienna, Lower Austria and Burgenland. Some of these experts were personally involved in large-scale development projects and planning cases in urban-suburban planning contexts such as e.g. the Viennese/ Lower Austrian development area in Rothneusiedl. The interview-guideline included several sections, out of which one focused specifically on cross-sectoral cooperation reflecting the thematic aspects listed in section 4.3.

5 REUSULTS

This section provides an overview of the core results from the three methodological steps, the analysis of the Austrian case study, the international case studies and parts of the expert interviews related to integral planning to face climate change.

5.1 Entry points for integral planning strategies in the Viennese larger metropolitan area

Similar to the international literature, the Austrian strategy for climate change adaptation points out the importance of cross-sectoral consideration of adaptation measures in order to avoid conflicts and create benefits for diverse ecosystem services (BMNK 2017). In this context, cooperation between spatial planning, agriculture, forestry, water management, tourism, energy, protection from natural hazards as well as urban and green spaces planning is acknowledged as a highly relevant matter.

All three federal states in the PGO region have cross-sectoral strategies at the state level that deal with climate change mitigation and adaptation considering different sectors (Lower Austria climate and energy programme (Amt der NÖ Landesregierung 2017), Burgenland climate and energy strategy (Amt der Burgenländischen Landesregierung 2019), Smart City framework strategy (Magistrat der Stadt Wien 2019) climate protection programme of the City of Vienna (Stadt Wien 2009)). With regard to climate change adaptation only lower Austria partly takes cross-sectoral synergies into consideration. What the strategy documents have in common is that they name spatial planning as a central "player" that is relevant both for reducing greenhouse gases and for fulfilling major adaptation needs.

The integrative function of spatial planning regarding adaption to climate change can be implemented at various planning levels and with various instruments (MA 22, 2015). Points of contact are provided by nominal spatial planning, informal and civil law instruments as well as sectoral policies with planning instruments, which are not subject to the rules of spatial planning laws such as water management plans, forest development plans or danger zone plans.

The federal state development programmes combine the legal requirements with the implementation instruments of spatial planning and are therefore a central point of contact for the implementation of adaptation measures to climate change. They specify the guiding principles, goals and strategies and are therefore also suitable for the strategic anchoring of adaptation to climate change. They serve to coordinate the development concept at different planning levels, planning areas or planning departments, i.e. between the state, the regions and the municipalities. They are mostly aligned across sectors, so they also serve to coordinate different planning departments and sectors. But that is where the similarities end. All three PGO countries rely on fundamentally different instruments: Burgenland and Lower Austria have regulatory planning and legally binding programmes. Burgenland has a legally binding regional development programme (LEP 2011, based on the ROG regional spatial planning plan (§ 2a), development programme (§7)), which consists of a model with goals and principles as well as an organisational plan. Lower Austria's spatial planning programme for the state (Section 3 (1)) is a basic document with a control and coordination function and contains the main features of spatial development as well as goals and principles. Vienna has an urban development plan and various specialist concepts with the corresponding targets. These are decided by the Vienna City Council and have a predominantly strategic character. Nevertheless, it is precisely this level that is relevant in order to anchor adaptation to climate change strategically across sectors and planning regions.

Another central planning level, which is basically created across municipalities and across sectors, is that of the regional development concepts or programmes. As highlighted previously, it is necessary to consider impacts in a cross-regional perspective and from a cross-sectoral point of view to confront effects of heat waves and heat exposure for example. Tackling this impact involves, for example, large free areas for the production and conduction of cold air or a network of green spaces. A supra-local coordination of the green spaces and the settlement boundaries is necessary here. Land use of the respective areas is decisive for both the production of cold air (e.g. type of agricultural or forestry uses) as well as for the cooling air duct (e.g. keeping it free from buildings). This can require inter-community exchange but also regional planning and even cross-regional approaches. In addition, there are questions related to water management or coordination with nature conservation in order to protect areas in the long term. For the city-region +, there is no common regional concept that acts across levels, planning areas and sectors and delimits and coordinates issues such as settlement boundaries and climatically relevant areas. Initial approaches to a joint regional strategy were discussed in 2019 at a meeting of the city-surrounding area management. During this meeting, the lack of coordination of the goals, principles, and measures for the city-region + were pointed out (SUM n.d.).

Consequently, measures to implement climate change adaptation are only carried out at the respective municipal planning level. In addition to the legally binding instruments of the zoning and development plan (in Lower Austria and Burgenland also local development concepts), non-binding concepts and master plans are decisive implementation levels which primarily exist for Vienna and suburban bordering areas in Lower Austria (see also Schlipf und Dickhaut 2018 for German metropolitan areas). In the case of local development concepts, the necessary spatial research on various sectoral topics and the strategic goals for community development derived from them provide a first point of contact for cross-sectoral coordination. It is also possible to locate the measures here. At the level of zoning planning, the phase before the specific zoning decision is particularly crucial for cross-sector coordination (see also Section 5.3). A crucial gap in an international comparison is the lack of solid information on expected impacts on natural conditions in the planning area such as water bodies, soil, or vegetation. In other countries explicit landscape planning instruments can provide essential knowledge on these aspects such as the landscape plan at the level of the land use plan or the green space plan at the level of the development plans, which exist for example in Germany (Federal Agency for Nature Conservation 2012). Additionally, they allow to control the implementation of green infrastructure effectively. Unfortunately, also the SEA, which could add information to assess interrelationships and cumulative effects of climate change and foster integral strategic approaches to reduce negative impacts and enhance positive co-benefits to planning processes, is rarely applied in Vienna and Burgenland. An application at a strategic planning level is hardly happening (see also 5.3).

Positive opportunities were observable when examining informal instruments in urban and sub-urban planning. Due to the freedom of the design processes of informal planning instruments such as master plans, they offer the possibility of promoting sectoral coordination and thus are creating appropriate framework

conditions for instruments such as zoning or development planning. At the level of these master plans, there are initial experiences in the PGO space for adaptation to climate change, at least between Vienna and Lower Austria, such as the Rothneusiedl urban development area (see also Chapter 5.3) or the green belt around Vienna.

5.2 Enhancement of cooperation across planning boundaries – challenges and opportunities from international case studies

The following section presents the results of the international case study analysis. The examples of Stuttgart and the Greater Stuttgart Region as well as Zurich and its surrounding area illustrate, how regional planning can support climate proofing across planning levels, sectors and planning boundaries.

In Germany, several projects funded by the federal government have supported climate change adaptation in regional planning over the last ten years. Examples are the model projects "Spatial Development Strategies for Climate Change" (KlimaMORO I and II) or the research project "Managing climate change in the regions for the future" (KLIMZUG) (BMBF 2020; BMVBS 2013). As a consequence, a number of regions and regional planning associations in Germany develop common adaptation strategies and coordinate regional and municipal climate change adaptation activities (Zimmermann 2017). The "Greater Stuttgart Region" (Verband Region Stuttgart) – a regional planning authority in the form of a public law cooperation, consisting of the city of Stuttgart and its five surrounding districts – is one of the model regions of the KlimaMORO funding programmes, which were implemented between 2009 and 2013 (BMVBS 2013; Verband Region Stuttgart 2021a, b). The association used the programmes to bundle and further develop the climate change mitigation and adaptation activities that already existed in the region (BMVBS 2013).

In Zurich and its surrounding areas, urban-suburban coordination on climate change adaptation started to take place within the framework of the umbrella organisation "Regional Planning for Zurich and the Surrounding Area" (Planungsdachverbands Region Zürich und Umgebung – RZU). The RZU operates as a private-law association that unites the city of Zurich, six regional planning groups in the Zurich region and the canton of Zurich into an umbrella organisation and coordinates their spatial development (RZU 2019; RZU 2018). The city of Zurich is one example of many cities in Europe that are already strongly affected by the effects of climate change and have developed their own climate change adaptation measures at an early stage, based on a given need for action. The RZU has taken initial steps towards cross-regional and cross-level coordination of climate change adaptation in the Zurich area, building on the experience of the city of Zurich.

5.2.1 Communication and coordination between planning units across planning borders

To support intersectoral and cross-regional coordination of climate change adaptation within the involved regions, both examples established stakeholder networks. As part of the KlimaMORO projects, the Greater Stuttgart Region initiated an informal network of spatial planners and experts from municipalities and various planning departments (including agriculture and forestry, nature conservation, water and energy management) as well as stakeholders from science and politics (BMVBS 2014; Verband Region Stuttgart 2021a). The KlimaMORO projects "helped to establish functioning working structures between local, regional, and scientific actors within the region" (Verband Region Stuttgart 2014, p. 18). In 2019, the RZU launched a network project on climate change adaptation and inwards development that brought together experts from spatial planning and climate change adaptation from the city of Zurich, from other cities and municipalities in the RZU region, as well as from cantonal administration entities (RZU 2021). In both cases, the planning associations functioned as initiators of the networking process and as leading coordinators of the discursive development of regional climate change adaptation strategies.

5.2.2 Data availability and knowledge of climate change impacts

The analysed examples found different solutions to coordinate existing data across regions and sectors and to use common, region-wide data as basis for planning decisions. In order to establish an institutionalised data exchange between planning departments and municipalities, the Greater Stuttgart Region set up a regional climate information system (Klimainformationssystem Stuttgart–KISS) as a web-database. It provides an overview of regionally available spatial, environmental and climate data, describes the data content and data properties and names sources, responsible institutions and contact persons (BMVBS 2013). In addition, the Greater Stuttgart Region has been providing uniform climate analyses for the entire region since 2008. The

"regional climate atlas" serves as a regional and cross-sectoral basis for considerations in planning processes and further specific vulnerability analyses (BMVBS 2014; Verband Region Stuttgart 2008). Similarly, the canton of Zurich has been creating canton-wide climate analyses and simulations since 2018. The results are available as open government data and form the basis for planning decisions of municipalities and various planning departments (Kanton Zürich 2021).

5.2.3 Procedural entry points for cross-sectoral cooperation to confront climate change

From the case study analysis, the development of common regional strategic goals and concepts for climate change adaptation can be identified as central entry point for cross-sectoral and cross-regional cooperation in planning processes. The inter-sectoral and interdisciplinary networks described in 5.2.1 were the main drivers in the discursive joint development of regional climate change adaptation strategies and goals. Another entry point is the coordination and use of common data as a basis for conducting the vulnerability analysis and deriving planning decisions (see 5.2.2). Indications of cross-sectoral cooperation can also be identified in the integration process of regional climate change adaptation strategies into the formal and informal planning instruments at the municipal level. The results of the KlimaMoro projects are incorporated into the regional and municipal planning processes in the Stuttgart region. The vulnerability analyses for flood protection resulting from the KlimaMORO projects as well as the measures derived from them, are, for example, planned to be integrated into the partial update of the regional plan. The results report emphasises the necessary coordination with water management planning in this context (BMVBS 2013). The climate change adaptation strategy of the city of Stuttgart builds on the regional climate and vulnerability analyses. The fact that the strategy proposes measures for different sectors and disciplines indicates a continuation of an intersectoral perspective (Landeshauptstadt Stuttgart 2012). The city of Zurich has been focusing on the topic of heat mitigation and adaptation since 2011 – years before the RZU started its regional network project on climate change adaptation. Links to climate change adaptation are already anchored in the draft of the communal structure plan (RZU 2021; Stadt Zürich 2019) as well as in the municipal land use plan (e.g. open space factor or obligations to implement green roofs in certain areas) (RZU2021; Stadt Zürich 2016). Whether and to what extent cross-sectoral and cross-regional cooperation took place in these integration processes cannot be deduced from the desk research. In 2020, the city published a detailed heat mitigation strategy, which is based on the climate analysis and simulations of the canton of Zurich. The document addresses the need for collaboration with various planning departments and calls for a cross-sectoral planning approach (Stadt Zürich 2020).

5.3 Entry points or cooperative integral climate proofing across urban, sub-urban and rural boundary areas

In the following, central entry points for climate proofing in a multidisciplinary cross-sectoral approach are discussed in more detail in the light of the interview results. Therefore, key citations are included in the text.

5.3.1 Communication and coordination between planning units across planning borders

Some interviewees from spatial planning mentioned the input of the other departments as a central element for taking climate change impacts into account. Several times during the interviews, this exchange was attributed particularly to the local level of spatial planning, before a decision on land use (changes)/ dedication to a certain land use happens, as the following quote shows. Additionally, there are points of view that show that a consideration at higher planning levels, especially with regard to planning of climate proofing measures, can be important. This includes the instruments of other specialist planning matters, such as for instance the forest development plan.

„The timeframe of zoning has become increasingly important in recent years. This is the time when measures can be examined most intensively. We send amendments regarding new zonings out to 16 assessment bodies (e.g. cultural heritage conservation, the energy department, the water management department, nature conservation etc.) – everyone is integrated. In this way, you can examine amendments and projects carefully in a focused manner taking all factors into account. The main focus, however, is on the assessing institutions in other departments. They need to focus on the topic and have to think about problems related to climate change." (IRP14)

Two interviewees emphasised the particular potential for interdisciplinary climate proofing approaches in case of extensive urban development projects:

„With new urban development areas, it is a lot easier than in the existing city. This is also supported by politicians and the municipal administration. However, there are also major challenges. You can already see very clearly that this topic is very interdisciplinary.“ (I FP01)

With regard to the communication of interdisciplinary teams, the potential for coordination but at the same time also the complexity of interdisciplinary, integrative cooperation was pointed out. Thus, some experts considered a superordinate, coordinating institution necessary as the following quote shows:

„For each federal state it is important that the expertise of the climatologists is integrated into the administration. The fact that there a competence centre exists is essential. It's not a trivial but a complex topic climate change, it's indeed very interdisciplinary. It would be far too complicated if this was only divided into several institutions – this needs to be carried out in a coordinated way.“ (I FP04)

5.3.2 Data availability and knowledge of climate change impacts

Some of the interviewed spatial planners perceived the integration of data as a basis for decision-making in the planning process as a fundamental advantage of interdisciplinary exchanges and coordination with departments such as geology, water management, forestry and nature conservation. In this context, some of the instruments of other departments were also highlighted – both established and new ones – such as the forest development plan or the rainwater plan as well as interdisciplinary cooperation in urban planning competitions:

„Similar to the drinking water plan, we have newly developed a rainwater plan. The municipality can develop a plan on how to deal with rainwater management in the best possible way in the future. It is not only about averting danger in the event of heavy rainfall, but it is also about the sustainable use and retention of the water resources. [...]The municipality now has more options in the construction and building plan. The municipality gets the technical basics via the rainwater plan. They serve as data bases for the future development but are not mandatory.“ (I FP11)

„We now need new instruments or an adaptation of the existing instruments. I could, of course, solve this with a competition, but it has to be set up differently. The competitors that submit their ideas would have to be much more interdisciplinary. You need someone for climate change related aspects, for rainwater management, etc. Also energy issues should also be included much earlier. [...] The interdisciplinary approach must already be visible in the submissions of the competitors.“ (I FP01)

Likewise, the interviewees addressed the issue of the legal security of planning decisions, e.g. in case of dedication to a certain land use or restrictions to some types of land use purposes (e.g. settlement boundaries) and emphasised the necessity for increased cooperation in this context.

5.3.3 Procedural entry points for cross-sectoral cooperation to confront climate change

Overall, the interviews underline that integral perspectives for the cooperative consideration of climate proofing in spatial planning are particularly beneficial with regard to the following four procedural steps:

- The consideration of targets to tackle climate change impacts along with other planning objectives
- The cross-sectoral collection and interpretation of data to assess likely effects of climate change for the specific scope and planning territory as well as for the adaptation capacity
- A foresighted consideration of planning alternatives reflecting diverse drivers of land use change and the likely development in the area
- The development of measures to minimize negative impacts of climate change and maximize co-benefits for other sectors as far as possible

The following two quotes illustrate entry points in the development of measures through cross-sectoral thematic input on how to cope with climate change impacts as well as for the legal „backbone“ (explanation) of dedication (land use) decisions based on data from water management and geology departments:

„There is also no more new zoning as construction land possible in case no slope water concept exists. Here, the legislature has sharpened and passed a new law a few days ago in the state parliament. We are now

following the same way as Lower Austria in terms of suitability for building land. In the case of flooding, we have a very restrictive dedication. In HQ100 it is simply not allowed to build. With the slope water, it's a bit different but you now need a concept developed by the water management department“ (I RP13)

„We then always engaged for feedback with the detailed construction planning department and then looked at what statements could already be made and where else we had to leave some room for manoeuvre. For the leeway, we then had a catalogue of qualities. We formulated it together with the ARE [...] development company) and the architects and that was then also the basis for an urban development contract.“ (I FP01)

Experts confirmed the potential of the SEA as accompanying instrument to foster the integration of climate change at several procedural steps from a more multi-disciplinary perspective. However, according to the practitioners the application of the instrument does not meet its potential so far. The following citation provides an example that outlines the core problem, which is the delayed application of the SEA either regarding the planning level or the timing of its integration in the planning process:

“The SEA needs to be applied at the right scale, because otherwise you are too early or too late. Then it's just a pro forma process. A SEA for a zoning plan only is too late.” (I FP02/03)

5.3.4 Opportunities to increase co-benefits for climate change mitigation, public health and nature conservation

Interviewees considered the avoidance and/ or mitigation of conflicting goals as a special opportunity for integrative approaches. An example of a forward-looking strategy which emerged through cooperation is shown in the following quotations, in which conflicts of interest and resources regarding the production of renewable energies as well as the spatial goals of settlement development are addressed:

Smart forest owners are now considering whether they can do anything else on these areas. A company has come up with the proposal to build 150 ha of PV systems and wanted a new zoning category. We collaborated closely with the department of spatial planning. They developed the priority zones for solar power systems for the federal state and thank God, the forest was completely taken out of these concepts.“ (I SP10)

„Finally one has to weigh up and decide whether a fresh air corridor is more important than the advantages of densification for climate change mitigation.“ (I RP07)

The example above illustrates the exacerbated conflicting interests over resources such as space or water due to divergences between the goals of climate change mitigation and climate change adaptation. In some other interviews the potential of combining climate change mitigation and climate change adaptation was also highlighted as a strength of integral approaches. This referred, among other things, to the exchange of instruments of nature conservation and green space planning and integration of relevant information with spatial planning.

6 DISCUSSION AND OUTLOOK

The results of the analysis show that particularly in the urban-suburban context, an integral planning approach is decisive. Challenges related to resource scarcity and trade-offs between different adaptation needs, but also mitigation and adaptation targets are even more evident in metropolitan areas such as the Stadtregion+. To confront these impacts, a strategic development of the green and blue infrastructure – reflecting principles such as connectivity and multifunctionality is decisive, as pointed out by Monteiro et al. (2020) amongst others. Cross-sectoral perspectives on planning goals, susceptibility to climate change and opportunities for the development of climate proofing measures at diverse planning scales enable the identification of co-benefits and can contribute to the reduction of conflicts of interest. In order to realize these potentials, it is crucial to increase awareness of climate change problems among planners, strengthen communication structures, as well as data and knowledge exchange across institutions (Serrao-Neumann et al., 2014; Raymond et al., 2017). At the core, this requires an understanding of how different sectors are affected by climate change, which objectives they pursue in response to that and how these objectives interconnect (Serrao-Neumann et al., 2014; Wamsler & Johannessen, 2020). While spatial planning laws differ between the federal states, sector-specific law of disciplines such as forestry and water management are comparable as they derive from federal legislation. Nevertheless, data on climate change impacts still

vary between the federal states; and so do indicators and standards on how to consider these effects in spatial planning practices.

While institutionalised cooperation partly happens e.g. for the consideration of heavy rainfall and its impacts at the local level with hydrology and geology departments, cooperation across planning borders is still scarce and typically only event-related. In this regard, research shows that institutional cooperation is largely dependent on motivated individuals to date, lacking formalized processes of cooperation and knowledge exchange (Steele et al., 2014; Widmer, 2018). The strengthening of formal cooperation processes largely relies on institutions reaching a common ground with regard to their climate adaptation goals (Arens, 2012).

The interviews with planners in Eastern Austria confirmed the vast potential evolving from the integration of multidisciplinary approaches for large-scale development projects for both urban extension or re-densification and brownfield development. According to the international case study analysis, funding and research programmes can be drivers of cross-regional and inter-sectoral cooperation. In this way, the challenges of the scarcity of monetary resources can be overcome, which is often cited as an obstacle to the development of cross-regional and regional adaptation strategies. The examples from Germany also show that an umbrella organisation is needed that creates a stakeholder network involving representatives from the various planning bodies, regions and municipalities as well as sectors and that coordinates the overall process. Interviews confirmed the advantage of a superordinate coordinating institution to foster and steer cross-sectoral cooperation in planning also in the Austrian case study. An institution such as the PGO could take on exactly this function for the Stadregion+.

The interviews also confirmed that in addition to the concrete implementation of the measures, strategic planning and cross-sectoral coordination at a higher level is necessary. This requirement is also supported by the current draft for the Austrian Spatial Development Concept, which calls for an improvement and further development of vertical and horizontal governance. Especially the federal orientation of spatial planning and development in Austria requires vertical and horizontal cooperation that transcends sectors and territorial authorities (ÖROK 2020). Looking at efforts to minimize climate change impacts, this cross-scale approach and full exploitation of the whole hierarchy of climate proofing measures, starting with an integral examination of planning alternatives, becomes even more valid.

The lack of interdisciplinary instruments such as the SEA being applied at regional level and the tiering at local level was discussed by the planners in several interviews. As the analysis of the case study in Eastern Austria and the interviews show, it could be precisely the regional planning level that holds a large potential to coordinate adaptation to climate change but also to balance adaptation and mitigation goals across sectors more strategically. Theoretically, the instruments of regional planning are available in both Lower Austria and Burgenland in the meantime and would imply strong opportunities to consider e.g. adaptation to heat and drought in the future from a multidisciplinary perspective e.g. throughout the functional analysis of spatial structures and future land use.

So far, regional planning instruments have not been applied across federal state borders yet and/or have not integrated cross-border adaptation needs. The Stadregion + could be the first Austrian regional concept for adaptation to climate change across federal states. At the moment, legal framing conditions differ significantly despite novel amendments in spatial planning legislation in Lower Austria and Burgenland, which set the frame for a more progressive climate change adaptation. An option to establish the implementation of climate proofing measures across planning borders for novel developments are primarily municipal development contracts “Städtebauliche Verträge” so far. Cross-border and cross-sectoral coordination is necessary to create the same framework conditions also with regard to data and standards applied as well as the opportunities to integrate climate proofing measures and monitor their implementation.

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