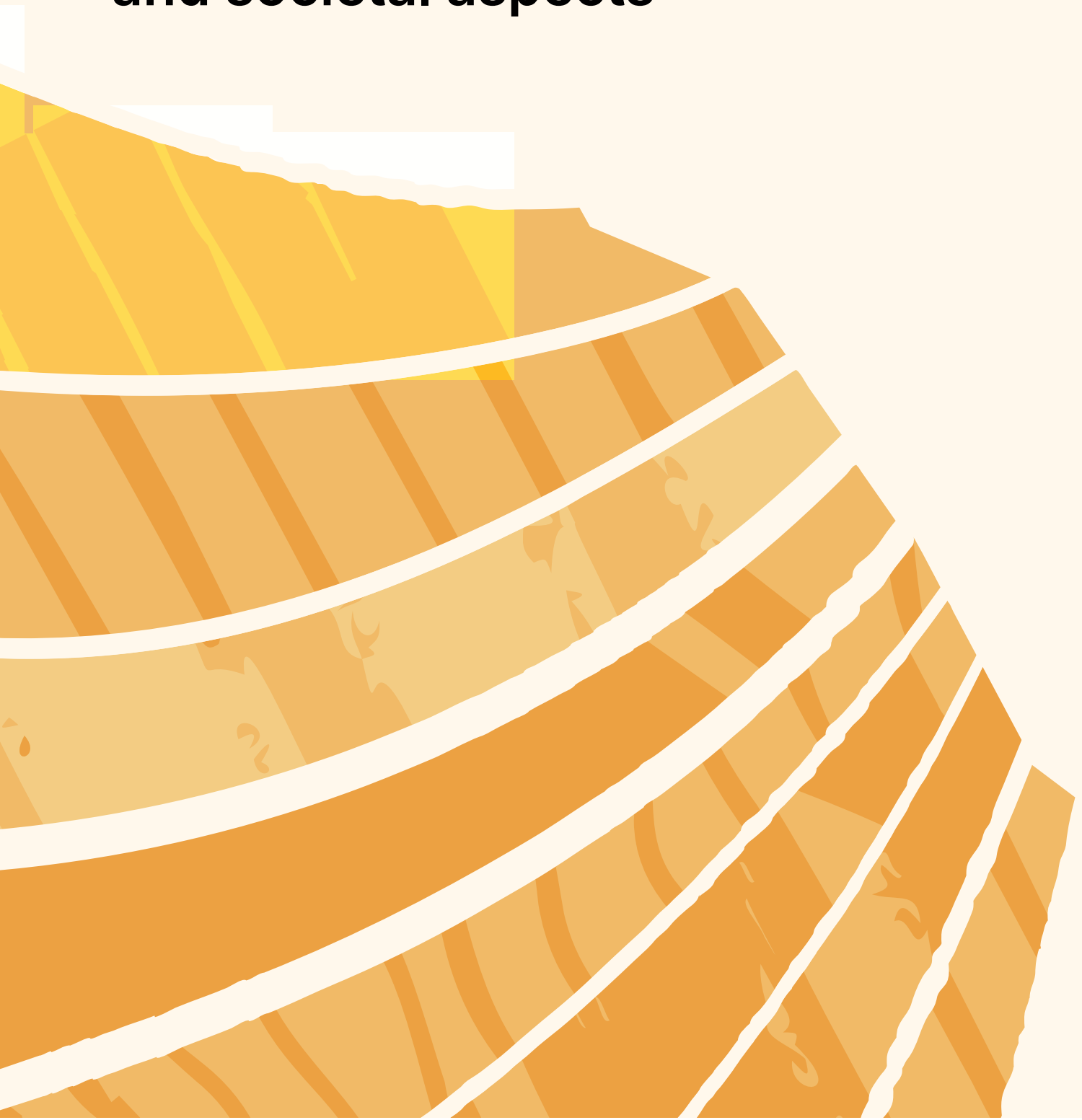
Chapter 6

Climate governance: Political, legal, economic and societal aspects



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EXECUTIVE SUMMARY

Climate policies currently in place are insufficient to achieve the targets set out for Austria (*high confidence*). For Paris-aligned policymaking at all levels of government, it is essential to integrate climate policy comprehensively, both vertically and horizontally (*high confidence*). This integration should also encompass a clear prioritization of climate policies in case of target conflicts. In addition to mitigation policies, adaptation instruments are necessary to offset the negative effects of unavoidable climate change. Measures supporting a just transition are crucial for the successful implementation of climate policies. They can alleviate undesired social hardships and improve social and political acceptance (*high confidence*). {6.5}

The GHG emission reductions achievable through the current policy instruments are insufficient to meet the EU legal targets in line with the Paris climate goals *(high confidence*). International treaties related to climate protection have no direct effect ('nicht unmittelbar wirksam') on the legal framework for climate protection in Austria. This is evident in the reluctance of Austrian policymakers to implement a Climate Protection Act ('Klimaschutzgesetz'), which would have specified sectoral targets for GHG reduction up to 2030 and beyond. Austria's legally binding GHG emission reduction targets are derived from the effort sharing provisions set forth in EU legislation. The framework of EU energy and environmental law serves as the primary driver for Austrian climate law *(high confidence)*. {6.3}

It is essential to consider the wider structural context in which climate governance is embedded when assessing Austrian climate governance (*high confidence*). To enable deep decarbonization, climate policy must address the structural context of climate governance, including the politico-juridical framework and wider societal (nature) relations. Given that such interventions inevitably result in winners and losers and may disrupt established routines, they meet resistance. Failure to address these resulting transformation conflicts could lead to backlash against climate action (*high confidence*). {6.2}

Although climate governance in Austria includes a large variety of instruments to foster effective mitigation and adaptation measures, these have not been sufficiently implemented by political actors so far (*high confidence*). This is exemplified by a reluctance of policymakers to phase out climate counterproductive subsidies and to green the tax system. Powerful economic and political interest groups in Austria are obstructing effective climate action and thus preventing the full potential of climate governance from being realized (*high confidence*). As a result, an implementation gap has emerged – ambitious climate targets exist without sufficient measures and instruments in place to achieve them (*high confidence*). Implemented instruments do not alter existing power relations, growth logics, and the dominant mode of production and living (*high confidence*). This is reflected in the lack of sufficiency-oriented 'avoid' policy instruments capable of significantly reducing demand for energy, materials and land. {6.4}

The significant and rising costs associated with climate inaction will exceed the budgetary costs of effective climate action (*high confidence*). Reaching net-zero and adequate adaptation will require considerable investments, with the projected benefits exceeding the costs (*high confidence*). The additional investment required is estimated at between 1.3 % and 4.8 % of GDP per year. Public budgets, in terms of both revenue and expenditure, are a crucial lever in this process. However, they are currently underutilized and undermined by counterproductive measures such as climate harmful subsidies (*high confidence*). In addition, effective climate action also requires the mobilization of private funds to bridge the investment gap. This can be achieved by providing adequate standards for green finance and reducing the carbon exposure of the economy (*high confidence*). {6.7}

Climate change losses in Austria, currently averaging EUR_{2019} 2 billion annually, are projected to rise significantly by 2030 (EUR_{2019} 2.5–5.2 billion) and by 2050 (EUR_{2019} 4.3–10.8 billion) (estimates from 2020) (*limited evidence, high agreement*). Austria is currently impacted by climate-related damage and loss, and future climate change along with socioeconomic development will intensify these effects (*limited evidence, high agreement*). {6.7.2}

Just transition policies should address the asymmetric impacts of climate policy on employment and workers across sectors and regions. Furthermore, they must consider the wider inequalities and vulnerabilities exacerbated by the transition to climate neutrality (*high confidence*). While the concept of a just transition, retaining its labor-centric origin, remains a point of contention, with interpretations

spanning from narrow socio-technical shifts to comprehensive social-ecological transformations of the social relations of production, the introduction of such policies is crucial to secure public acceptance and support for rapid decarbonization (*high confidence*). {6.8.1}

The links between climate change and migration are largely disregarded in the political debate in Austria, and significance is mainly attributed when climate change results in increased international migration to Austria (*limited evidence, high agreement*). The evidence base remains limited, revealing ambiguous effects on whether climate change will drive increased migration to Europe, with no clear indication of its specific impacts on Austria. {6.8.2}

Education is universally recognized as a key instrument for achieving all SDGs, and this is particularly true for Climate Change Education and SDG 13 'Climate Action' (*high confidence*). However, education itself needs to be transformed in order to fully exploit its transformative potential for sustainable and climate-friendly living in Austria. This applies to the entire educational spectrum, starting in early childhood and extending through adulthood, in both formal and non-formal settings. The contributions of all players and stakeholders to climate change education must be promptly and fundamentally transformed and strengthened (*high confidence*). {6.8.3}

Media representation of climate change likely increased in Austria since the mid-2000s. While dominant frames focus on the negative economic consequences of climate action, parts of the media represent climate change-skeptical positions. In contrast, several perspectives, such as the need for fundamental transformation of economy and society beyond market-based approaches and individual responsibility, as well as the question of social inequality tend to be underrepresented in the media discourse (*limited evidence, high agreement*). {6.8.4}

6.1. Introduction

Effective climate action combines legal, economic, political and societal aspects. This chapter assesses these aspects from an interdisciplinary perspective. It begins with the structural context of climate governance (Section 6.2). In a second step, the legal framework and the international commitments for Austrian climate policy are addressed (Section 6.3). The following section (6.4) assesses the role of institutions and actors. This is followed by an integrated assessment of existing policy instruments for climate change mitigation and adaptation (Section 6.5).[1] Section 6.6 assesses the legal remedies of climate liability by reviewing selected climate lawsuits. Public finances, investment requirements[2] and costs of (in)action for mitigation and adaptation are addressed in Section 6.7. The final section (6.8) examines the literature on various societal aspects, such as distribution and justice, migration, education, and media in the context of the climate crisis.

6.2. The structural and dynamic context of climate governance

Climate governance refers to the various interactions of political, economic and social institutions to steer social systems towards climate change mitigation and adaptation. These interactions are embedded into societal structures, such as political and legal frameworks, societal (nature) relations, and the political economy of modern societies, as well as the conflict dynamics and antagonisms that arise within them. Achieving the deep decarbonization necessary to meet the goal outlined in the Paris Agreement requires addressing these structures and dynamics that both enable and hinder such efforts (Novy et al., 2023a) (see Section 8.3) (*robust evidence, medium agreement*). The literature on sustainability transformations points to *three core problem complexes* that need to be addressed in order to understand which aspects of society need to be changed and why deep decarbonization is such a contested process (Newell, 2015; Scoones et al., 2015; Brand, 2016; Görg et al., 2017; Stirling, 2019; Morgan, 2020; Pichler, 2023):

(1) The first complex includes deep-rooted structures such as the modern growth economy, unequal and unsustainable societal (nature) relations, and associated mental infrastructures and political institutions that shape and impede transformation (*robust evidence, medium agreement*).

Political economy and political ecology research show that climate governance is embedded in a broader structural context that encompasses modern society, its economy, and the state (Perreault et al., 2015; Paterson and P-Laberge, 2018). These societal structures comprise both material and ideational dimensions and serve as both facilitators and entrenched obstacles to achieving deep decarbonization (Hirth et al., 2023). First, modern economies are seen as inherently driven by competition, economic growth, and profit-seeking (Feola, 2020; Hausknost, 2020), which poses fundamental challenges to a low carbon transformation (see Fouquet, 2019; Buch-Hansen and Carstensen, 2021) (see Cross-Chapter Box 7).[3] An economy prioritizing profit-seeking over basic human needs is identified as a main driver of ecological disruptions (Görg et al., 2017), mainly because competition forces producers to strive for unsustainable growth in order to maintain competitiveness (O'Connor, 1991; Saitō, 2016; Bärnthaler et al., 2021). This implies an expansionary dynamic that is also considered as a cause of geopolitical and geoeconomic tensions (Arrighi and Silver, 2001; Harvey, 2003; Scheffran, 2023; Brand and Wissen, 2024) and, since the late 18th century, is a driver of and itself driven by the large-scale use of fossil fuels (Malm, 2013; Ortiz, 2020; Christophers, 2022). Second, various forms of intra-societal inequality as well as unequal north-south relations have also been found to be entangled with structures of growth-oriented and fossil-fuel-based economies (Hickel, 2017; Daggett, 2018; Brand and Wissen, 2021). Inequalities such as class and unequal gender relations as well as racist divisions serve as structural features reinforcing and stabilizing unsustainable modes of producing and living, particularly as they enable to shift and thus externalize negative social and environmental impacts of economic activities to other places and populations (Lessenich, 2019; Sovacool et al., 2020; Brand and Wissen, 2021). These very inequalities are also identified as main drivers of vulnerability and lack of adaptation to the effects of climate change (Cappelli,

[1] The focus here is on providing a general overview, while more detailed accounts and information on the effects of these policies on GHG emissions are given by the sectoral chapters of this report.

[2] Green finance in particular is addressed in Cross Chapter Box 8.

[3] This view contradicts standard economics, which sees these very characteristics as key levers for decarbonization (Hawken et al., 2000; GCEC, 2014; World Bank, 2023a).

2023). Third, structural unsustainability also has an ideational dimension, as it shapes widely shared conceptions of modern societies or 'mental infrastructures' (Welzer, 2011), that is, deep-rooted understandings of a good life, freedom (Bergthaller, 2017), progress and emancipation (Blühdorn, 2022). Fourth, different perspectives exist towards the extent structural unsustainability also shapes modern political institutions such as the state and liberal democracy.[4] On the one hand, there is a broad body of literature considering the state as the key for a deep decarbonization (Mazzucato, 2014; Eckersley, 2021; Babić and Dixon, 2023). Due to its capacity to allocate and distribute resources, facilitate innovation, regulate production and consumption, manage free-rider problems, and enforce legal frameworks, the state is seen as essentially capable to steer societies towards sustainability. On the other hand, scholars argue that growth imperatives and related deeply rooted societal relations and orientations shape and stabilize the modern state and liberal democracy. The functionality secured, e.g., by taxes, and legitimacy generated for instance by the welfare state and liberal democratic procedures of states co-evolved with and partially rely on a growth-based fossil economy (Hausknost, 2020; Pichler et al., 2020; Koch, 2022; Mitchell, 2023). Consequently, doubts arise about the state's steering capacity, as it is perceived not as a neutral regulator but as an asymmetric terrain (Jessop, 2007), that tends to favor strategies aligned with the dominant fossil fuel-based growth paradigm (Silvester and Fisker, 2023). This inclination results on the one hand in institutional dependencies on fossil fuels, reinforcing carbon lock-ins (Unruh, 2002). On the other hand, it constitutes a structural limitation of transformative state action to a narrow corridor of ecological modernization (Johnstone and Newell, 2018; Hausknost, 2020). For example, due to the automotive industry's central role in Austria's export-oriented industrial economy, its substantial contribution to the tax basis of the state, its role for the formation of labor relations and wage dynamics, and a persistent connotation of automobility with a good life within the Austrian population, state action to move beyond car-centered mobility systems as well as a conversion and downscaling of the automotive industry is relatively difficult to achieve (Pichler et al., 2021a). Therefore, climate governance as an issue specific arrangement embedded in these wider institutional arrangements is not only reactive and responsible for developing solutions to respond to the risks caused or compounded by climate hazards but is also constitutive of them and contributes to the emergence of risks (see Cross-Chapter Box 1). This implies that the state and other institutional contexts vary in their openness to ambitious climate action. For example, Austria's membership in the EU means that the structures and processes of climate governance in Austria are embedded in the European legislative architecture. This framework would allow for more ambitious climate governance objectives and measures than what has been pursued by Austrian governments so far (Nash and Steurer, 2019).

(2) The second complex entails more dynamic aspects such as interest and power constellations, as well as resulting conflicts that arise over deep decarbonization (*high confidence*).

Actors are differently positioned within unsustainable and unequal societal (nature) relations. As a result, they have different, sometimes even conflicting, interests, visions and policy preferences with regard to climate governance, and different capacities to shape it (van der Ven, 2016; Marquardt, 2017; Schneider et al., 2023). Accordingly, social science research on sustainability transformations pays much attention to the contested nature of climate action. First, the obstructive and delaying role of incumbents and (more recently) other powerful actors (e.g., in politics and the media) has been well studied (Geels, 2014; Meckling et al., 2015; Newell, 2019; Turnheim and Sovacool, 2020; Ekberg et al., 2022; Brulle et al., 2024; Plehwe et al., 2024). Sociological research highlights, e.g., how the strategies of powerful actors interact with dominant non-transformative attitudes and unsustainable practices within societies characterized by cleavages and class divisions (Fritz and Eversberg, 2024). Popular perseverance is at times seen as a major obstacle. This includes a protracted tendency of large parts of the citizenry to prefer the convenience of unsustainable lifestyles and to reject climate policy proposals, partly despite growing awareness of the climate crisis (Blühdorn, 2020; Beckert, 2024). Scholars of International Relations and International Political Economy highlight the international and global dimensions of contested transformations and show how manifest geopolitical and geoeconomic tensions shape climate governance (Paterson, 2020; Scheffran, 2023; Brand and Wissen, 2024). This multifaceted contestation of climate action is reflected in a burgeoning literature on transformation conflicts at multiple sites and scales (Brand and Wissen, 2024; Dörre et al., 2024; Eversberg et al., 2024; Fritz and Eversberg, 2024; Herring et al., 2024; Kalt, 2024),

[4] The state is treated in more detail than other aspects here because much of the recent literature emphasizes its central place in governing the climate crisis.

and on how these conflicts may lead to backlash against climate action (Patterson, 2023).[5]

(3) The third complex includes the structurally and power-shaped, and inherently conflictive character of policies and policymaking (*robust evidence, medium agreement*).

The prioritization, formulation and implementation of climate-related policies, as well as their content, are framed and shaped by structural inequality, unsustainability, power and conflict. This is highlighted by critical policy studies (Pichler, 2023; Schneider et al., 2023) and has three main consequences: First, policies are understood as the outcome of conflicts and compromises between diverging interests and visions. Contestations between forces of inertia and change implies a conflict orientation of climate policy (Niedertscheider et al., 2018; Plank et al., 2021), as effective climate policy needs to counter powerful interests by building strategic state capacity (Meckling and Nahm, 2022). Second, policies differ in the extent to which they reproduce or transform the structural context of unsustainable societal (nature) relations. This is crucial, because the effectiveness of climate policies depends on their ability to change structures of unsustainability (Novy et al., 2023a). Third, it is highlighted that policymakers are more likely to adopt policies that align with existing societal structures, dominant interests, and power relations than more transformative policies, as these non-disruptive policies avoid challenging dominant growth imperatives and their associated interests (Markusson et al., 2018). Such institutional biases may partly explain the lack of sufficiency or 'avoid' policies in Austria and the EU, i.e., those focusing on reducing demand rather than merely increasing efficiency (Zell-Ziegler et al., 2021; Jarre et al., 2024; Brad et al., 2025) (see also Cross-Chapter Box 4). Fourth, to address popular resistances and increase the acceptability and legitimacy of climate policies, considerations of justice and participation need to be firmly embedded in climate governance. This is all the more important given the unequal distribution of responsibility for climate change, the unequal distribution of its impacts, and the unequal distribution of the means to adapt to it (Newell et al., 2022).

[5] However, studies also find evidence for broad popular support for climate policy focused on green investment and industrial policy as well as measures compensating unpopular climate policy instruments like carbon pricing in different European countries (Abou-Chadi et al., 2024).

Cross-Chapter Box 7. Degrowth and other beyond growth concepts: The desirability and feasibility of (limiting) growth

Jarmo S. Kikstra, Ernest Aigner, Richard Bärnthaler, Halliki Kreinin, Danyal Maneka, Michael Miess, Andreas Novy, Nicolas Roux, Thomas Schinko

Context

Critiques of relentless economic growth have a long history. Active academic debates on steady-state economics (Daly, 1973) and attempts to model and illustrate the limits to growth (Meadows et al., 1972) are already more than half a century old. The debate is fierce and continuing, discussing the feasibility and desirability of different elements of growth (Meadows et al., 1992; Nordhaus et al., 1992). Here, the core question is what kind of economic structures are conducive to improving well-being while achieving ecological stability and sustainability (Hickel and Hallegatte, 2022). A strong consensus exists on the need to leave behind GDP as an indicator of social progress (Stiglitz et al., 2009; Costanza et al., 2014), but there are different frameworks to analyze what this means for policymaking and the organization of economies around the world. It includes recognizing that while more energy use is required to provide decent living standards for all that are currently deprived (Kikstra et al., 2021), there is a large potential for simultaneous reduction of energy demand, which can bring multiple interacting benefits (Grubler et al., 2018; Creutzig et al., 2022). Moreover, moving beyond growth requires replacing the existing economic growth paradigm with alternative social imaginaries and narratives (Fournier, 2008; Latouche, 2009). Skepticism towards green-growth strategies is widespread among climate-policy researchers (King et al., 2023), and resource and emissions decoupling in the past decade have been highly insufficient

to be on track to meet climate targets, both global targets and targets for Austria (Haberl et al., 2020; Vogel and Hickel, 2023), across many biophysical pressures (CCBox 7 Figure 1).

Beyond growth frameworks

Beyond growth frameworks see most current economic systems as unsustainable and unable to sufficiently increase human well-being within a socially just transition process unless they address perverse growth incentives. Approaches to structural economic changes, tools, and preferred policy interventions differ between frameworks. Definitions used here are in CCBox 7 Table 1. This box focuses on degrowth, a prominent growth-critical approach (Kallis et al., 2018). Degrowth and green growth are contrasted as alternative climate mitigation strategies (CCBox 7 Table 1) to identify common and differing insights on what type of growth is feasible and desirable. A key distinguishing feature is the role of 'avoid' and sufficiency strategies for climate mitigation, which are valorized much more heavily in degrowth (see also Cross-Chapter Box 4).

CCBox 7 Table 1 Overview of relevant terms.

Framework	Definition
Agrowth	An argument that sees GDP as an unreliable indicator for progress and argues that we should not focus on it.
Beyond growth	An umbrella term for terms and approaches that are critical of continued economic growth.
Decent Living Standards	"A set of *material* requirements that are essential for human flourishing" (Rao and Min, 2018).
Degrowth	A research field and socio-political movement focusing on a targeted, redistributive and democratically planned downscaling of production and consumption, primarily in industrialized countries, as a way to achieve sustainability and well-being, while minimizing key risks.
Doughnut economics	"A multi-criteria boundary tool to support economic planning by identifying environmental limits and social thresholds and is agnostic towards GDP growth" (Raworth, 2017), as it does not see GDP as a good indicator for environmental or social progress.
Feminist ecological economics	An approach to economics that centers household and community (re)production and interrelations with nature, for instance through care and unpaid work, and justice related to gender, ecological degradation, decolonization, and global inequities.
Foundational economy	An approach to restructuring the economy to prioritize the provisioning of everyday human needs like food, housing, health services and transport within planetary limits.
Green growth	A set of policies that aim to bring together and simultaneously stimulate sustainable development and economic growth.
Post-growth	A broad set of approaches that challenge the necessity, feasibility, and desirability of continuous economic growth, especially in advanced economies.
Steady-state economics	A concept focused on maintaining a sustainable non-growing economy, including a constant level of resource use, population, and capital stock, with a focus on social welfare not economic growth.
Sufficiency	A set of measures and daily practices that avoid demand for energy, materials, land and water while delivering human well-being for all within planetary boundaries.
Well-being economy	A set of measures that delivers on five core needs for ecological and human well-being: Dignity, connection, nature, fairness, and participation.

(De)growth in the context of climate change mitigation and broader sustainable development

Many proposals have attempted to quantify what might be considered 'enough' and 'too much'. Proposed minimum requirements for human flourishing have been based on theories of the human needs (Max-Neef, 1991; Sen, 2012; Lamb and Steinberger, 2017) that "avoid serious harm and are universalizable, objective, empirically grounded, non-substitutable and satiable" (Gough, 2015). For one example, the Decent Living Standards (Rao and Min, 2018), minimum energy requirements are less than half of current global energy use (*medium confidence*) (Millward-Hopkins et al., 2020; Kikstra

et al., 2021). Total levels consistent with decent living standards for all are higher due to inequality (Millward-Hopkins, 2022) but can be lowered with improvements in service provisioning systems and reduced within-country inequality (Kikstra et al., 2024a). The minimum material footprint to support decent living standards has been estimated at 3–13 t per capita per year (Vélez-Henao and Pauliuk, 2023) (*medium confidence*), which is also less than half of the current annual material footprint, estimated at 24–33 t per capita in Austria pre-COVID (Giljum et al., 2019; Eisenmenger et al., 2020; Lenzen et al., 2022; Plank et al., 2022; UNEP IRP, 2023; Statistik Austria, 2024) (*high confidence*). The federal government's Circularity Strategy has recently set a 7 tMF/cap target for 2050, which expresses the intention to lower resource use levels (see Cross-Chapter Box 5).

Ceilings on activity are more often linked to large-scale environmental thresholds and risks such as planetary boundaries, tipping points, and climate impacts more broadly. Maximum activity levels are then most often linked to carbon budgets corresponding to global warming levels (see Chapter Box 1.1), through estimates of carbon intensities of certain activities, and through the concepts of consumption and production corridors (Di Giulio and Fuchs, 2014; Bärnthaler and Gough, 2023). Additionally, ethical arguments have been made to determine upper limits based on preferences and perceptions of fair levels of income inequality (Osberg and Smeeding, 2006), and a recent survey distinguished the 'rich' from the 'super-rich' in the Netherlands at between EUR 1 million and 3 million total personal wealth (Robeyns et al., 2021).

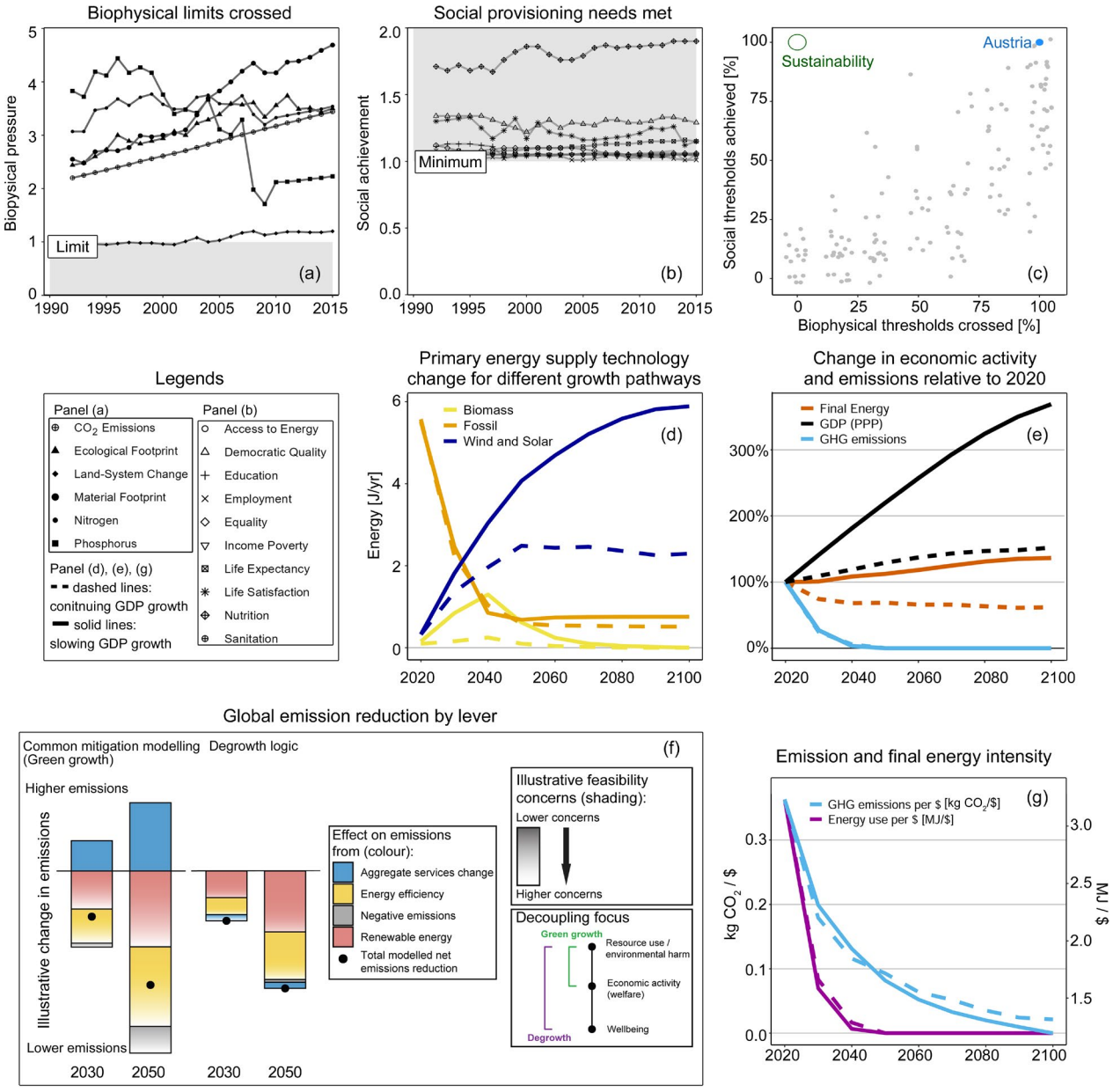
Whether it is desirable and feasible for climate mitigation strategies to downscale a particular activity depends strongly on the sector and country, noting different levels of development, inequality, and needs. Less necessary, and ecologically destructive sectors may include short-distance flights (Dobruszkes et al., 2022) and other inefficient and harmful mobility (Muller et al., 2011; Cattaneo et al., 2022), housing-as-asset (zu Ermgassen et al., 2022), leisure (Smetschka and Wiedenhofer, 2023), fast fashion (Niinimäki et al., 2020), affluent energy overconsumption (Büchs et al., 2023), and animal-based foods (Kozicka et al., 2023). At such a policy level, many of these proposals are supported by both degrowth and green growth analyses, although the approaches to identifying and embedding them differ.

While advocates for degrowth strategies typically call for a clear break with standard economic doctrine, there are elements of agreement with conclusions from standard economic analyses. A full accounting of the external costs of energy calls for rapidly shrinking fossil-based energy production (Muller et al., 2011). Induced technological change explicitly calls for a shift from 'dirty' to 'clean' sectors (Acemoglu et al., 2012), with demand reduction playing a significant role. IEA (2020), for example, shows how, by 2050, 50 % of global steel demand could be met by reuse and recycling, under a 1.5°C decarbonization pathway.

Challenges to green growth strategies have been more extensively researched than challenges to degrowth. For example, efficiency improvements can lead to rebound effects, i.e., induce increased demand, partially offsetting environmental gains (Gillingham et al., 2016; Moshiri and Aliyev, 2017; Raimund, 2023). Much less is known about how strong challenges, including possible rebound effects (Sorrell et al., 2020), to achieving a beyond growth pathway could be, with limited evidence available about the effects of systematically targeted downscaling on employment and productivity, on international competitiveness and financial stability in the case of unilateral or cooperative implementation, or on the financial ability to finance the energy transition, or on the extent to which the transition to renewables induces productivity gains and resulting economic growth (Arkolakis and Walsh, 2023).

From a macro-perspective, to achieve sustainability, economic activity needs to be sufficiently decoupled from emissions as well as from material, energy, water and land resources. To mitigate climate change, the emission intensity of economic activity and energy consumption needs to decline faster with higher economic growth and the same emission reduction target, which may be an indicator of a higher macroeconomic challenge. At the same time, to stabilize at any temperature, CO_2 emissions need to go to zero, ultimately requiring full decoupling. Even if a degrowth scenario achieves absolute decoupling from economic growth in both GHG emissions and final energy, this does not necessarily mean that the year-on-year change in emissions intensity or final energy intensity is different from a green growth scenario (CCBox 7 Figure 1f). At the same time, higher energy demand in a green growth scenario requires a larger energy supply system, which requires more energy and metals such as copper for the energy system itself (Granier et al., 2007; Lesk

et al., 2022; Slameršak et al., 2022; Wang et al., 2023), as illustrated by the scenario highlighted in CCBox 7 Figure 1f, and may thus come with higher environmental pressures beyond emissions, potentially lowering feasibility of decoupling from all environmental pressures (*limited evidence, medium agreement*). Economic growth is also related to biodiversity loss through greater resource consumption and higher emissions (Otero et al., 2020), while the combination of degrowth and efficiency gains can lead to simultaneous emissions and health benefits (Bodirsky et al., 2022).



CCBox 7 Figure 1 Past trends in (a) Biophysical pressures and the exceedance of ecological thresholds for Austria; (b) Trends in social provisioning and the meeting of social minima for Austria; (c) Share of thresholds crossed in 2015 across all countries with Austria highlighted compared to a state where sustainability would be achieved. All data from panel a–c is from Fanning et al. (2022). (d, e, and g) A modeling example comparing the need for upscaling renewables (d) under a 1.5°C consistent target for Australia for a 'continuing GDP growth' versus a 'slowing GDP growth' scenario, with their respective (e) total energy use, GDP, and emissions pathways, and (g) emissions and energy intensities. All data from panel (f) based on Kikstra et al., (2024b). (g) Theoretical representation of a degrowth logic for climate change mitigation compared to common mitigation modeling approaches, based on Li et al. (2023).

Integrated modeling approaches that adequately reflect the dynamics of a global degrowth transition across sectors in coherent global integrated frameworks with high regional detail do not yet exist, but many partial studies have provided explorations and preliminary quantifications. Exploratory country-level modeling indicates that an emissions reduction can be combined with reductions in consumption and increases in social prosperity (D'Alessandro et al., 2020), while lowering the challenges of upscaling renewables and carbon prices fast enough to meet ambitious climate targets (Kikstra et al., 2023) (CCBox 7 Figure 1f). Global studies are few, and range from simplified energy-emissions modeling, to illustrate the space for developing new process-based mitigation pathways (Keyßer and Lenzen, 2021), to first versions of process-based modeling of the conflict between economic growth, climate policy and resource sustainability, with a green-growth scenario failing to meet climate goals and a post-growth scenario meeting emissions objectives (Nieto et al., 2020). For food and land systems, a modeling study showed the possibility of achieving a steady-state, net-zero GHG food system that improves nutritional outcomes (Bodirsky et al., 2022). A few studies have also looked at post-growth modeling using stock-flow consistent models (Victor, 2012; Jackson and Victor, 2020; Sers, 2022). While these models tend to remain conceptual rather than empirically calibrated, one recent working paper described the possibility of finding higher inflation in 'the North' and somewhat slower economic growth in 'the South' due to reduced international trade if 'the North' unilaterally shifted to degrowth while 'the South' continued to focus on economic development (Leoni et al., 2023).

As discussed above, qualitative literature exists on the feasibility, desirability, and economic dynamic effects within and across countries for a transformation beyond growth (Kallis et al., 2018; Kerschner et al., 2018; Hickel et al., 2022). However, attempts to quantify feasibility and desirability are mainly explorative (D'Alessandro et al., 2020; Jackson and Victor, 2020; Nieto et al., 2020; Keyßer and Lenzen, 2021; Moyer, 2023; Kikstra et al., 2024b). Instead, quantifications demonstrate the need for 'avoid' strategies by showing the shortcomings of green growth strategies (Vogel and Hickel, 2023) or by comparing high and low resource demand scenarios (Grubler et al., 2018; Sugiyama et al., 2024).

Key elements

In short, the degrowth approach:

- Emphasizes empirical evidence on the difficulties of decoupling GDP-growth from growth in emissions, energy, and material footprints, and is concerned about the speed and scale needed to achieve climate targets without the relying on speculative levels of deployment of negative-emission technology;
- Problematizes the limited number of mitigation strategies available due to growth imperatives and concerns about rebound effects without concurrent sufficiency-based policies;
- Links emission and resource-use reductions in the spheres of consumption and production;
- Aims at guaranteeing and potentially expanding necessary forms of consumption/production, for instance through collective forms of service provisioning, while downscaling less necessary and ecologically destructive forms of production/consumption, for instance through sufficiency and 'avoid' strategies;
- Raises a key question for democratic deliberation and democratic planning: What do we – as a society – need more of and what do we need less of to live a good life within planetary boundaries?
- Takes a eudaimonic approach to well-being and welfare, assuming universal objective basic needs or decent living standards, whose fulfilment 'for all' is prioritized over growth to satisfy wants or preferences when the two conflict;
- Centers on national and international justice implications, problematizing the disproportionate share of the Earth's resources that richer countries appropriate both in terms of common resources such as carbon emissions into the atmosphere, and through processes of unequal exchange (e.g., Dorninger et al., 2021);
- Intends to move our socio-economic-ecological system from scarcity to (radical) abundance by re-connecting humans to each other, land, nature, and a culture of care, while de-commodifying and de-colonizing the socio-economic system.

For climate mitigation, compared to green growth, degrowth approaches:

- May reduce geophysical and technological feasibility concerns, and therewith enable faster emissions reductions, due to a reduced speed and scale of upscaling renewables for the same emissions reduction target compared to a green growth approach;
- Reduce environmental pressures beyond climate change due to reduced resource needs (*high confidence*);
- Come with a stronger focus on improving eudaimonic human well-being and focus less on preferences;
- May come with higher sociopolitical feasibility concerns due to rapid economic, sociocultural, and economic breaks with past trends.

6.3. Regulatory framework of adaptation and mitigation

6.3.1. International: Requirements of the Paris Agreement

The Paris Agreement is currently the central international treaty for combating climate change, committing signatories to limit global warming to well below 2°C and possibly to 1.5°C above pre-industrial levels. Unlike its predecessor, the Kyoto Protocol, it contains neither numerical reduction targets nor a sanction mechanism (Binder and Ritter, 2023). It is not directly applicable in Austria. Other treaties and conventions also have an indirect impact on climate protection in Austria, such as the General Agreement on Tariffs and Trade (Mayr et al., 2021) or the Convention on International Civil Aviation (Karimi-Schmidt, 2019).

Article 3 of the Paris Agreement requires all parties to contribute to the reduction targets. These contributions are to be determined by the states themselves but must be based on an ambitious level and include a steady increase with the aim of achieving the objectives of the agreement. The EU and its Member States submitted a joint Nationally Determined Contribution and updated their initial commitment in December 2020 to a net domestic GHG emission reduction of at least 55 % by 2030 compared to 1990. The EU Effort Sharing Regulation (ESR) partially transfers this commitment to Member States by setting separate binding annual GHG emission targets for each Member State for emissions not covered by the EU Emissions Trading System (EU ETS) (Handig and Stangl, 2023).

Among other commitments, Article 7 of the Paris Agreement sets out the goal of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change in order to contribute to sustainable development and ensure adequate adaptation in the context of the temperature goal.

6.3.2. The EU regulatory context

The European Climate Law (Regulation (EU) 2021/1119) establishes a framework for reducing GHG emissions by sources and increasing removals of GHG by sinks. It sets a binding interim target of climate neutrality by 2050. At the same time, it aims to make progress in implementing adaptation strategies. In order to achieve the binding target of climate neutrality, the binding target within the EU is to reduce GHG emissions by at least 55 % by 2030 compared to 1990 (Frenz, 2022; Handig and Stangl, 2023). The European Climate Change Act is a central part of the EU's Fit for 55 package, a set of proposals to revise and update EU legislation. Most proposals have already been adopted (see Table 6.1). EU law is the driving force behind Austrian national climate legislation (Ennöckl, 2020; Hofer, 2024a) (*high confidence*).

The EU's climate change strategy is based on reducing GHG emissions, increasing the share of renewable energy and energy efficiency, and addressing the climate change impacts of land use and land-use change. The overall GHG emission reduction target is divided between sectors covered by the EU ETS and sectors covered by the ESR. The EU ETS currently covers emissions from energy-intensive industry, energy utilities and domestic aviation, and will be extended to include emissions from maritime transport in 2027. These sectors are subject to an EU-wide reduction target of 62 % for 2030 compared to 2005 (Directive (EU) 2023/959) (see Section 6.5.1). For the ESR sectors, an overall emission reduction target of 40 % applies for 2030, and specific targets have been defined for individual Member States. Austria is obliged to achieve a reduction of 48 % by 2030 compared

Table 6.1 Overview of Fit for 55 legal measures

Measures	New legal measure / Revision of existing legal measure (n/r)	Legal act
Stronger emissions trading system including aviation	n/r	Directive (EU) 2023/959
Extending emissions trading to maritime, road transport, and buildings	n/r	Directive (EU) 2023/959
Restructuring taxation of energy products and electricity (not adopted)	n/r	COM/2021/563 final
New Carbon Border Adjustment Mechanism (CBAM)	n	Regulation (EU) 2023/956
Updated ESR	r	Regulation (EU) 2023/1319
Updated Land Use, Land Use Change and Forestry (LULUCF) Regulation	r	Regulation (EU) 2023/839
Updated Renewable Energy Directive (RED)	r	Directive (EU) 2023/2413
Updated Energy Efficiency Directive (EED)	r	Regulation (EU) 2023/955
Stricter CO_2-performance for cars and vans	r	Regulation (EU) 2023/851
New infrastructure for alternative fuels	n	Regulation (EU) 2023/1804
ReFuelEU: more sustainable aviation fuels	n	Regulation (EU) 2023/2405
FuelEU: Cleaner maritime Fuels	n/r	Regulation (EU) 2023/1805
Reduction of methane emissions in energy sector	n	Regulation (EU) 2024/1787
Updated energy performance of buildings	r	Directive (EU) 2024/1275
Social Climate Fund	n	Regulation (EU) 2023/955
Decarbonization of gas markets and promotion of hydrogen	r	Directive (EU) 2024/1788

to 2005 (Regulation (EU) 2023/857). EU law provides for a governance mechanism in this area (Dederer, 2021). Integral to this are integrated national energy and climate plans for ten-year periods, which the Member States are required to prepare and report to the European Commission. They are obliged to implement effective instruments to reduce GHG emissions, often based on European directives on buildings, vehicles, energy efficiency, renewable energy, etc. In addition, a separate EU-wide emissions trading system ('ETS 2') will be introduced in 2027 for buildings and transport, as well as for energy supply and manufacturing not covered by the EU ETS. A Social Climate Fund (SCF) will be established, including revenues from ETS auctioning, with the general objective of supporting vulnerable households as well as measures and investments to reduce emissions in the road transport and buildings sectors (Regulation (EU) 2023/955). An EU-wide legislative framework to reduce methane emissions in the energy sector complements efforts to achieve significant GHG emission reductions (Regulation (EU) 2024/1787).

Article 5 of the European Climate Change Act requires the European Commission and Member States to develop strategies for adaptation to climate change. The new EU Adaptation Strategy was adopted in 2021 and aims to achieve a climate-resilient Union by 2050 by promoting smarter, faster and more systemic adaptation and strengthening international action on adaptation. Through 'smarter adaptation', the EU aims to improve data and risk assessment tools to advance knowledge on adaptation and manage uncertainty. Under the goal of 'faster adaptation', the EU focuses on the need for faster and more comprehensive adaptation by accelerating the development and deployment of adaptation solutions. The objective of 'more systemic' adaptation refers to the need for policy developments at all levels and sectors, taking into account the cross-cutting priorities of local resilience, integration of adaptation into macro-fiscal policies and implementation of nature-based solutions for adaptation (COM/2021/82 final).

6.3.3. The national regulatory context

The Austrian legal framework for climate protection is largely based on EU legislation, which is mainly determined by the European Climate Change Act, the ETS Directive, the ESR and the LULUCF Regulation, and supplemented by numerous sector-specific regulations and directives. Purely national regulations are of secondary importance. Member States have policy space mainly in those sectors that are currently not covered by the EU ETS (transport, buildings, agriculture). It is precisely in these areas that national legislative measures have so far been taken only selectively (Ennöckl, 2020).

Within the existing division of powers between the federal government and the federal provinces in the Federal Constitutional Law, there is no explicit area of responsibility for climate protection measures. Climate protection, as well as environmental protection in general, is a cross-cutting issue (Handstanger, 2022; Ennöckl, 2023a) (*high confi-*

dence). The Constitutional Sustainability Act ('BVG Nachhaltigkeit') (BGBl. I Nr. 111/2013) contains a constitutional commitment to sustainability and thus to climate protection in all areas of government action. It sets a mandate for action for all responsible actors in legislation and implementation (Sander and Schlatter, 2014). Insufficient efforts in these areas have not yet been taken up by the courts. The legal effectiveness of the Constitutional Sustainability Act is therefore considered to be very low (Ennöckl, 2023a; Kirchmair and Krempelmeier, 2023) (*medium confidence*). In Austria, an appropriate design of the legal framework can make a significant contribution to the transition to a climate-neutral society and economy. However, this requires addressing and resolving deeper structural problems of the law, including the reorganization of the legal institutions and infrastructures that co-constitute and regulate the political economy. Thus, necessary legal changes affect not only environmental law, but also essential parts of economic law in general and the overall legal order of fundamental socio-economic structures (Lachmayer and Müller, 2023) (see Section 6.2).

In 2011, Austria was an early adopter of a Climate Protection Act ('Klimaschutzgesetz') at the national level. The Climate Protection Act does not include any competences, strategies or instruments for the reduction of GHG emissions, but rather consists of a mere mechanism to distribute the emission reduction targets in 2020 set by EU and international law to different sectors (Ennöckl, 2023b). The law is therefore mainly described as a 'mandate or negotiation law' (Ennöckl, 2020; Schulev-Steindl et al., 2020). Adaptation to climate change plays a minor role in the Austrian Climate Protection Act.

Since the GHG reduction targets contained in the law expired in 2020, Austria has been de facto without a functioning nationally determined climate protection act. The Federal Energy Efficiency Act (BGBl. I Nr. 72/2014) provides for energy efficiency targets at the national level, which should contribute to achieving climate neutrality by 2040 (Suchanek et al., 2023). Although the goal of achieving climate neutrality by 2040, as envisaged in the Government Program 2020, has not yet been explicitly enshrined in legislation, some legal provisions refer to this target. For example, § 35 (12) (a) of the Federal Energy Efficiency Act states that the goal is to contribute to achieving climate neutrality by 2040.

Concerning the expansion of renewable energies, Austria has set a target of producing 5 TWh of renewable gas and raising electricity production from renewable sources on a yearly balance[6] to 100 % until 2030 (Ennser, 2022). It has introduced a set of measures to accelerate the deployment of renewable energy production. Regarding energy efficiency, Austria aims to achieve a linear decrease in final energy consumption up to a maximum of 920 PJ in 2030. Various laws, e.g., on renewable gas are under consultation but not yet decided or will have to be amended once the directives from the Fit for 55 directives come into force.

6.4. Institutions and actors of climate governance in Austria

This section assesses Austrian climate governance strategies, their institutional design and the actors involved. It analyses the interests and power relations involved in governance processes that may limit their effectiveness. The concept of governance refers to a mode of political steering that includes, but is not limited to, state actors. It can involve multiple scales (from local to international) and a variety of private, public and civil society actors and institutions. It is typically conceived as a consequence of the failure of states to 'govern' complex societal problems, such as climate change, through vertical 'top-down' regulation alone (Jordan et al., 2003; Biermann et al., 2012; Brand, 2016; Bäckstrand and Kronsell, 2017). Climate governance often focuses on technological (and sometimes social) innovations and their diffusion across economies and societies. However, as the climate crisis is a time-bound problem, a complementary focus on *exnovation*, i.e., the "intended dismantling of practices, products, technologies and infrastructure" (Krüger and Pellicer-Sifres, 2020, p. 117) becomes ever more important. This includes, for example, phasing out fossil energy infrastructures such as coal-fired power generation, as well as phasing out fossil subsidies and socio-technical systems such as the internal combustion engine and its various applications. In this report, the relationship between innovation and exnovation in climate policy and governance is systematically reflected in the Avoid-Shift-Improve (ASI) framework (see Cross-Chapter Box 4). Governance of exnovation is necessary to shift societies from fossil to sustainable socio-technical systems. It is also essential to implement forms of climate governance that aim to avoid unnecessary and harmful consumption patterns (*robust evidence, medium agreement*).

[6] This means that the percentage is to be determined based on the total quantity of energy consumed in a year and does not have to be achieved in all hours, days or months of the year.

Austria has long had a reputation as a leader in environmental policy (Lauber, 1997). However, despite this reputation, Austria's weak climate policy record contrasts with its strong declared climate ambitions (Melidis and Russel, 2020). Therefore, there is a strong mismatch between Austria's (powerfully produced) self-image as a country with relatively high environmental standards and the actual unsustainability in many sectors. The general climate policy consensus in the Austrian state apparatuses is to deal with climate change in a mode of 'ecological modernization', i.e., to change the energy and resource base without changing social structures and power relations as well as the prevailing modes of production and consumption. This ties in with the clientelist character of Austrian climate policy, in which certain state apparatuses often act in favor of certain groups, e.g., farmers or the business sector (Steurer et al., 2020; Nash and Steurer, 2023) (*medium confidence*).

In the last 20 years, the Austrian government and parliament have formulated three climate strategies and a Climate Protection Act (Nash and Steurer, 2023) (see Section 6.3.3), which has been amended several times. However, climate policy in Austria remains fragmented and incremental and has so far failed to achieve its goals (Niedertscheider et al., 2018; APCC, 2023; Tebecis, 2023). Climate governance has not been a coherent government priority (Scherhaufer and Clar, 2021). As in other European countries, climate governance in Austria has so far mainly relied on 'soft' measures – so-called 'New Environmental Policy Instruments' – which include voluntary measures and market-based instruments, that do not constitute deep interventions in the economic structure of society or in consumer practices (Wurzel et al., 2013; Feichtinger et al., 2021). It remains deeply committed to a perspective of technological change and market-driven innovation to stimulate 'sustainable' or 'green' growth, while there is no vision for sufficiency-oriented governance, i.e., policy frameworks and governance mechanisms that address the systemic drivers of the climate crisis (Novy et al., 2023b). So far, climate governance has not attempted to steer the scale, nature or scope of final consumption (e.g., through mandatory carbon labeling or choice editing) (Maniates, 2010). The incremental nature of Austrian governance can be exemplified by the automobile sector, where government responses to the climate crisis have so far relied on market-based solutions, technological fixes (e.g., shifting to electric vehicles instead of public transport), international competitiveness, and technological innovation, and have failed to achieve the much-needed downscaling and conversion of production and consumption (Krenmayr et al., 2020; Pichler et al., 2021b) (*robust evidence, medium agreement*).

6.4.1. Institutions

In this chapter, 'institutions' refers to the political, legal, and economic rules and forms of organizing climate governance. Institutions are located at and traverse multiple levels of scale, from local/municipal to regional, national, European, and international (Pierre and Peters, 2020). Here we focus on the national and federal provincial level. At the national level, the establishment of a Ministry for Climate Protection, Environment, Energy, Mobility, Innovation and Technology (BMK) in 2020 was a symbolically important step for climate governance in Austria (Nash and Steurer, 2023), both because climate was explicitly mentioned in the title of the ministry and because it was given priority over the other areas covered by the ministry. Moreover, the integration of the key sectors of transport and energy into the ministry's remit brings important levers for climate change mitigation (Eberl et al., 2020).

Federalism

The fragmented structure of the Austrian government and its respective agencies remains an obstacle for the realization of ambitious climate policies at the national level. In particular, Austrian federalism is more of a hindrance than an enabler for the formulation and implementation of ambitious climate policies. Conflicting interests between the federal and federal provincial levels favor either agreements with unambitious targets, unclear responsibilities, a lack of sanction mechanisms, or no agreement at all (Steurer et al., 2020; Scherhaufer and Clar, 2021) (*medium confidence*). The recently adopted Fiscal Equalization Agreement for the period 2024–2028 does not provide for substantial reforms to strengthen intergovernmental climate governance in Austria (Bittschi et al., 2024). In terms of institutional design, national climate councils, as provided for in the European Climate Change Act, can play an important role in convening stakeholders and providing expert scientific advice on climate policy to relevant authorities (Evans and Duwe, 2021). They can also monitor relevant policy developments (EEA, 2021a). Despite the encouragement to do so, not all Member States have yet established an independent climate advisory body.[7]

[7] These are ESABCC, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Luxembourg, the Netherlands, Slovenia, Sweden, Iceland and the United Kingdom.

Social partnership

The Austrian social partnership, an important mechanism for well-designed economic and social policies, has not yet reached the heights of climate policy (Tobin, 2017; Niedertscheider et al., 2018; Brand and Niedermoser, 2019) (*medium confidence*). The social partnership was designed to reconcile conflicting social interests in an era of rapid fossil-based economic and socio-metabolic expansion, and as such may not be ideally suited in its current form to manage the decarbonization of a complex economic structure. Empirical research has even identified the Austrian social partnership as a force obstructing climate action (Brand and Pawloff, 2014). However, in recent times, important initiatives have been launched to 'green' the Austrian social partnership, e.g., the initiative 'Growth in Transition' that started in 2008 or a more recent initiative to strengthen the perspective of a comprehensive social-ecological transformation within the Chamber of Labor (Arnecke, 2024).

Institutional focus on climate change adaptation

There is evidence that Austria's governance system is better suited to enabling effective adaptation to climate change than mitigation (Clar and Steurer, 2014; Steurer and Clar, 2018) (*medium confidence*). Clar and Steurer (2014, p. 23), for example, argue that Austrian federalism "could prove helpful in mediating between national guidance and local adaptation". However, the existing institutional set-up seems to be more geared towards conventional strategies to help individual and collective actors cope with or gradually adapt to climate change (Fekete et al., 2022), e.g., via sophisticated disaster risk management systems or adapted building standards (Nordbeck et al., 2019). In contrast, it seems much less prepared for what Fedele et al. (2019, p. 116) call "transformative adaptation", that is "fundamental systems' changes that address root causes of vulnerability to climate change" (cf. Brand and Wissen, 2024) (*high confidence*).

Natural hazard management and climate change adaptation – internationally, but also in Austria – are currently largely uncoordinated in dealing with some of the same climate-related risks (see Cross-Chapter Box 1). In terms of risk analysis and decision making, natural hazard management focuses strongly on experience, while climate change adaptation focuses mainly on possible future developments (Schinko et al., 2017; Leitner et al., 2020) (*high confidence*). As climate change impacts intensify in the future and adaptation limits may be reached, current incremental risk management measures may no longer be sufficient to maintain societal goals and values (Dow et al., 2013; Preston et al., 2013; Schinko et al., 2024) (*high confidence*). To improve the effectiveness and efficiency of climate-related risk management, the two currently largely independent approaches need to be more closely integrated into a holistic approach – a concept known as 'climate risk management' (Jones et al., 2014; Mechler et al., 2014; Schinko et al., 2017) (*high confidence*). In order to achieve this integration, it is crucial to first understand the current, often isolated governance structures in specific countries or regions and thus identify the potential synergies, but also conflicts, at the interface between these two policy areas (Leitner et al., 2020) (*high confidence*).

Moreover, historically, risk management strategies have been developed for single hazards (Leitner et al., 2020), while advancing climate change will increasingly cause compound climate-related risks (e.g., Zscheischler et al., 2018) (*medium confidence*). To overcome existing path dependencies (Hanger-Kopp et al., 2022; Seebauer et al., 2023) of single-hazard risk management arrangements, which may ultimately cause barriers to transformative adaptation efforts and lead to the intensification of existing societal inequalities, Thaler et al. (2023) argue for a compound risk governance system and management practice (*medium confidence*).

The various institutional deficits with regard to both mitigation and adaptation point to the need for substantial changes, not only in existing policies, but also in the polity, i.e., the (political, legal and economic) institutional framework within which mitigation and adaptation policies are formulated and implemented (Pichler, 2023).

6.4.2. Actors

Actors relevant to climate policy and policymaking can be found both inside and outside institutions and can be collectively organized in institutions such as political parties. As in many other democratic industrialized countries today, the existing constellation of actors in Austria harbors the danger of 'climate delay' or 'climate policy dismantling', i.e., the possibility of obstructing and delaying already agreed climate policies and decarbonization targets, as well as cutting, reducing or abolishing existing policies (Lamb et al., 2020a; Ekberg et al., 2022; Paterson et al., 2024) (see Section 8.5.1). After a phase of progressive climate policy formulation starting around 2019, the EU and many of its Member States, including Austria (Arnecke, 2024), are currently facing an era of reluctance and restraint with regard to the further development of climate policy (Plehwe et al., 2024) (*high confidence*).

Political parties

The positions and strategies of political parties on climate change in Austria vary greatly. In the legislative period of 2019–2024, the government has set the target of climate neutrality by 2040. There are, however, substantial differences among parties when it comes to concrete measures to achieve this goal, despite a formal commitment of all parties to the overall objective of climate neutrality (Kirchengast et al., 2019a) (*high confidence*).

Ambitious climate action – mostly within the corridor of ecological modernization – is demanded primarily by the Austrian Green Party. Accordingly, it is also the party most clearly identified with the issue of climate change in Austria, by experts and the electorate (Dolezal, 2016; Abstiens et al., 2021). While the Green Party has benefited considerably from the issue salience of climate change in the parliamentary elections of 2019 and in several regional elections, more recent elections, e.g., to the European Parliament, have seen Green losses in an atmosphere of increasing societal polarization and strong gains of far-right parties across Europe, including in Austria (Cunningham et al., 2024; Schwörer, 2024). While this provides an ambiguous picture of the impact of polarization and far-right popularity on the salience of climate change as an electoral issue and the performance of the Green Party (Buzogány and Scherhaufer, 2018), it also suggests that the salience of the climate change issue in recent years positively influences the Green Party's performance, both on the European (Pearson and Rüdig, 2020) as well as the national level, where the Greens entered a governing coalition as the junior partner of the conservative People's Party (ÖVP) after the snap elections in 2019 (Eberl et al., 2020) (*medium confidence*).

Representing business as well as agrarian interests, the ÖVP is located at the blocking end of the party spectrum when it comes to ambitious climate action. With an emphasis on the principles of voluntariness and 'technology openness', a construal of the climate crisis as a question of technological innovation and a framing of more binding and far-reaching measures as a threat to the national economy and prosperity, it has repeatedly hindered the implementation of more ambitious climate policy. In recent years, it has done so from a powerful position, leading two governments and dominating key state apparatuses such as the BMF and the Chancellery (Steurer et al., 2022; Auel and Schmidt, 2023; Pearson, 2024) (*medium confidence*). One area of climate policy where the ÖVP has recently taken a more proactive role is Carbon Capture and Storage (CCS) and Carbon Capture Utilization (CCU). In spring 2023, the ÖVP-led BMF initiated the development of a carbon management strategy, aimed at establishing a regulatory and subsidy framework for CCS and CCU in Austria. This integration of CCS and CCU into Austria's climate strategy is in line with the party's inclination towards techno-solutionism. It poses crucial political challenges in terms of addressing the risk that unwarranted expectations of CCS and CCU undermine other mitigation efforts, in terms of limiting CCS to residual emissions that are truly hard-to-abate, and dealing with the persistent risks and uncertainties of these technologies (Brad et al., 2024).

On a programmatic level, the Social Democratic Party (SPÖ) is committed to global or European multilateral agreements and stresses that global responsibility requires local action. It sees climate protection as a challenge that requires a profound restructuring of modes of production and consumption as well as the economy and society at large. However, in a 2019 analysis of party positions on climate change, the alignment of the SPÖ's climate policy with the Paris Agreement was rated as "unclear", partly due to shortcomings in spatial planning (Kirchengast et al., 2019b). An infamous example of these shortcomings is the Lobautunnel, a proposed underground segment of a bypass highway beneath a Viennese nature reserve. The tunnel not only represents the SPÖ's reluctance to abandon emission and resource-intensive pathways like car-centered mobility, but it is also emblematic of how climate-related issues are still highly contentious within the party. While the Viennese party stands firmly behind the project, others in the party, including the federal chair and the party youth, intermittently opposed it. Looking beyond mobility, the federal chair has introduced plans for a climate transformation fund ('Klima-Trafo') in early 2024. This fund is intended to foster and secure sustainable investments, e.g., in renewables or innovative start-ups (Arnecke, 2024).

For the resurgent far-right Austrian Freedom Party (FPÖ), the protection of nature and immediate environment is a salient and fundamental component of ideology and legislative activity. This is nourished by a long-established ethno-nationalist ecological framework of anti-anthropocentrism and organicism (Voss, 2019), and sometimes serves more strategic ends (Tosun and Debus, 2022). It also entails a programmatic embrace of a domestic green energy transition as a way to strengthen national sovereignty (Selk and Kemmerzell, 2022) and sometimes even seems to extend to climate mitigation (Ruser and Machin, 2019; Ćetković and Hagemann, 2020). However, climate policy sceptic positions

in the guise of economic pragmatism and even outright denial of anthropogenic climate change are still firmly anchored within the party (Forchtner, 2020; Malm, 2021) (*medium evidence, high agreement*). This is reflected not only on the programmatic level (Kirchengast et al., 2019a), but also in parliamentary decision making – both at the national and EU level – where the FPÖ has repeatedly opposed mitigation measures (Ćetković and Hagemann, 2020), most infamously in its vote against the Paris Agreement (Austrian Parliament, 2016). While this can be interpreted as an act against multilateralism rather than climate obstruction (Selk and Kemmerzell, 2022), there are also domestic issues where the FPÖ has positioned itself against measures that allegedly harm the so-called 'common man', symbolized, e.g., by the figure of the car driver, who is claimed to suffer from increasing restrictions imposed by climate change policies (Ruser and Machin, 2019). This points to a populist strategy dividing the political space into a self-righteous (urban) and climate-conscious 'elite', imposing their climate agenda on a victimized 'people'. Climate action thus appears as an elitist project directed against the majority in the FPÖ's discourse (Buzogány and Mohamad-Klotzbach, 2022). This also points to a more general characterization of right-wing parties as unbridled defenders of a resource and emission intensive 'imperial mode of living' (Eversberg, 2018; Brand and Wissen, 2024).

The liberal party Neos is strongly committed to multilateral and transnational efforts to mitigate climate change in which it wants Austria to lead by example. Crucially, Neos claims that effective climate protection can best be achieved within an ecologically modernized market economy that promotes technological innovation. While the party perceives state regulation as an obstacle to economic development in many respects, climate protection measures form a notable exception here. For Neos, the decarbonization of the market economy does also require regulatory action by the state, e.g., in the form of a restructuring of subsidies. Importantly, however, this does not imply an expansion of the current regulatory framework or the state's ability to intervene in the economy. Instead, climate protection measures such as a CO_2 tax should be 'revenue-neutral', i.e., accompanied by deregulation measures that offset the additional costs for Austrian companies. Many of the climate protection measures proposed by the federal government are supported by the Neos. While they joined the Greens in opposing the Lobautunnel, Neos supported the Renewable Energy Act and the Energy Efficiency Act (Arnecke, 2024).

Organized interest groups

The neo-corporatist character of Austrian politics places specific interest groups in a key position in climate policymaking, by formally establishing links between the state and a limited set of social partner organizations (Tálos and Hinterseer, 2019). While the social partnership is strong when it comes to economic and social issues, it is weak when ambitious climate policies need to be formulated and implemented (Brand and Pawloff, 2014; Niedertscheider et al., 2018). However, there is a range of positions on climate change among the social partners. The Chamber of Labor is the most ambitious social partner trying to pursue ambitious climate policies, despite its occasional advocacy for the expansion of fossil infrastructure to secure employment (Arnecke, 2024) (*high confidence*).

Historically, the relationship between trade unions and environmentalists in Austria has been complicated and conflictive (Brand and Niedermoser, 2019). In the past, trade unions have repeatedly opposed climate protection measures, which they believed would hinder economic development and undermine their bargaining power. In doing so, they have even joined forces with energy companies to secure cheap energy prices (Soder et al., 2018). Despite the complex relationship between trade unions and environmental goals, newly emerging alliances between trade unions and environmental groups have been identified as potential new societal alliances for social-ecological transformation (Soder et al., 2018). It should also be noted, that some 'traditional' trade union policies, e.g., working time reduction, can be considered as 'implicit climate policy', as they are not understood as measures to combat climate change but can contribute to climate-friendly living (Brand and Niedermoser, 2017; Liebig, 2019) (see Section 4.7.3).[8] In recent years, the climate crisis has become an increasingly central issue for the Austrian Trade Union Federation (ÖGB), whose 2023 program includes fourteen pages on climate change and a 'just transition'. Here, the ÖGB emphasizes the risks of climate change itself (e.g., working in increased heat) as well as its mitigation (e.g., layoffs due to stricter regulation). Despite their warnings, they also point out the potential long-term synergies between their fundamental goals of improving wages, working conditions and job security on one side and climate protection on the other.

[8] The potential positive contribution of a (wage) worktime reduction to enabling climate-friendly living depends on the design and mix of respective policies (Hardt et al., 2020, 2021).

However, it is important to note the sectors and class fractions represented by the ÖGB. While some branches, such as the sectoral union for transport and services (vida), have common interests with climate movements like Fridays for Future (FFF) and in fields like public transport even engage in a joint campaign called 'We ride together', conflicts exist in individual cases such as plans for airport expansion. In other sectors, climate politics is even more contentious. The sectoral union for construction and wood, for example, has also entered into a coalition with FFF, demanding, among other things, subsidies for renovation. In response to the severe crisis in the construction industry, however, the union has since joined the WKO in calling for an economic stimulus package that includes resource-intensive measures such as subsidies for single-family homes (Arnecke, 2024). Meanwhile, in sectors such as the automotive industry, the contradiction between the immediate interests of workers and environmentalists is even more obvious (Pichler et al., 2021a). Where they exist, union's climate strategies tend to remain within the corridor of ecological modernization, as they tend to support climate action only if the primary goals of employment, competitiveness, and economic growth are not compromised (Brand and Niedermoser, 2019) (*medium confidence*).

The Austrian Economic Chamber (WKO) and the Federation of Austrian Industries (IV) represent different business factions with different interests regarding climate policy. For instance, oil and gas producers and renewable energy producers are both represented by the WKO, yet they have conflicting interests regarding an energy transition. However, WKO and IV have been identified as powerful veto players, blocking the implementation of ambitious climate policy (Abstiens et al., 2021) (*high confidence*). A concrete example is the development of the 2011 Climate Protection Act, where the WKO played a central role in limiting ambition, especially of GHG emission reduction targets (Brand and Pawloff, 2014; Nash and Steurer, 2021). This obstructive role is also reflected in the perceptions of the members of the Citizens' Climate Council. Evaluations of the body show that members were disappointed with the IV and the WKO, who were late in submitting their inputs, were the only stakeholders not to attend in person but online, and attended only one round of discussions with the citizens, while all the other stakeholders stayed for two rounds (Buzogány et al., 2022). A more ambivalent role seems to be played by the Austrian Chamber of Agriculture. While sometimes described as 'pro-environment', it sided with the other social partners in slowing down the transition to renewable energies. In support of agribusiness interests, it favored subsidies for biofuels and lobbied against feed-in-tariffs for wind or solar power (Tobin, 2017; Arnecke, 2024).

Climate organizations and movements

Although Austria has established environmental organizations, policymakers and social partners only partially view them as legitimate partners in policymaking (Hermann et al., 2015). However, in recent years, as in many other countries around the world, the FFF movement has become a key civil society actor in Austrian climate politics, ushering in a new phase in the history of the Austrian environmental and climate movement (Daniel and Deutschmann, 2020; Arnecke, 2024). In Germany, FFF has been identified as supportive of representative liberal democracy, but also critical of incumbent power relations (Buzogány and Scherhaufer, 2022). Although putting pressure on politicians was the main motive for participants taking part in a 2019 FFF demonstration in Austria (Daniel and Deutschmann, 2020), they also showed little trust in the government to act appropriately to counter climate change (Buzogány and Mikecz, 2019). As well as demanding from politicians to make decisions in-line with climate science and international agreements such as the Paris Agreement, FFF Austria has been involved in specific conflicts, opposing fossil infrastructure projects such as the Lobautunnel and the proposed third runway at Vienna Airport, and supporting the expansion of wind farms in the Waldviertel region of Lower Austria (Arnecke, 2024).

The Lobautunnel conflict also led to the founding of the Austrian branch of the Last Generation protest movement, which is best known for its civil disobedience (Arnecke, 2024). As with the German branch of the movement (Rucht, 2023), Last Generation's strategy has been highly conflictual and has led to polarized responses, including repressive measures against climate activists (Simsa, 2024). The movement ceased its activities in 2024.

In addition to demonstrations, NGOs and movement actors have also used climate litigation as a strategy to influence climate policy change (see also Section 6.6). For example, a 2017 court case to prevent the construction of a third runway at Vienna Airport was initiated by individuals together with an NGO, the Anti-Aircraft Noise Society (Setzer and Bangalore, 2017). In 2020, Greenpeace and numerous other plaintiffs filed a human rights lawsuit with the Constitutional Court based on preferential tax conditions for air travel compared to train travel. The case is currently pending before the European Court of Human Rights (Wallner, 2022).

A central mainstream actor in recent years has been the 'Klimavolksbegehren'. Using a formal direct-democratic instrument for citizens to bring issues to the attention of parliament, which is obliged to consider and report on the issue, climate activists initiated a popular petition on climate policy in 2020. It was signed by 380,590 Austrian citizens (5.9 % of the population entitled to vote), making it the 20th most-supported public petition in Austrian history and leading to its subsequent consideration in parliament (Wallner, 2022). Of the four demands made by the petition – binding and sector-specific CO_2 budgets, a constitutional amendment guaranteeing climate protection, eco-social tax reform, and a citizens' climate assembly – the last two were taken up (Arnecke, 2024).

The Citizens' Climate Assembly was a representative mini-public initiated in 2021. Although designated independent and impartial, the assembly was associated with the minister for climate action from the Green Party from the outset (Buzogány et al., 2022). A key output of the assembly was a set of policy recommendations that demanded more ambitious climate policy than the status quo across a very comprehensive range of policy areas, although these have not been discussed in parliament and the main feedback loop in the political process has been a detailed response from the relevant ministries (Clar et al., 2023). The assembly was praised as a good example of a deliberative forum at the national level (Clar et al., 2023). It was built upon important procedural aspects – specialized facilitation, a scientific advisory board, and possibilities for participative deliberation by participants on both procedural and substantive aspects (Buzogány et al., 2022), all of which were highlighted as beneficial by participants (Praprotnik et al., 2022). The extent to which participants were concerned about climate change did not change over the course of the assembly, which participants put down to being able to direct their concerns in a meaningful direction (Praprotnik et al., 2022). This empowerment continued after the assembly concluded, with former members founding an official organization to continue their work. Criticism of the assembly was that the stakeholder board lacked meaningful engagement (Buzogány et al., 2022). Furthermore, despite the intention to constitute a representative proxy of the Austrian population, the assembly members were found to be more concerned about climate change and more interested in politics than the general population (Praprotnik et al., 2022). In particular, the exclusion of people who had not been vaccinated against COVID-19 from participation excluded a group overrepresented among FPÖ supporters (Arnecke, 2024).

6.5. Policy instruments for climate change mitigation and adaptation

This subchapter addresses policy instruments for climate mitigation and adaptation in Austria, offering only a brief overview of specific instruments, with detailed discussions provided in the sector-specific Chapters 2, 3 and 4.

Effective climate policies enable structural change towards climate-friendly living and producing, and increase resilience in the face of unavoidable climate change. This includes transforming unsustainable consumption and production patterns (see Section 6.2). Key levers to achieve this goal are demand-side mitigation policies, and associated instruments focused on increasing sufficiency, i.e., reducing demand for energy, materials and land while ensuring high levels of well-being within planetary boundaries. These policies, also characterized as 'avoid'-instruments, work by preventing demand altogether, distinguishing them from instruments that 'shift' demand to other means or merely 'improve' existing provisioning structures (see Cross-Chapter Box 4).

'Avoid' instruments span across various categories (regulatory, economic, etc.) and sectors. In the transport sector, for instance, teleworking incentives such as subsidies for energy bills, help reduce commuting needs. Some instruments contribute both to avoiding and shifting demand, e.g., banning domestic flights can reduce (air) travel while also shifting traffic from air to rail. Evidence from Austria and other EU countries indicates that such 'avoid' instruments are significantly underrepresented in both current policy mixes and medium- to long-term policy plans (Zell-Ziegler et al., 2021; Novy et al., 2023b; Jarre et al., 2024; Olesen and Vikkelsø, 2024; Brad et al., 2025).

Moreover, the design of policy instruments is subject to a variety of problems, including imperfect information, undefined property rights, multiple externalities, market power, vested interests, unobservable or immeasurable behavior, monitoring problems, uncertainty, lack of stakeholder support, and constraints on available administrative capacity (Bennear and Stavins, 2007). This motivates a second-best policy framework using a combination of regulatory, economic and other instruments to address the identified problems and explains the widespread use of climate policy packages. EU Member States reported 2,052 climate change policies or measures in 2021, of which 44 % were economic instruments and 41 % regulatory instruments (EEA, 2021b).

Table 6.2 Summary table on the status of policy instruments in Austria (content based on expert estimations by the Lead Authors of AAR2).

Part A: Mitigation

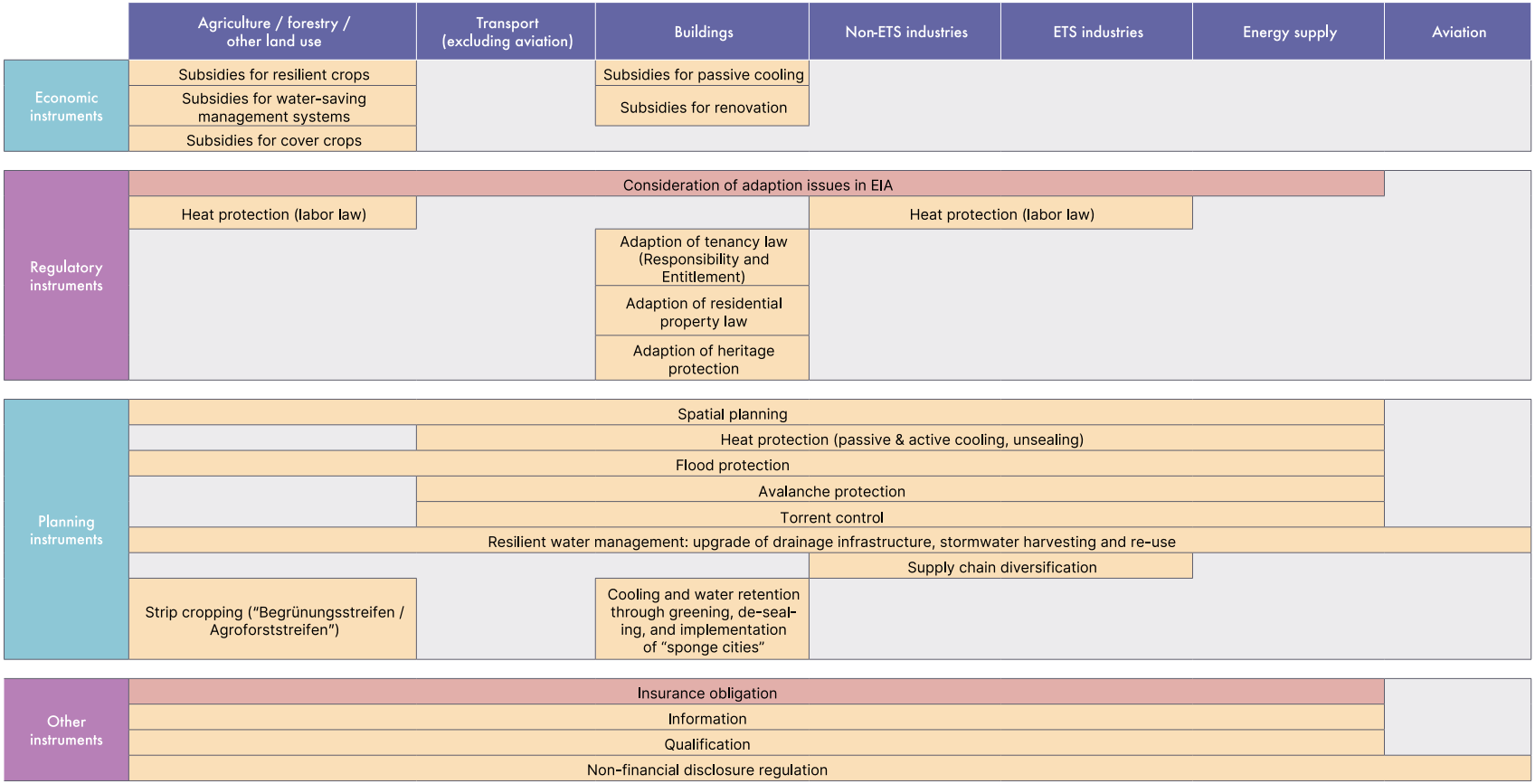
	Agriculture / forestry / other land use	Transport (excluding aviation)	Buildings	Non-ETS industries	ETS industries	Energy supply	Aviation
Economic instruments: taxes and ETS	National emission trading system				EU ETS		
	Energy taxes						Fuel taxes
	Carbon border adjustments				Carbon border adjustments		
	EU level border-meat-adjustment tax					VAT exemption for PV systems	VAT on international flights
	Elimination of reduced VAT or higher taxes rate for meat and dairy products	Road pricing trucks	Vacancy fee	Resource taxes			Passenger taxes
	Higher taxes for emission-intensive products	Road pricing cars / city toll	Secondary residence fee				
	Fertilizer tax	Vehicle taxes	Real estate tax				
	Soil sealing taxes	Parking fees					
Economic instruments: subsidies	R&D subsidies						
	Investment subsidies	Subsidies for low emission mobility	Subsidies for change of heating systems	Environmental protection subsidies		Investment subsidies	
	(Restructuring of) subsidies		Subsidies for thermal refurbishment			Feed-in premiums	
	Payments for eco-system services						
	Premiums for the reduction of livestock						
	De-sealing premiums						
	Earmarked compensation payments directed to re-naturation						
		Commuting subsidies					
		Subsidies for company cars					
Planning instruments	Reduction of rezoning of green spaces	Spatial planning					
			Energy planning			Energy planning	
		Unsealing / greening	Re-densification	Re-naturation of industrial sites			
		Expansion and electrification of public transport	Adaptation of infrastructure			Expansion & adaptation of grid infrastructure	
		Infrastructure for e-mobility					
				Product passes			
Other instruments	Non-Financial disclosure regulation						
	Qualification programs						
	Information campaigns						
	Fiscal equalization					Fiscal equalization	
	Labeling						
	Reform of communal tax						
	Guideline for fertilizer applications						

Not implemented / missing | 11% Implemented but insufficient | 77% Implemented and (fairly) sufficient | 9% Counterproductive instrument | 3%

	Agriculture / forestry / other land use	Transport (excluding aviation)	Buildings	Non-ETS industries	ETS industries	Energy supply	Aviation
Regulatory instruments	LULUCF regulation	CO_2 fleet emission limits / ban of fossil drives	Building codes	Product design standards		Renewable quotas	Ban of short flights
	Feedstuff regulation	Speed limits	Moratoria on expansion of natural gas network	Obligatory energy audits		Regulations for energy communities	Ban of private jets
	Supply chain responsibility regulation	Vehicle access restrictions	Ban of fossil heating systems (new buildings)	Obligatory waste heat utilization		Sustainability standards for biofuels	
		Environmental impact assessment		Environment impacts assessment			
	Regulation on deforestation-free products	Parking space management	Ban of fossil heating systems (old buildings)		IPPC standards		
	Afforestation obligation	Obligatory shift of longer freight transport to rail	Adaptation of residential property law		CCU/S regulation		
	Fertilizer regulations	Obligatory transport on rail for certain goods	Adaptation of heritage protection				
	Restrictions regarding menus in public canteens	Mobility budgets	Adaptation of tenancy law				
	Conservation of biodiversity, nature restoration law	Adaptation of building regulations					
	Regulation on the sustainable use of plant protection products	Moratoria on building of high-ranking roads	Refurbishment of public buildings				
	Maximum livestock-to-land ratio	Right to telework					
	Re-naturation of forests through reduced timber extraction						
	Guidelines for soil protection						
	Advertising bans for meat	Advertising bans for cars					Advertising ban for airline
	Public procurement						
	Change in the forestry act		Parking space obligation				
Just transition instruments / compensation instruments	Coupons for vulnerable consumers	Subsidies for public transport for low-income households	Subsidies for changing heating systems and refurbishment for low-income households	Financial support for affected regions			
		Lump-sum payments ('Klimabonus')		Reductions in corporate taxes			
			Energy efficiency programs	Reductions in labor taxes			
			Consumer protection and information	Employment subsidies			
			Preferential loans / energy efficient mortgages	Active labor market policies			
			Curbing monthly back payments of tenants for renovation measures				

Not implemented / missing | 11% Implemented but insufficient | 77% Implemented and (fairly) sufficient | 9% Counterproductive instrument | 3%

Part B: Adaptation



Not implemented / missing | Implemented but insufficient | 97% | Implemented and (fairly) sufficient | 3% | Counterproductive instrument

For both mitigation and adaptation, this subchapter focuses on regulatory, planning, economic and other instruments such as information and behavioral instruments. Regulatory instruments are highly sector-specific, ranging from building codes to feedstock regulations to fossil fuel bans. For planning instruments, this section focuses on energy planning. Regarding economic instruments, the focus is on instruments that aim at mitigation and adaptation by steering relative prices.[9] Regarding mitigation, instruments to compensate for potentially negative distributional impacts of mitigation policies are also addressed.

Table 6.2 provides an overview of important climate policy instruments in Austria in different sectors, distinguishing instruments according to their implementation status and their alignment with climate policy objectives. Instruments are further divided into different types (economic, regulatory, planning, just transition and other instruments). Table 6.2 (A) displays mitigation instruments while Table 6.2 (B) presents adaptation instruments.

6.5.1. Mitigation instruments

Regulatory instruments for climate change mitigation

There are numerous examples in policy practice where regulatory instruments have been used effectively, e.g., to increase energy efficiency, control toxic substances, or manage natural resources such as forests or fisheries (Bennear and Stavins, 2007). Furthermore, regulatory instruments such as bans and limits have been identified as key levers to achieve phase-out and exnovation of unsustainable structures and practices (Heyen et al., 2017; Green, 2018; Rosenbloom et al., 2020; Pichler et al., 2021b; Rinscheid et al., 2021).

[9] Economic policy goes beyond measures to influence prices and, consequently, shape economic activities. It encompasses a wide range of measures of government interventions to proactively steer structural change. While some types of measures merely alter the framework conditions under which producers and consumers act (i.e., they do not aim at direct intervention), others intend to intervene more directly into economic activities (Peters, 2015). Many recent studies highlight the contribution of economic policy to the transformation to a climate-friendly economy (Blanchard et al., 2022). This includes, for example, trade policy (Wolf, 2021), industrial policy (Rodrik, 2014; Eder and Schneider, 2018; Pichler et al., 2021b), financial and monetary policy (Krogstrup and Oman, 2019; Cahen-Fourot, 2021), (re-)distributional policy (Theine et al., 2022; Kapeller et al., 2023), and labor market and employment policies (Bohnenberger, 2022; Hofbauer et al., 2023).

However, regulatory instruments also come with general policy issues (see introduction of Section 6.5). This is illustrated by the mixed track record of the European Union's Corporate Average Fuel Economy (CAFE) targets. Political influence from car manufacturing lobbies (Oki, 2021) has played a role in undermining the standard's effectiveness (for more information on the influence of obstructive actors, see Sections 6.2 and 6.4.2). This interference contributed to missed emissions targets in the mobility sector and ultimately led to a reduction in overall welfare (Reynaert, 2021).

Standardization is crucial for both market and non-market interactions among individuals or groups for two key reasons: (i) without a basic level of standardization, it becomes highly costly for individuals to compare goods and services, making informed purchasing decisions difficult (standards are therefore essential for reasonable price formation); and (ii) even in the absence of formal or centralized regulation (laws, directives, etc.), implicit or decentralized forms of regulation still emerge through social interactions, including habits, customs, and practices (Pindyck and Rubinfeld, 2018).

Transport

The legal framework for the transport sector in Austria has not yet been adapted to the requirements of sustainable transport in passenger and freight transport (see Section 3.4). There is a lack of regulatory instruments in transport law aimed at avoiding CO_2 emissions. Current measures, such as speed limits and driving bans, are mainly directed at reducing local emissions, e.g., particulate matter, and thus can only contribute indirectly to the reduction of GHG emissions (Schulev-Steindl et al., 2021). In permit procedures for construction of new road infrastructure, GHG emission reduction aspects only play a minor, if not negligible, role (Graber, 2023). There are also few legally binding requirements for public transportation (Fitz, 2023a). Amendments to building codes in some federal provinces have introduced requirements for the installation of EV infrastructure (i.e., charging infrastructure) in new buildings (Cejka, 2024) and have also facilitated the installation of charging infrastructure in apartment buildings (Fidler, 2023). Furthermore, an amendment to road traffic law introduced provisions to promote cycling and walking (Hugeneck, 2023).

Currently, certain waste shipments must be made by rail or by other means of transportation with equal or lower pollutant or GHG potential. However, this obligation does not apply equally to primary raw materials. Therefore, evaluating the instrument in terms of its impact on the recycling

of secondary raw materials could be an important step in reducing the use of natural resources (Krasznai, 2023).

Industries and energy supply

GHG emissions from installations are primarily regulated through the economic instrument of emissions trading (see Chapter Box 6.1). Whether Member States can take additional measures in the context of the EU ETS is controversial (Hofer, 2023a). The GHG intensity of installations currently plays little or no role in plant permit procedures (Ennöckl and Sander, 2023; Hofer, 2023a). Regulatory instruments currently focus mainly on energy efficiency and GHG emissions of households and individuals; for industrial emissions and electricity generation, economic instruments are currently favored by policy makers. One exception is the Environmental Impact Assessment (EIA) Act: For example, projects subject to EIA must be designed to limit GHG emissions according to the state of the art or best available techniques. However, for plants included in the EU ETS, no emission limits for direct GHG emissions of GHG subject to emission trading apply (Baumgartner and Niederhuber, 2023; Hofer, 2023b).

The ban on geological storage of CO_2, which came into force in 2011 and is currently under discussion, does not apply to the sequestration and transport of CO_2 or to research projects, and the storage volumes permitted for research projects are so small that this also hampers the implementation of research projects (Tiefenthaler, 2022).

Buildings

Various regulations on EU, national and federal provincial level regard energy efficiency, electricity and heating of buildings. For example, the Renewable Heat Act ('Erneuerbare-Wärme-Gesetz') bans the installation of gas heating in new buildings (BGBl. I Nr. 8/2024). The building regulations of the federal provinces integrate mitigation aspects, e.g., by establishing the principle that buildings and all their parts must be planned and constructed in such a way, that the amount of energy required during use is limited according to the state of the art. Most regulations on sustainable and low-emission buildings have been implemented because of EU legislation. More comprehensive, possibly nationwide, regulations are needed to strengthen mitigation efforts (Häusler and Schlenk, 2021) (see Section 3.3.3). Concerning the energy-efficient renovation of buildings protected by heritage law, the competent authority has to consider aspects of ecological sustainability in general and energy efficiency and renewable energy sources in particular when deciding on permits to modify such buildings.

Agriculture

In the agricultural sector, too, the national regulatory framework is largely determined by EU law (The Common Agricultural Policy, CAP) (Eckhardt, 2022). According to EU law, the Austrian CAP strategy must include agri-environmental and climate commitments as well as voluntary schemes for climate, environment and animal welfare ('eco-schemes'), and is complemented by fertilizer regulations and afforestation obligations.

Planning instruments for energy and climate change mitigation policies

Spatial planning laws of the federal provinces either directly address climate protection as a spatial planning objective or implicitly include mitigation aspects by referring to the protection of the environment and natural resources in general. In addition, some provinces explicitly refer to the expansion of renewable energies as a primary objective in their spatial planning laws (Stöglehner, 2023a). Nevertheless, land consumption in Austria is high (Pories and Pfeiffer, 2024). This section focuses on energy planning, while spatial planning is addressed in detail in Section 3.2.

Energy Planning

In addition to lengthy permitting processes, inconsistencies resulting from a lack of coherent nationwide spatial planning for renewable energy infrastructure are barriers to the rapid expansion of renewable energy. Both federal provinces and municipalities are required to designate areas for renewable energy development and infrastructure according to their competencies (Storr, 2024). Efficiency losses thus may result from varying spatial capacity designated for renewable energy projects at different levels. The amended Renewable Energy Directive (Directive (EU) 2023/2413) requires Member States to identify potentials and define areas for accelerated approval of renewable energy projects in order to accelerate the transformation process (Handig and Rathmayer, 2024). Additionally, based on an amendment to the EIA Act and only for wind turbines, in the absence of both local and supra-local spatial energy planning in the federal provinces with regard to the designation of sites for wind turbines, the

consent of the municipality alone is now considered sufficient for the granting of a permit for a wind turbine. This means that the lack of designated areas for wind turbines is no longer a legal obstacle to accelerating the expansion of wind turbines (Altenburger et al., 2024).

The legal framework aims to resolve the tension between the expansion of renewable energy and the protection of biodiversity by, among other things, compensating for biodiversity losses through the designation of specific compensation areas, i.e., areas that must be designated and permanently secured as compensation for biodiversity interventions. However, there is currently no detailed legal framework for compensation areas (Wagner and Ecker, 2013).

Currently, Austrian spatial planning legislation does not consistently and comprehensively address the spatial dimensions of energy consumption and energy supply (Stöglehner, 2023a, 2023b). In 2014, the Austrian Conference on Spatial Planning (ÖROK) developed an expert paper that contains the relevant action requirements for the transition to renewable energies. Here, improving the legal framework for spatial planning has great potential to support the energy transition (see Section 3.2.2).

Strategic Environmental Assessment

A Strategic Environmental Assessment (SEA), i.e., the assessment of the environmental impacts of a project at the planning stage[10], must be carried out for major planning projects and programs with significant expected environmental impacts (Alge et al., 2019). This includes significant effects of the plan or program on climatic factors (Stöglehner, 2023b).

Without further specifying the scope and depth of the assessments, the European legal framework for the acceleration of renewable energy (Council Regulation (EU) 2022/2577) strongly emphasizes the role of SEAs in energy planning. According to Article 6 of the EU Acceleration Regulation, the EIA and the assessment of species protection under Article 12 (1) of the Habitats Directive (Council Directive 92/43/EEC) can be omitted if a project is carried out in an area designated for the expansion of renewable energies, provided that this area has been designated for this purpose after an SEA has been carried out (Handig and Rathmayer, 2024). It is therefore important that the SEA adequately addresses all environmental issues that would otherwise have been considered at project level (e.g., CO_2 emissions) and that public participation in the process is ensured (Stangl, 2024).

Nature Impact Assessment

As biodiversity and climate protection are inseparably linked (see Section 1.6.4), the Nature Impact Assessment (NIA) resulting from Article 6 of the Habitats Directive (Council Directive 92/43/EEC) provides an instrument for balancing interests and defining compensatory measures effectively and uniformly in all Member States when expanding renewable energy (Wagner and Ecker, 2019).

The current EU framework for the expansion of renewable energies provides for exemptions from NIAs for renewable energy installations by affirming the overriding public interest in the expansion of renewable energies and allowing compensation for biodiversity losses, while ensuring that the design of compensation areas is consistent with the overall system of EU habitat and species protection law (Handig and Rathmayer, 2024; Stangl, 2024).

Economic instruments for climate change mitigation

Economic instruments encompass fiscal and other economic incentives and disincentives to incorporate environmental costs and benefits into household and firm budgets. They include pricing instruments (e.g., carbon taxes and emissions trading), subsidies and fiscal transfers.

Carbon pricing instruments are used specifically to influence the incentive structures of production and consumption activities. They focus on market interactions and the efficient allocation of scarce resources. In the presence of negative externalities, pricing instruments are theoretically the most efficient policy intervention to internalize negative external costs that would otherwise be borne by the public (Metcalf and Weisbach, 2009; Ellerman et al., 2010; Pigou, 2013). Second order implications, such as distributional or leakage effects, require additional instruments. Economic instruments are increasingly used internationally in climate policy and have proven to be effective (Bayer and Aklin, 2020; Gugler et al., 2021; Koch et al., 2022; World Bank, 2024) (*medium confidence*). However, available evidence shows that the degree of environmental effectiveness varies across sectors and countries, suggesting that a policy mix of pricing instruments and command and control approaches is needed (Haites, 2018; Shmelev and Speck, 2018; Green, 2021; van den Bergh et al., 2021) (*high confidence*).

[10] While the EIA assesses the environmental impact of a specific project (project level), the SEA examines effects of plans and programs on the environment (planning level).

The scope, stringency, coherence and timeframe of the use of economic instruments for climate change mitigation in Austria can be strengthened considerably (COM/2021/555 final; OECD, 2021a; Steininger et al., 2024) (*high confidence*). Also, the menu of readily available and affordable low-carbon substitution possibilities in response to the use of economic instruments is moderate to high as well as steadily increasing due to social and technological innovation.

Implementing economic instruments – in particular carbon pricing in the form of emissions trading or emission taxes – faces trade-offs due to other potentially conflicting policy objectives (e.g., economic competitiveness) and unintended consequences such as negative distributional impacts. Carbon pricing approaches require additional measures to minimize or compensate for these impacts, for which robust strategies exist (e.g., the Austrian 'Klimabonus'). Analyses for Austria (Kirchner et al., 2019; Eisner et al., 2021; Mayer et al., 2021) show the importance of revenue recycling to compensate for the regressivity of carbon taxes (see Section on compensation instruments) (*high confidence*).

Carbon pricing instruments have limits. These can be structural, when flexible response options are not (sufficiently) available (e.g., public transport in rural areas), or informational, when affected actors lack sufficient knowledge about relevant data, such as underestimated total cost of ownership of private cars (Andor et al., 2020), when actors exhibit present bias (Heutel, 2015)[11], or in the presence of principal-agent problems, e.g., between landlords and tenants (Seebauer, 2021), or due to lack of public trust in carbon-pricing mechanisms and general distrust of policy (Ewald et al., 2022). Thus, the presence of other types of market failures beyond externalities requires the use of further specifically designed instruments formed into policy packages (*high confidence*).

Carbon pricing instruments have the advantage of generating revenues that can be used either to mitigate negative impacts on competitiveness or income distribution, or to subsidize investments and research and development (R&D), etc. Both auctioning revenues from ETS and ESR could be substantial sources of public revenue to support just transition and modernization funds, and transparent earmarking could increase public acceptance (Klenert et al., 2018).

[11] Present bias is the tendency to settle for a smaller present reward rather than wait for a larger future reward, in a trade-off situation.

Setting price signals is a normative endeavor with significant distributional impacts and prone to creating resistance from political opponents, incumbent firms or (parts of) the public. This may result in decisions to weaken the stringency of the political intervention (Michaelowa, 1998; Segerson et al., 2024).

Although subsidies can provide important incentives and can result in societal benefits in the case of positive externalities (e.g., R&D, nature conservation) compared to carbon-pricing instruments, they represent a second-best solution. While they are politically easier to implement, they also have several shortcomings – they burden public budgets, the additionality of the funded investments is not ensured, they may have negative distributional impacts; by reducing prices, they may lead to increased production and consumption, and there are significant barriers to subsidy removal, due to the vested interests of beneficiary groups (Michaelowa, 1998; Kärnä et al., 2020; Renström et al., 2021; Heyl et al., 2022; Segerson et al., 2024). Reducing environmentally counterproductive support measures is the other side of the coin and is necessary to correct the pricing of externalities, not only to bring prices closer to the true social cost of carbon, but also to avoid conflicting and inefficient use of several policy instruments (OECD, 2005; Skovgaard and van Asselt, 2018; Elgouacem, 2020; Kletzan-Slamanig et al., 2022). This underlines the dual role of economic instruments, which not only correct externalities, but can also preserve or transform (market) structures (Segerson et al., 2024).

Emissions from the non-ETS sectors (especially buildings and transport) are currently addressed by various types of instruments at EU and Member State level. While the building sector is mainly addressed by regulatory instruments (regional building codes; see Section on regulatory instruments for mitigation), economic instruments like subsidies for thermal renovation and the substitution of fossil heating systems also play a role in combination with incentives provided by energy taxation or exogenously caused energy price increases. In 2027, both sectors will be included in the new emission trading system (ETS 2). GHG and air-pollutant emissions of mobile sources (passenger cars, duty vehicles) are addressed with economic instruments, especially pricing approaches (registration and circulation taxes, mineral oil tax, tolls, parking fees). In addition, investment subsidies and tax benefits for electric vehicles have been increasingly provided in recent years. The combination of various economic instruments for transport is justified by affecting not only the regular use but also investment decisions, thus

compensating the present bias of consumers (Heutel, 2015) and also considering other externalities. Additionally, EU directives regulate fleet fuel efficiencies.

However, the rate of change in the building sector to date has been insufficient, and for the Austrian transport sector the use of economic instruments had no statistically significant impact on GHG emissions (Koch et al., 2022), due to a lack of (effective) regulation, rebound effects overcompensating fuel efficiency gains, and the existence of opposing incentives provided by fossil fuel subsidies and other counterproductive measures (e.g., commuter subsidies, company car taxation). The latter is particularly relevant for aviation, where regulation is either insufficient (inclusion of only intra-EEA flights in the EU ETS, mostly free allocation of allowances, too moderate airline ticket levies) or non-existent (general tax exemption for international aviation for fuels and VAT). Furthermore, efficiency gains have been overcompensated by the continuous growth in air traffic.

Industry and energy generation have been included in the EU ETS since its introduction. Emissions from these sectors in Austria have decreased by 7.2 % between 2005 and 2022 (Umweltbundesamt, 2024), indicating a certain effectiveness of the instrument, at least regarding emissions from energy generation. The price incentive from the ETS was complemented by other policies like energy taxation (albeit with tax refunds for energy intensive industries), subsidies for renewables, energy efficiency and R&D. From 2026 onwards, a new instrument on EU level, the CBAM, will apply a carbon price on emission-intensive goods entering the EU in line with the reduction/phase-out of free allowances in the EU ETS.

In the agricultural sector, the only economic instruments currently aimed at reducing GHG emissions are subsidies for those agri-environmental measures within the Austrian rural development program that have been shown to effectively reduce GHG emissions (Freudenschuß et al., 2010; Foldal et al., 2019; BML, 2024; Kraxner et al., 2024) (*medium confidence*), i.e., greening of arable land, reduced tillage and mulching, reduced application of mineral fertilizer, environmentally friendly and biodiversity-promoting management, and organic agriculture. However, the overall impact of all subsidies in the rural development program may lead to a rebound effect, as they can result in increased production output and consequently higher GHG emissions.

Chapter Box 6.1. Carbon pricing in the EU and Austria

The EU Emissions Trading System (EU ETS)

The EU implemented the EU ETS as its flagship climate policy instrument in 2005 (Directive 2003/87/EC). Initially the scheme only covered CO_2 emissions from energy supply and emission-intensive industry.[12] However, in 2012, it was expanded to include domestic aviation (Directive 2008/101/EC), and by 2027 maritime shipping will also be integrated into the system (Directive (EU) 2023/959). In 2021, the EU ETS covered approximately 38 % of the EU's GHG emissions. In addition to EU members, Norway, Iceland and Liechtenstein have been participating directly in the EU ETS since 2008 (EEA Joint Committee, 2007), and the Swiss ETS has been linked to it since 2020 (European Commission and Swiss Confederation, 2017). The EU ETS is a cap-and-trade system: First, an emission limit ('cap') is set for the regulated entities, and then emission allowances (certificates) are distributed to them, either through free allocation or auction. These allowances must be surrendered to cover emissions and can be traded between entities, which, according to economic theory, leads to least-cost abatement.

The design of the EU ETS has been adjusted several times. While the definition of the cap and the allocation of emission allowances to sectors and installations was initially the responsibility of the Member States, there has been an EU-wide cap and allocation process since 2013. This cap decreases by an annual linear reduction factor, which has been increased twice to reflect the increasing ambition of the EU's climate targets. Moreover, the allocation process has shifted towards auctioning, particularly for the electricity sector. For this sector, allowances are generally auctioned, while emit-

[12] The set of industry activities covered by the EU ETS has increased since 2013. Moreover, in addition to CO_2 emissions for certain activities also other GHGs were included (e.g., nitrous oxides from the production of certain chemicals).

ters in sectors potentially exposed to carbon leakage receive free allocation based on benchmarks. For all other sectors, a mix of free allocation and auctioning applies. In the future, the CBAM will gradually replace free allocation (Regulation (EU) 2023/956). For a long time, the EU ETS was characterized by low allowance prices due to an oversupply of allowances following the economic crisis in 2009. As a result, quantity management provisions (the 'Market Stability Reserve', MSR) have been introduced in the EU ETS to create a stable and continuously increasing price signal (Decision (EU) 2015/1814; Directive (EU) 2023/959). In case of an oversupply of allowances in the market, allowances will be placed in the MSR. If the oversupply does not decrease, these allowances will eventually be canceled. Conversely, in case of a shortage of allowances in the market or if the price increases excessively, allowances are released from the MSR.

The national emission trading system in Austria ('Nationale CO_2-Bepreisung')

To reduce energy-related CO_2 emissions not covered by the EU ETS, 17 European countries have so far implemented carbon taxes (World Bank, 2023b). Austria has, however, followed the approach of Germany and introduced a national emission trading system for these sectors in October 2022 (BGBl. I Nr. 10/2022), in the context of the Recovery and Resilience Facility. As in Germany, the carbon price follows a pre-defined pathway increasing from EUR 30/tCO_2 in 2022 to EUR 55/tCO_2 in 2025. However, in Austria the price is automatically adjusted in case of substantial price fluctuations. This adjustment led to a price of EUR 32.5/tCO_2 in 2023 (instead of the initially planned EUR 35/tCO_2) due to energy price increases caused by the war in Ukraine. In contrast to the downstream approach of the EU ETS, the design of the national ETS follows an upstream approach, which means that the suppliers of fuels will ultimately have to surrender the certificates and pass on the costs to their consumers. As there is no emission cap in place, the national ETS functions like a carbon tax.

For households, revenues from the national ETS are recycled via regionally differentiated lump-sum payments ('Klimabonus'), distinguishing between four types of regions according to the quality of public transport and settlement density.[13] For companies, hardship and carbon leakage provisions apply. Agriculture is currently exempt from the national ETS. In 2027, the national ETS will be replaced by a newly established European emissions trading system ('ETS 2') covering energy-related CO_2 emissions from transport and buildings as well as from energy supply and manufacturing not covered by the EU ETS.

[13] In 2023, adults received a payment between EUR 110 and EUR 220. In 2022, all adults (independently of their area of residence) received payment of EUR 250 to also compensate for the strong energy price increases. Children receive(d) half the amounts of adults.

Other policy instruments for climate mitigation

Information instruments

Information-based instruments address the consumption side of mitigation and aim to support consumers in making sustainable choices (Jordan et al., 2013; van den Bergh et al., 2021). They include labels, education, ratings, rankings, and campaigns.

Environmental labeling and information schemes (ELIS) are a set of instruments aiming at 'empowering' consumers by providing information on the environmental impacts of products and services (Gruère, 2013; Klintman, 2016). ELIS in Austria are largely harmonized with EU and OECD standards and with the International Organization for Standardization (ISO) 14020 series of labeling standards. Many ecolabels have an implicit link to climate mitigation (organic agriculture, wood and fiber sourcing, etc.), but there are few (if any) third-party ecolabels in Austria certifying a low carbon-footprint. Recently, first-party claims of climate neutrality by companies have mushroomed and increasingly face accusations of 'greenwashing' or 'carbonwashing' (In and Schumacher, 2021; Kubat and Tokić, 2024) (*high confidence*).

Beyond organic farming, which is based on an EU regulatory framework, evidence of environmental effective-

ness of ecolabels is scarce (Meis-Harris et al., 2021). Recent NGO criticism blamed eco-certification schemes of being weak, ineffective and in some cases fraudulent (Vogt, 2019; Greenpeace International, 2021). Ecolabels typically generate market niches, but do not contribute to transforming the respective market segment as such. A general criticism of information-based instruments is that they help create sustainable options, but do not eliminate unsustainable ones (Hausknost, 2014; Bärnthaler, 2023).

Government-sponsored mandatory climate score labeling schemes have been proposed as a more effective alternative to voluntary labeling (Lemken et al., 2021). However, this would cross the line to being a regulatory instrument. Overall, evidence suggests that substantial changes in consumption-based emissions and individual behavior will require regulatory frameworks and strong public policies rather than reliance on voluntary labeling (Dubois et al., 2019).

Behavioral instruments

Behavioral public policy, as understood here, includes all means and modes of public policy aimed at influencing human behavior by using insights from behavioral economics, behavioral sciences, psychology or neurosciences (Straßheim, 2020) (see Section 5.3.1). Nudges are the most prominent type of behavioral public policy. Nudging has been criticized for targeting individual behavior only, and for neglecting the societal determinants of choice (Mock, 2023). Understanding (market) behavior as 'social practice' that is embedded in and constrained by societal structures suggests the need for policy instruments that intervene in these structures (rather than addressing individual behavior) and, as a result, "restrict or eliminate choice" (Mock, 2023, p. 381) where necessary. Examples include the reduction of automobile-centered infrastructure and the sustainable reorganization of interconnected social domains like work, housing, education, and food. This category also includes regulatory experiments, which are "an instrument which deliberately deviates from the existing regulatory framework to try out new rules in a real-world setting" (Bauknecht and Kubeczko, 2024, p. 45). The idea is to create a legal free space in which new ways of regulating technological and social innovations can be tried out. This can take the form of 'regulatory sandboxes' that provide legal exemptions to experiment with new ways of doing things, or of 'regulatory innovation experiments' that aim to adapt an existing regulatory framework to new societal (and technological) challenges. In Austria, an example of the latter is the *Energy.Free.Room* program created by the BMK (Bovera and Lo Schiavo, 2022). For the European energy sector, the EU has published a *state of play of regulatory experimentation in the EU* (Gangale et al., 2023). In Germany, the planned *Real-world Laboratory Act* (BMWK, 2023) aims to provide a legal basis for experimenting with new approaches. Regulatory experimentation could be a crucial instrument for expanding and mainstreaming niche innovations, but also for adapting existing regulatory frameworks more quickly to the challenge of the climate crisis.

Enabling instruments

Enabling instruments aim to facilitate the transformation of social practices by providing the respective material, organizational and legal infrastructures for new ways of doing things (e.g., recycling schemes, new legal forms of shared ownership or use of products and utilities) (Grubb et al., 2020). Enabling instruments are essential for experimenting with and implementing social innovations and structures for climate-friendly living (APCC, 2023).

Instruments compensating negative distributional effects of climate policies

The necessity of compensation measures is mostly addressed in the literature regarding the introduction or increase of environmental taxes in general and carbon taxes in particular, which are often shown to be regressive in high-income countries, particularly when electricity and heating are taxed (less regarding fuel taxes) (*high confidence*). Such compensation measures aim to mitigate undesirable distributional effects of climate mitigation measures, which has also been shown to be an important determinant of their public acceptance (see Köppl and Schratzenstaller (2023) for an overview of recent empirical research regarding carbon taxation). Regulatory and planning instruments will also have distributional impacts that may require compensation measures (*limited evidence, high agreement*).

The section is based on empirical findings for Austria regarding the incidence of the burden of climate measures (Kirchner et al., 2019; Eisner et al., 2021; Kettner-Marx et al., 2021; Mayer et al., 2021; Six and Lechinger, 2021; Budgetdienst des Österreichischen Parlaments, 2022) and regarding the effects of potential compensation measures for Austria (Kettner et al., 2024). Simulations of social-ecological tax reform scenarios in Austria confirm, on the one hand, that carbon pricing can contribute to reducing CO_2 emissions,

spur renewable energy use and improve energy efficiency (*medium evidence, high agreement*). On the other hand, this literature confirms a trade-off between equity and efficiency with respect to revenue recycling (see Table 6.3) (*medium evidence, high agreement*): Reducing labor costs increases GDP and employment, but does not increase low household incomes or improve equality. The opposite is true for lump-sum payments. One potential compensation measure not considered in Table 6.3 are green vouchers. Their distributional effect is likely similar to that of direct payments, but may reduce potential rebound effects better (Büchs et al., 2021). Currently, no study exists that assesses the impact of using carbon tax revenues for green vouchers for Austria.

In its 2022 social-ecological tax reform, the Austrian government has opted for lump-sum payments ('Klimabonus') to compensate households for the introduction of the national ETS. These per capita climate bonus payments do not differ according to household income but according to the region of residence (with the exception of the first year, 2022, when all adults received equal payments of EUR 250 to also compensate for the strong increase in energy prices due to the war in Ukraine); children receive half of the payments of adults (BGBl. I Nr. 10/2022; BGBl. I Nr. 11/2022).

In addition to studies focusing on carbon pricing, there is a growing literature on compensation measures regarding housing and increasing energy prices in general, with a particular focus on energy poverty. Interestingly, not much research in this area seems to be currently available for the sector of private mobility.

Regarding the housing sector, most research focuses on how to mitigate burdens on energy poor or low-income households (see also Section 5.6.3). While many compensation measures exist in the housing sector such as financial interventions, energy efficiency programs, consumer protection and information (Pye et al., 2017), research highlights the challenge of financing retrofits and/or energy efficiency measures and the impact of these measures on energy use and energy poverty (Berger and Höltl, 2019; Seebauer et al., 2019; Bertoldi et al., 2021; Bourgeois et al., 2021; Seebauer, 2021; George et al., 2023). There is agreement on the need for compensation measures that can alleviate the burden of both upfront costs, financing costs and the tenant/landlord dilemma (*medium evidence, high agreement*). Studies show that targeting energy poverty may require (i) public funding schemes that operate at the building level (to avoid displacement) and focus on energy-inefficient buildings with households at poverty risk (Berger and Höltl, 2019); (ii) addressing the tenant/landlord dilemma by implementing personalized support, limiting tenant's back payments for renovation measures, higher subsidies for retrofitting measures for buildings with poor households, and a better coordination of climate change initiatives to target energy-poor households (Seebauer et al., 2019; George et al., 2023); and (iii) combining a polluter-pay principle with an ability-to-pay approach for low-income tenants (Seebauer, 2021).

The recent increase in energy prices, especially for natural gas, due to the war in Ukraine has resulted in numerous compensation measures in Austria and other European

Table 6.3 Effects of carbon pricing with different compensation mechanisms in Austria.

SDG-Targets	No compensation	Direct payment (dividend)	Reduced value added tax		Reduced labor costs	Investments for climate mitigation	Multiple compensation measures[1]	
13.2 Reduced CO_2 emissions	[6], [8]	[2], [3], [5], [4], [6]	[4], [5], [6]		[5], [6]	[3], [7]	[1], [2], [3], [8]	
7.2 Renewable energies	[6]	[6]	[6]		[6]	[7]	No data	
7.3 Energy efficiency	No data	No data	No data		No data	No data	No data	
8.1 Economic growth	[6], [8]	[3], [4], [5], [6]	[4]	[5], [6]	[5], [6]	[3], [7]	[1], [2], [3], [8]	
8.5 Employment	[6], [8]	[3], [5], [6]	[6]	[5]	[5], [6]	[6]	[1], [2], [3]	[8]
10.1 Income of low-income households	[6]	[2], [4], [5], [6]	[4]	[5], [6]	[5], [6]	No data	[2]	
10.4 Increase equality	[6]	[2], [4], [5], [6]	[4]	[5], [6]	[5], [6]	No data	[2]	

Evaluation scheme: Strong negative | Medium negative | Weak negative | Neutral | Weak positive | Medium positive | Strong positive

[1] Multiple compensation measures refer to comprehensive climate mitigation packages

Sources: Authors' own visualization based on [1] Goers and Schneider (2019); [2] Großmann et al. (2019); [3] Großmann et al. (2020); [4] Mayer et al. (2021); [5] Kettner et al. (2024); [6] Kirchner et al. (2019); [7] Kratena and Schleicher (1999); [8] Schneider et al. (2010).

countries. For Austria, Kettner et al. (2023) show that most of the implemented compensation measures have negative effects on climate mitigation, especially those that directly reduce energy prices. Only energy efficiency subsidies, investment subsidies for energy independence and support of climate-friendly mobility show synergies between climate protection and mitigating social burdens. A study by Baumgartner et al. (2022) recommends compensation measures that have synergies with climate mitigation, i.e., investment subsidies for building retrofits and heating boiler exchanges, alternative energy supply and energy use (e.g., anergy, geothermal), promotion of public transport and active mobility, town center revitalization, and energy efficiency subsidies. Baumgartner et al. (2022) argue that the Austrian commuter allowance should not be increased to avoid disincentives.

6.5.2. Adaptation instruments

Regulatory instruments for climate change adaptation

Article 5 of the European Climate Law requires the European Commission and the Member States to develop strategies for adaptation to climate change. Member States must adopt national adaptation strategies and implement them (Handig and Stangl, 2023). Every five years, starting in 2023, the European Commission will assess the compatibility of national measures with the integrated national energy and climate plans and the biennial progress reports to be prepared under the Governance Regulation (Regulation (EU) 2018/1999).

The Austrian Climate Protection Act only refers to adaptation issues in § 4 (2): The National Climate Protection Committee shall, among other things, advise on adaptation to the unavoidable consequences of climate change (Ennöckl, 2023b). Otherwise, only a few areas of law explicitly address adaptation to climate change (Bertel, 2023, 2024).

In 2024, the BMK published the third Austrian Strategy for Adaptation to Climate Change (BMK, 2024a). The document provides a framework for adaptation policy in 14 fields of activity: Agriculture, forestry, water balance and water management, tourism, energy (with a focus on the electricity sector), construction and housing, protection against natural hazards, disaster management, health, ecosystems and biodiversity, transport infrastructure including mobility aspects, spatial planning, economy, cities (urban open and green spaces). Recommendations for action to achieve climate change adaptation are given for each area of activity. However, these are hardly reflected at the legal level. Only in exceptional cases does legislation take climate change adaptation into account. Legal research on adaptation issues is also scarce.

One example, relevant for certain projects in the Non-ETS and ETS industries, energy supply and transport sector, is the EIA Act. According to § 6 (1) and § 3 (5), the environmental impact declaration or individual decision of the competent authority must consider a project's vulnerability to the impacts of climate change, especially due to its location (Baumgartner and Niederhuber, 2023). Also, the Water Act obliges the competent authority to include the projected impacts of climate change on the occurrence of floods in its flood risk assessments and flood risk management plans.

Furthermore, some legal provisions at national or federal state level address climate change adaptation in their objectives, e.g., stating that in order to maintain an economically healthy, efficient and comprehensive agricultural and forestry sector in a functional rural area, adaptation to climate change should be taken into consideration according to § 1 (1) Agricultural Act (BGBl. Nr. 375/1992), or that the effects of climate change on electricity supply should be taken into account by appropriate measures as stated in § 1 (3) of the Vienna Electricity Sector Act (LGBl. Nr. 46/2005). § 37 (1) of the Burgenland Spatial Planning Act (LGBl. Nr. 49/2019) further specifies that shopping centers and supermarkets shall be designed to meet the requirements of climate change mitigation and adaptation.

According to the Austrian Adaptation Strategy, measures should be implemented in the transport and energy sectors to strengthen the resilience of infrastructure to the impacts of climate change and to ensure security of supply, e.g., by incorporating adaptation requirements into the relevant regulatory framework. In the building sector, legislative changes are also needed to ensure the consideration and integration of adaptation requirements in the relevant regulatory frameworks. This includes, e.g., amendments to tenancy, heritage and residential property laws to facilitate the transformation of existing buildings.

Planning instruments for climate change adaptation

Spatial planning law and building regulations as well as disaster control law contain provisions relevant to climate change adaptation, as they provide a legal framework for natural disaster scenarios (e.g., floods, droughts, debris flows), establish warning systems or risk zones (Stöglehner, 2023a, 2023b). However, most legal provisions do not ex-

plicitly mention climate change adaptation, nor do they currently emphasize the impacts of climate change.

The Austrian Adaptation Strategy proposes a stronger integration of water management planning and water demand into spatial planning for the purpose of adaptation. Such a proposal has not yet been taken up.

Equally important in terms of this strategy is the planning of ecologically significant open spaces (near-natural spaces, habitat corridors) and the anchoring of cold air corridors in spatial planning.

Introducing a mandatory Nature and Climate Impact Assessment for all legal acts with regard to the adaptation and mitigation goals would contribute to ensuring that climate change adaptation is taken into account in all new laws within the framework of the above-mentioned fields of action (Wagner et al., 2021).

Economic instruments for climate change adaptation

Economic instruments to promote climate adaptation include market-based instruments (i.e., monetary incentives such as taxes, subsidies or permits), as well as financial and risk-financing instruments. Instruments that have been identified by Bräuninger et al. (2011) as being suitable for climate adaptation include land use taxes to reduce the vulnerability from sealed soil or guarantees to reduce borrowing costs for mitigation measures. Agrawala et al. (2008) focus on insurance, environmental markets and public-private partnerships as viable options to incentivize private action for adaptation. Economic instruments can play an important role and complement and reinforce existing instruments for land use planning and flood protection (Filatova, 2014; Ackerschott et al., 2023). A particular role is played by risk financing instruments, which do not tackle adaptation directly, but pool risks with the aim of redistributing direct losses (e.g., from flooding) and reducing consequential losses such as bankruptcy. A challenge for the use of market-based economic instruments for adaptation is the definition of measurable and tangible adaptation units (such as 'saved wealth' or 'saved health' as proposed by Bräuninger et al. (2011)).

Other policy instruments for climate change adaptation

In contrast to mitigation, adaptation policy instruments typically do not address individuals as consumers or private decision-makers outside their professional roles. Therefore, the market-related categories of information and behavioral instruments do not apply to adaptation in the same way. In Austria, adaptation measures strongly rely on public action regarding initiation, financing and implementation, and mostly address public authorities, industry actors and practitioners (Knittel and Bednar-Friedl, 2016). At the same time, adaptation measures tend to be voluntary and weakly institutionalized, lacking binding rules of implementation (Clar and Steurer, 2019).

Academic literature increasingly emphasizes that adaptation can no longer be understood as an isolated policy objective, but that the adaptation and transformation of societies are deeply interlinked (Mach and Siders, 2021; Werners et al., 2021; Fekete et al., 2022). Climate change is already beginning to transform the socio-economic structure of Austria, e.g., winter tourism is losing ground as the economic backbone of alpine provinces, and agriculture and forestry are experiencing increasing transformational stress. Adaptation, conceived as an attempt to adjust the status quo to a changing climate, may reach its limits once losses and damages undermine human well-being beyond the local level (Mechler et al., 2020; Schinko et al., 2022). There is a lack of policy instruments reflecting the need for comprehensive and transformative climate risk management in response to a rapidly changing alpine and lowland climate (Schinko et al., 2022) (*high confidence*).

Researchers have proposed some ideas to strengthen the effectiveness, scope, reach and depth of adaptive measures in Austria and their transformative potential:

- The establishment of a 'National Climate Risk Council' to create missing decision-making structures (Leitner et al., 2020)
- The extension of the Austrian Disaster Fund ('Katastrophenfonds') to include private sector anticipatory adaptation (Leitner et al., 2020)
- The strengthening of participatory adaptation instruments, including participatory budgeting, which has yielded successful adaptation measures in Vienna (Thaler and Seebauer, 2019; Ahn et al., 2023)
- Greater reliance on nature-based solutions (including restoration and protection of ecosystem functions) (Dubo et al., 2022; Schinko et al., 2022; Turner et al., 2022)

6.5.3. Climate Policy Integration

Climate policies are more effective when they are part of policies in the respective policy fields (e.g., agriculture, trans-

port, buildings) than when they are separate policies. Climate Policy Integration (CPI) is primarily concerned with the integration of climate change into all policy areas (Adelle and Russel, 2013). Four different categories of analysis have been identified for CPI: (i) normative CPI, (ii) CPI as a process of governing, (iii) CPI as a policy outcome (Jordan and Lenschow, 2010), and (iv) CPI through reflexive learning, given that diverging interests – which need to be acknowledged – and the often contentious nature of politics and the fragmented nature of the polity (i.e., political institutions) require complex processes to enable CPI (Plank et al., 2021) (see Section 6.2). The CPI label, however, risks glossing over this conflictual nature of substantive decarbonization, as has been shown in the literature for Austria and the EU (Kettner and Kletzan-Slamanig, 2018; Niedertscheider et al., 2018; Plank et al., 2021) (*high confidence*).

Social science literature shows that coherent climate policies face a structurally fragmented apparatus, which formulates and implements policies, as well as competing policy targets and often unsustainable policies. Therefore, climate policy integration is much more a question of political priorities and power than of well-designed policies (see Sections 6.2 and 6.4).

With regard to climate mitigation, Austria's federal structure has been identified as a factor hindering CPI (Steurer and Clar, 2015; Steurer et al., 2020) (see Section 6.4.1), with the challenge of vertical coordination compounding the already difficult challenge of horizontal CPI. Successful CPI requires the institutional prioritization of decarbonization as an overarching policy goal, for example by elevating climate protection in a constitutional framework or introducing climate protection as a human right.

No analyses of CPI in the context of adaptation in Austria are available so far. However, a mapping of adaptation governance for Switzerland (Braunschweiger et al., 2018) shows that while strategic decisions and funding are usually located at the federal level, the actual implementation takes place at the regional or local level, underlining the common division of labor in multi-level governance systems.

Using the national adaptation strategy as a framework, all federal provinces have developed regional adaptation strategies following a dialogue process and the involvement of federal province's representatives in the development of the national strategy. The implementation of adaptation measures, however, is not obligatory or mandated by law. Thus, policy-making for adaptation involves to a large extent informal, cooperation-oriented, 'soft' governance modes and coordination formats, and vertical cooperation or the adherence of stakeholders to non-binding agreements (Probst et al., 2019). Actual implementation seems to be particularly driven by problem pressure, i.e., experienced climate change impacts, rather than governance arrangements (Clar and Steurer, 2019).

6.5.4. Integrative perspective on Austria's climate policy instruments

Austria's official emission scenarios (Umweltbundesamt, 2023a, 2023b) show that the country's climate neutrality target for 2040 cannot be achieved through existing and currently planned policy measures alone. This illustrates the need for comprehensive policy mixes and that climate issues must be mainstreamed across all policy areas to enhance effectiveness of climate policy. Achieving this requires attention to the interactions and overlaps among various measures (*high confidence*) (see Section 6.5.3). With the window to reach the Paris Agreement goals rapidly closing, climate governance and policy must prioritize not only the objectives of (technological) innovation, but also the goals of 'exnovation', that seek to rapidly phase out fossil-based technologies, products and practices (David, 2017; Davidson, 2019). Austrian climate governance to date is mainly oriented on adding sustainable technologies to an unsustainable structure, rather than implementing a targeted strategy of 'creative destruction' (Kivimaa and Kern, 2016) (see Section 6.5.1). This points to a lack of transformative ambition within the current Austrian climate governance, which is further highlighted by the absence of sufficiency instruments that could avoid energy and resource demand by transforming provisioning systems (Zell-Ziegler et al., 2021; Jarre et al., 2024; Brad et al., 2025) (see Section 6.5.1).

The preceding sections assessed low hanging fruits, challenges, and barriers for Austrian climate policy from an interdisciplinary perspective. Achieving targeted climate action calls for balancing various policy objectives, in particular effectiveness, justice, and efficiency.

6.6. Climate policy litigation

Climate policy litigation denotes legal remedies aimed at obliging the state and/or corporations to reduce GHG emissions. These lawsuits often aim not only to achieve legal success in court, but also to raise public awareness and initiate political developments to strengthen efforts in climate change mitigation (Fitz, 2023b). So far, in Austria there has

been a clear focus on lawsuits against the state, a recent example being the case of twelve children and adolescents who invoked their constitutional children's rights.

6.6.1. Human rights, climate lawsuits and environmental proceedings

The Austrian constitution does not explicitly refer to climate change or climate protection (Ennöckl, 2023a). However, comprehensive environmental protection forms a state objective[14], and there is widespread agreement that climate protection is covered by this provision. The legal consequences of this state objective are still controversial (Kirchmair and Krempelmeier, 2023), culminating in the much-criticized decision of the Constitutional Court, which qualified the refusal of a permit for a third runway at Vienna's airport on the grounds of climate protection as arbitrary and unlawful (Madner and Schulev-Steindl, 2017; Merli, 2017). Moreover, human rights, as enshrined in the Austrian constitution (e.g., the right to life and the right to respect for private and family life), oblige the state to take sufficient measures to protect humans from the consequences of climate change, as the European Court of Human Rights confirmed in a lawsuit against Switzerland (Ennöckl et al., 2024; Hofer, 2024b; Hollaus, 2024) (*high confidence*).

To date, the Constitutional Court has not ruled substantively on the existence and scope of positive state obligations regarding climate change. Most lawsuits failed on formal grounds. Moreover, the court ruled that there was no constitutional claim for issuing an ordinance regarding a ban on sales of fossil fuels and heating oil (Gärner et al., 2023). Due to the high formal hurdles for filing a climate-related lawsuit, there is a deficit in legal protection under the Austrian constitution that may violate the European Convention on Human Rights (Hofer, 2024b; Hollaus, 2024) (*high confidence*). A pending case with potentially far-reaching consequences is Müllner vs. Austria before the European Court of Human Rights, in which a person with multiple sclerosis is demanding climate protection on the grounds that their disease symptoms increase with rising temperatures.

The right to participation in environmental proceedings according to the Aarhus Convention, especially for NGOs, has – despite the 'Aarhus-Beteiligungs-Gesetz' from 2018 – not yet been fully implemented in the Austrian legal framework, both at the level of administrative proceedings and in court trials (Handig, 2023). The question arises as to whether and by whom deficits in climate protection can be claimed against the state in general and in individual procedures for the approval of GHG-intensive projects. So far, climate change as a public interest (Üblagger, 2024) has mostly gained importance in administrative and judicial decisions on the expansion of renewable energy, when balancing different public interests affected by a renewable energy project, e.g., the construction of wind turbines.

6.6.2. Climate liability

The goal of so-called private climate lawsuits is to hold private CO_2 emitters liable for their climate-damaging behavior. The private plaintiffs base their claims on their legal rights to life, health and property, which are also guaranteed as human rights. Under the current legal system, such actions are admissible as actions for injunctive relief and damages (Wagner, 2023). However, the success of such actions depends on the requirement of causality (Burtscher and Spitzer, 2017). The action for damages also needs an allegation of unlawful conduct on the part of the CO_2 emitter (Perner and Spitzer, 2021). To facilitate litigation by private injured parties, the previous obstacles to actions for damages and injunctions against climate-damaging conduct need to be overcome by presuming causality, allocating responsibility among polluters in the case of proportional liability, and establishing a climate-related right of action for associations (Wagner, 2018, 2019, 2023; Burtscher and Schindl, 2022; Wallner, 2023; Rabl, 2024).

6.7. Budget, green public finances, investments and cost of (in)action

6.7.1. Investments for climate mitigation and adaptation

So far, only few studies have addressed the necessary (additional) investment costs for the transformation towards a carbon-neutral society (Gupta et al., 2014; Kreibiehl et al., 2022), and most of them focused exclusively on energy investment requirements (McCollum et al., 2018). Nevertheless, there is agreement that large investments (i.e., capital expenditures – CAPEX) are required to meet the 2030, 2040 and 2050 climate mitigation goals (*limited evidence, high agreement*). Notably, while this will require a substan-

[14] A state objective guides and binds the legislative and the executive, but it does not establish individual rights.

tial increase in additional investments, a large share will come from the reallocation of investments, i.e., away from fossil fuels towards renewables (Gupta et al., 2014; Riahi et al., 2022). Investments for climate mitigation are needed in all economic sectors and will need to target both infrastructure (e.g., the electricity grid, district heating, buildings, railways, bicycle lanes, and industrial installations) and technologies (e.g., renewable energy sources such as wind and photovoltaics, heat pumps, electric vehicles, and insulation), as well as R&D and education (Gupta et al., 2014; Kreibiehl et al., 2022). One of the most recent studies on additional investments for decarbonization in Europe, published by Institut Rousseau (2024), estimates that additional annual investments amount to about 2.3 % of European annual GDP until 2050; one important provision is that current fossil investments must be shifted to decarbonization.

Based on the Transition 2040 scenario, sectoral investment costs for climate neutrality and additional cost compared to already required legislative measures and replacement investments were estimated. The results reflect the high investments required in the energy, building and transport infrastructure, from which climate measures cannot be separated. However, the additional investments for climate neutrality are much lower than the total ones (Krutzler et al., 2023; Umweltbundesamt, 2023c). The estimated costs up to 2030 to achieve the Fit for 55 goals for Austria are reported in the National Climate and Energy Plan (NECP) (BMK, 2024b). The estimated costs up to 2040 and 2050 for the WAM NECP are reported in Krutzler et al. (2024).

For Austria, based on the Transition 2040 scenario, there is a recent estimate of the costs of achieving carbon neutrality (Weyerstraß et al., 2024). Additional costs (compared to a baseline scenario without additional measures, i.e., only with existing measures and policies) may amount to EUR_{2023} 6.2–10.9 billion/yr, for the period 2024 to 2040 (see Figure 6.1). This corresponds to about 1.3–2.3 %/yr of the Austrian GDP of 2023 (Weyerstraß et al., 2024). A previous study estimated the total investment potential and gap from 2022 until 2030 on the path to climate neutrality at EUR 169.7 billion (Miess et al., 2022). This corresponds to additional annual investments until 2030 of about 3.6–4.8 % of the Austrian GDP, inducing annual value-added effects between 2–2.7 % of GDP as well as creating and securing between 60,000 and 80,000 jobs annually. This estimate, based on transformation assumptions for all energy sectors, considers the largest investments until 2030 in the energy, building and mobility sectors. Industry enters the transformation process with comparably low investments, which means that most investments in the industry sector will follow after 2030 and towards 2040 and 2050 (Miess et al., 2022). For all sectors and the energy system it is important that climate-neutral and renewable energy becomes cheaper than fossil energy (*robust evidence, medium agreement*).

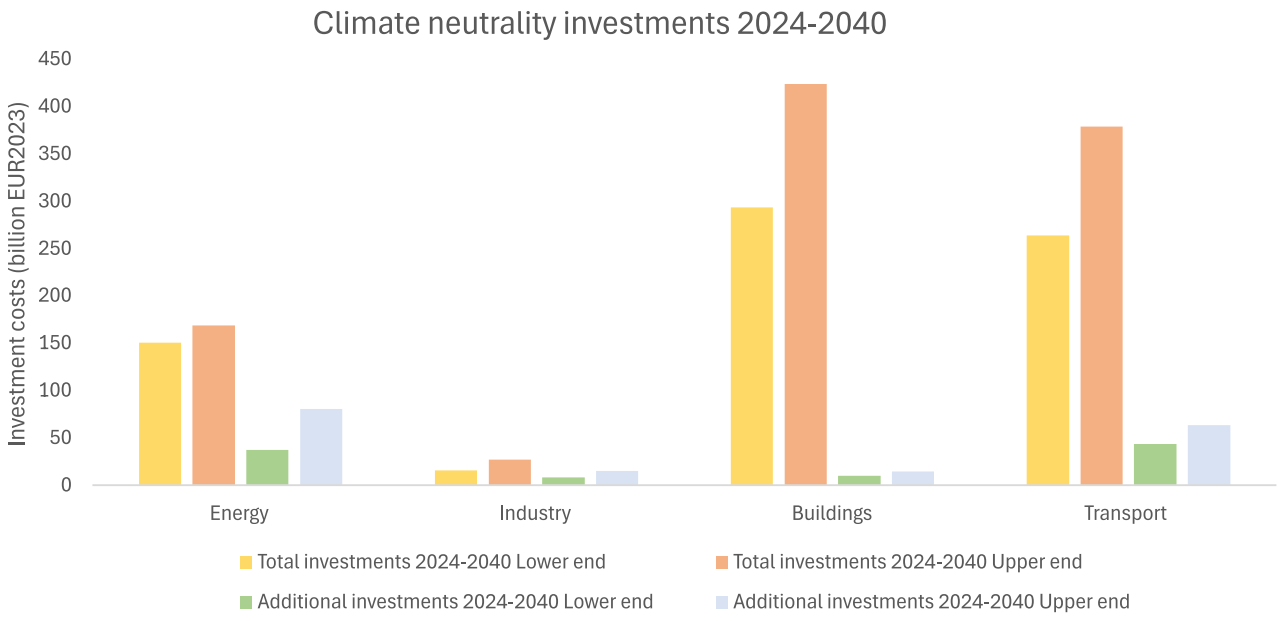


Figure 6.1 Expected investment costs for climate neutrality 2040 per sector (Source: Umweltbundesamt, 2023, in Weyerstraß et al., 2024).

A substantial share of additional investments will be made by the governments at different levels, or by public enterprises. Bröthaler et al. (2023) find that, until 2030, the Austrian government can make direct green investments between approximately EUR_{2023} 80 billion (conversion scenario) and EUR_{2023} 138 billion (expansion scenario – in line with the Transition 2040 scenario, especially for the energy sector) through specific decarbonization of the public capital stock and thus directly contribute to achieving climate neutrality in Austria. Compared to a baseline scenario, the government, including public enterprises, could directly make additional annual investments of between EUR_{2023} 5.4 billion (1 % of GDP) and approximately EUR_{2023} 12.6 billion (2.4 % of GDP) to contribute to a carbon-neutral Austrian economy and infrastructure.

A recent study by Schützenhofer et al. (2024) finds that the transformation of Austrian industries (iron and steel, mining, quarrying and glass, chemical and petrochemical products, paper and printing, wood products, food products, construction, vehicle construction) to meet Austria's climate targets in 2040 requires a total investment between EUR_{2023} 17.4 and 24.4 billion for the period 2025–2040. Investment volumes depend on the assumed scenarios. A focus on circular economy and thus secondary production requires the lowest investment volumes, while a focus on innovation, e.g., best-available and break-through technologies, requires the highest investment volumes.

Investments for climate adaptation will also be required to minimize damages from future climate change impacts that we are already committed to. For example, infrastructure will need to be made more resilient to extreme weather events (e.g., adjusting flood level protection levels) and suitable technologies implemented or developed to cope with ongoing climatic change (e.g., irrigation systems to better deal with drought spells, sowing of crop varieties and trees that are better suited to future climatic conditions). Finally, divesting from stranded assets (e.g., crude and refined oil or natural gas production) is a challenging but necessary requirement for achieving climate mitigations goals.

The macroeconomic effects of green investment are also of interest (see the emerging literature on green multipliers; for an overview see Köppl and Schratzenstaller (2022)).

6.7.2. Cost of (in)action

Climate inaction entails costs and future financial risks for private actors and public budgets as well as for the economy as a whole. The total costs of climate inaction already incurred today as well as future (budgetary) risks cannot be precisely and comprehensively quantified for Austria due to missing data (particularly for the subnational levels), uncertainties regarding future international developments (e.g., regarding climate-induced international migration; see Section 6.8.2) and the further progress of global warming, and because of measurement and valuation issues, particularly related to non-economic aspects (e.g., with regard to the recreational value of forests, biodiversity, or quality of life) (Parrado et al., 2021; Schiman-Vukan, 2022; Zenios, 2022; Klusak et al., 2023). Although data and estimates are incomplete and sparse, available analyses suggest that costs of climate inaction for Austria are already substantial today and are expected to increase in the coming decades (Steininger et al., 2020; Köppl and Schratzenstaller, 2024a) (*limited evidence, high agreement*). Obviously, only a part of these costs and future (budgetary) risks can be mitigated through policy measures by the Austrian government.

Climate change related damages, caused by extreme weather events and climate conditions as well as negative consequences of climate change for energy supply and public health, are estimated at currently EUR_{2019} 2 billion on average per year and are expected to increase to at least EUR_{2019} 2.5–5.2 billion/yr by 2030 and to EUR_{2019} 4.3–10.8 billion/yr by 2050 (Steininger et al., 2020). The European Environment Agency (EEA) estimates cumulative damages through extreme climate and weather conditions in Austria for the period 1980–2021 at EUR_{2019} 12.4 billion/yr. As of today, property insurance risks through weather hazards are estimated at 0.25 % of GDP by the Swiss Re Institute (Bannerjee et al., 2024). According to simulations by Bachner and Bednar-Friedl (2019), under a medium scenario of 2°C global warming by 2100, Austrian GDP will be reduced by 0.2 % annually until 2050. Gugele et al. (2022) and Schiman-Vukan (2022) estimate that climate change will reduce productivity by 0.05 % annually until 2050. Austria's overall – i.e., public and private – contributions to international climate finance reached EUR 398 million on average for 2021 and 2022 (BMK, 2022). Another cost factor for the overall economy are net imports of fossil energy, which amounted to a yearly average of EUR 9 billion in the period 2010–2021 and jumped to EUR 10.7 billion in 2023, illustrating the vulnerability of the Austrian economy due to its high dependency on fossil fuel imports. Moreover, privately as well as publicly owned fossil firms are exposed to substantial financial risks through stranded assets, for which no estimations exist.

Existing estimates point at considerable direct and indirect climate-related costs and future risks for public budgets

(Köppl and Schratzenstaller, 2024a) (*medium evidence, high agreement*). Bachner and Bednar-Friedl (2019) estimate annual climate adaptation expenditures by the federal government of EUR 1.1 billion for 2014–2020, which in a medium scenario of global warming will grow to a EUR 1.68 billion/yr from 2021–2030 and to EUR 2.338 billion from 2031–2050. Of the cumulative damages related to extreme climate and weather events estimated by the EEA for 1980–2021, EUR 9.4 billion (75.8 %) were not insured, so that it can be assumed that at least part of them would have had to be compensated by the government. In this context, it is highly relevant that the Austrian public sector focuses on ex-post compensation payments for private actors or subnational jurisdictions affected by damages through extreme weather events, instead of providing incentives for more formalized insurance arrangements, which could lead to lower and more predictable ex-post compensation payments for the public purse (Sinabell and Url, 2006; Unterberger et al., 2019). Bachner and Bednar-Friedl (2019) estimate an increase of public disaster management expenditures by 184 % (EUR_{2019} 547 million) until 2050. Based on the projection of GHG emissions by Gugele et al. (2022), Austrian emissions will be reduced by 30 % compared to 2005. On the new burden-sharing reduction goal of 48 %, Schiman-Vukan (2022) estimates overall expenditures for emission certificates of EUR_{2022} 4.7 billion for the period 2021–2030 and an annual average of 0.2 % of GDP after 2031. Average public contributions to international climate finance reached EUR_{2022} 327 million on average for 2021 and 2022 (BMK, 2022). Assuming the average yearly growth rate of these contributions between 2013 and 2020, which amounted to 10.2 %, Austria's public contributions will increase to EUR_{2023} 658 million by 2030 (Köppl and Schratzenstaller, 2024b). Climate counterproductive permanent public subsidies are substantial (*limited evidence, high agreement*). Kletzan-Slamanig et al. (2022) estimate climate counterproductive public subsidies at EUR_{2019} 4.1 to 5.7 billion annually on average during the past few years. Klusak et al. (2023) estimate that deficits in climate resilience and vulnerability to climate change will decrease the rating of the Republic of Austria by 1.16 notches by 2100, which would increase interest rates and therefore spending related to public debt by EUR_{2023} 204 to 296 million/yr in a medium scenario limiting global warming to 2°C. The estimated climate change induced decrease of GDP by 0.2 %/yr until 2050 entails a yearly reduction of tax revenues by 0.3 % and an increase of unemployment payments by EUR_{2018} 618 million (10.6 %) according to simulations by Bachner and Bednar-Friedl (2019). Not least, migration into Austria induced by climate change will put additional strain on public budgets; however, estimates for the potential additional public spending are not available (ACA, 2021).

Part of these (future) costs of climate inaction and climate change can be influenced by Austrian policy. The expansion of renewables reduces the dependence on and the cost of fossil fuel imports. By reaching the Austrian climate goals, public expenditures for emission certificates can be avoided; many climate-counterproductive subsidies can be influenced by the Austrian government; and by making the Austrian economy more climate resilient, an increase of interest rates for public loans can be avoided.

6.7.3. Greening public finances in Austria

The public sector plays an important role in advancing the green transformation (see Figure 6.2) (*high confidence*). In Austria, a federalist country, the relevant governmental actors are the federal government, the federal provinces, and the municipalities.

At the federal level, various implementation and monitoring mechanisms supporting the greening of public finances have been adopted recently. In 2021, the Action Plan Sustainable Public Procurement of 2010 was updated and reinforced to reorient public procurement, which accounts for about 18 % of GDP in Austria on average in the period 2015–2020 (Klien et al., 2023) and for about 19 million tons (5.6 million tons) of GHG emissions worldwide (in Austria), towards the SDGs. The Action Plan complements and reinforces the Federal Public Procurement Law, which anchors the best bidder principle and thus allows for the explicit application of sustainability-oriented selection criteria. A comprehensive evaluation of the effectiveness of the Action Plan is lacking. For public procurement at the federal level in six crucial areas, Klien and Berger (2023) estimate that the Action Plan will reduce GHG emissions by 2030 by more than 100,000 tCO_2eq in the first years and 43,000 tCO_2eq in 2030.

Starting in 2022, following the recommendations of international organizations and the examples of other OECD and EU countries, respectively (Bova, 2021; OECD, 2021b), the BMF launched several initiatives related to green budgeting (BMF, 2023). As one element, green spending reviews, which are part of the reforms included in the National Recovery and Resilience Plan, have been conducted. Federal expenditures with a positive climate impact are identified and quantified within yearly federal budgetary plans, whereby this green spending review focuses on mitigation spending,

thus neglecting expenditures for adaptation. Green as well as environmentally harmful tax expenditures are identified, however, without quantifying their budgetary and environmental impacts. At the subnational levels, green budgeting initiatives play a very limited role. An exception is the City of Vienna, which is currently setting up a climate budget. Moreover, the new Fiscal Equalization Agreement 2024–2028 foresees the implementation of green budgeting pilot projects in two federal provinces. An alignment of green budgeting with performance budgeting at the federal level and existing priority budgeting approaches (gender budgeting in particular) are lacking so far. Other priority budgeting approaches and in particular SDG budgeting do not play any role yet. Moreover, medium- and long-term budget planning and projections, which are generally underused in Austria, largely ignore climate-related aspects.

Environmental taxes (as defined by the OECD/Eurostat) have been increasing over time in Austria, although they remain considerably below the EU average (Köppl et al., 2023a). While tax increases in this area were initially motivated primarily by revenue considerations, environmental objectives have increasingly come to the fore in the last decades. With the recent steps to green the tax system, and particularly the introduction of a CO_2 price in 2022 (Baumgartner et al., 2021), Austria is joining the growing group of countries that have implemented a CO_2 price as an instrument of climate protection, albeit at a very moderate level and based on a rather unambitious trajectory (the CO_2 price is set to increase from EUR 30 in 2022 to EUR 55 in 2025) (Köppl et al., 2021). Recent initiatives to green the Austrian tax system through the implementation of new or the extension of existing green taxes and tax expenditures have focused almost exclusively on climate objectives, while further environmental objectives, in particular reducing resource use (including soil), protecting biodiversity, and supporting the circular economy, play only a minor role. Moreover, the potential of green levies at the subnational levels is not fully utilized (Kletzan-Slamanig and Schratzenstaller, 2022), particularly as instruments to contain land use (Arnold et al., 2023; Bröthaler et al., 2024) (*limited evidence, high agreement*).

Another revenue category that has recently gained importance is public green securities. The Republic of Austria's Green Framework, adopted in 2021, aims to raise green funds to finance green expenditures in eight categories: (i) Clean transportation, (ii) renewable energy, (iii) energy efficiency, (iv) pollution prevention and control, (v) environmentally sustainable management of living natural resources and land use, (vi) terrestrial and aquatic biodiversity, (vii) sustainable water and wastewater management, (viii) climate change adaptation (OeBFA, 2022). In 2022, Austria issued EUR 5.1 billion in green securities, followed by EUR 5.5 billion in 2023. According to the associated performance and impact assessment, the projects and infrastructure financed through green securities issued in 2023 lead to an annual GHG emissions reduction or avoidance of 4.4 million t (OeBFA, 2024).

A comprehensive greening of intragovernmental fiscal relations is still lacking (Kletzan-Slamanig et al., 2023), and the new Fiscal Equalization Act 2024–2028 implies only limited progress in this respect (Bittschi et al., 2024; Mitterer, 2024) (*limited evidence, high agreement*). Ecological fiscal transfers, which can be found in a growing number of countries worldwide (Busch et al., 2021), are used unsystematically in selected areas only. Additionally, there is a lack of a comprehensive multi-level climate governance framework aimed at coordinating particularly environmentally friendly subsidies and the reform of climate-counterproductive subsidies, green public investments, commitments to meet Austria's climate targets, and implementation and monitoring mechanisms across all levels of government.

Regarding European/international commitments and initiatives, three areas are of particular relevance. First, 59 % of the measures included in the Austrian Resilience and Recovery Plan (RRF), based on which funds from the European Resilience and Recovery Facility are granted, are dedicated to climate objectives, which by far exceeds the minimum share of 37 % and the share of 40 % for the RRF. Second, against the background of the current international discussions and negotiations on the contributions of industrialized countries to international climate finance, Austria's respective contribution is of interest. In 2015 Austria committed itself to make at least EUR 0.5 billion available by 2020 in contributions to international climate finance; with a total of EUR 1.365 billion, the promised amount was exceeded by far (BMF, 2023). Third, the national CO_2 pricing system is to be integrated into the EU ETS, which will be revised and extended by 2027 through a second EU ETS for transport and buildings (see Chapter Box 6.1).

In general, some progress has been made in greening of public budgets, however, substantial gaps remain (*limited evidence, high agreement*). Significant data gaps on the current status of the greening of public finances exist for all governmental levels, with the largest gaps at the subnational levels (Köppl et al., 2023a). Recently, some important steps and initiatives have been taken in several relevant areas, in par-

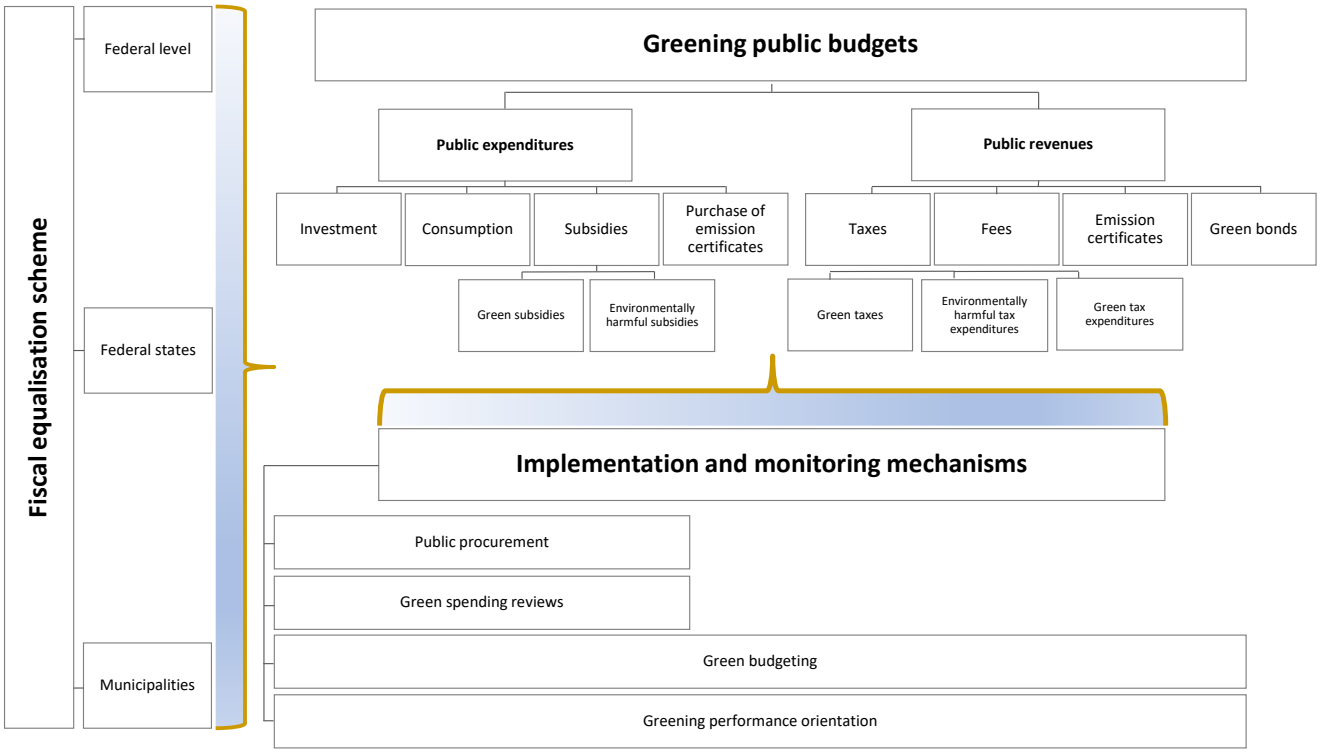


Figure 6.2 Areas and mechanisms relevant for greening public finances (Source: Modified from Köppl et al., 2023b).

ticular regarding climate expenditure, implementation and monitoring mechanisms, as well as the greening of public procurement, the tax system, the fiscal equalization system and public debt. Progress has been strongest at the federal level, with subnational levels lagging behind. There has been little progress in reforming the considerable volume of environmentally harmful subsidies, which have been significantly increased by temporary support measures to alleviate the social and economic consequences of the recent energy price crisis (Kettner et al., 2023; Kletzan-Slamanig et al., 2023). As Egger et al. (2024) show for the various areas of the welfare state, there is considerable potential for making social infrastructure and provisions more climate-friendly. Moreover, the current perspective on the greening of public finances is still largely input-oriented, while a systematic monitoring and evaluation of budgetary climate mitigation and adaptation measures is missing and existing mechanisms – in particular the performance-informed budgeting at the federal level – are underused (Köppl et al., 2023a). The negative consequences of climate change are already placing a substantial burden on public budgets (see Section 6.7.2). Future budgetary risks resulting from climate change are largely neglected in budgetary projections and medium-term budget planning, although they are estimated to be significant.

6.8. Societal aspects

6.8.1. Just transition

The just transition concept was first proposed in the 1970s by trade union movements to address tensions between social and environmental justice caused by the impacts of a shift to cleaner forms of production on the labor market (Henry et al., 2020; Stevis and Felli, 2020; Bainton et al., 2021). While maintaining the focus on labor markets and paid work as the central arena for securing livelihoods and welfare, the concept has greatly expanded, with NGOs, local authorities, corporations, governments and also scholars promoting multiple and contested interpretations (McCauley and Heffron, 2018; Roberts et al., 2018; Atteridge and Strambo, 2020; Wang and Lo, 2021; Newell et al., 2022; Kyriazi and Miró, 2023) (*high confidence*). These interpretations range from narrower visions of a socio-technical transition to efforts aimed at building a comprehensive social-ecological framework for justice. Key questions include who deserves justice, the balance between social and ecological justice, the role of the state, and the links between the Global North and South (White, 2019;

Tomassetti, 2020; Kalt, 2021; Pichler et al., 2021b), see also Cross-Chapter Box 7.

This rich foundation is reflected in the IPCC's (Pathak et al., 2022) expansive definition in its recent report, which describes just transition as "a set of principles, processes and practices aimed at ensuring that no people, workers, places, sectors, countries or regions are left behind in the move from a high-carbon to a low-carbon economy". The flexible use of the just transition concept is also visible in Austria, where stakeholders use the term differently, to promote socio-technical investments in SMEs in high-emission regions (ÖROK, 2022), and as a general call for basic public services, for co-determination and for the democratization of work (Initiative Wege aus der Krise, 2019; ÖGB, 2021).

The importance of a just transition is recognized for securing public acceptance, support for climate policy, and overcoming resistance to rapid decarbonization (Meckling et al., 2015; Evensen et al., 2018; Atteridge and Strambo, 2020; Groh and v. Möllendorff, 2020; Bolet et al., 2023) (*high confidence*). Conversely, high levels of existing inequality also hinder support for green policies (Vona, 2023). Besides their impact on fossil-intensive economic sectors and jobs, policies aimed at reducing CO_2 emissions can have direct and indirect negative impacts on vulnerable groups of people or households; they can also exacerbate existing inequalities or hinder social policy objectives (Gough et al., 2008; Markkanen and Anger-Kraavi, 2019; Lamb et al., 2020b) (*high confidence*). With such policies potentially having more pronounced and multi-dimensional regressive effects than previously thought, targeted place-based just transition policies for particularly vulnerable communities can be most impactful, especially when sensitive to political acceptability concerns (Vona, 2023; Weller et al., 2024). Just transition policies must consider structural differences (such as varying needs) and vulnerabilities such as low household income, old age and other obstacles to social inclusion (Atteridge and Strambo, 2020; Lamb et al., 2020b; Tikkakoski et al., 2024).

Little peer-reviewed research exists on labor market impacts of just transitions in Austria. Reports and gray literature use the term mainly to quantify sectoral-regional impacts of sustainability transitions. Decarbonization impacts extend beyond the immediate sectors and the overall employment effects are uncertain, with projections of employment impacts in Austria ranging from slightly positive to very negative outcomes. The studies agree on the most affected sectors but reach different conclusions due to methodologies and positions on the socio-technical transition potential. There is a high degree of agreement that the automotive and metal industries, mineral and chemical processing, pharmaceuticals, and the glass and ceramics industries will be strongly affected (Gabelberger et al., 2020; Großmann et al., 2020; Hoffmann and Spash, 2021; Keil, 2021; Meinhart et al., 2022) (*limited evidence, high agreement*). Research also highlights various federal provinces, such as Lower Austria, Carinthia, Upper Austria, and especially Styria, as significant areas with high GHG emissions and a substantial industrial workforce, with a potential regional mismatch of jobs (Gabelberger et al., 2020; Großmann et al., 2020; Hoffmann and Spash, 2021; Keil, 2021; Meinhart et al., 2022).

There is disagreement on the recovery potential of certain sectors (e.g., pulp and paper processing) and on overall labor market effects (Gabelberger et al., 2020; Großmann et al., 2020; Meinhart et al., 2022). The Austrian government's 'Just Transition' report (ÖROK, 2022) emphasizes that medium-term projections and forecasts have largely not considered the significantly increased adjustment pressure on different industries to meet the new target requirements of the Paris Agreement, with low-skilled workers being severely affected, especially support staff in highly affected sectors. Skills mismatches are therefore likely to worsen. Regardless of the overall expected level of employment, there is consensus on the need for retraining, upskilling, and addressing regional disparities (Gabelberger et al., 2020; Großmann et al., 2020; Hoffmann and Spash, 2021; Keil, 2021; Meinhart et al., 2022). Just transition potentially entails broader changes, including restructuring work and production, and providing basic services beyond paid labor (Kalt, 2021; Abram et al., 2022).

Regarding the just transition requirements on the labor market, Austria has prepared a national action plan on training and re-qualification (*Just Transition – Aktionsplan Aus- und Weiterbildung*). This action plan focuses on skill requirements for employees, job entrants and job seekers, defining education and training measures in the energy and heating sector. An Austrian Labor Market Service policy review (Neier et al., 2024) for the Austrian Chamber of Labor underscores Austria's just transition-relevant labor market policies, such as short-term work assistance, (re)training allowance, partial retirement, and educational leave. However, it reveals challenges, including undefined 'green jobs' and skills, insufficient information on environmentally friendly occupations, and lack of tailored programs to promote sustainable occupations, hampering a broader just transition.

A study commissioned by the Ministry of Social Affairs (Seebauer et al., 2021), which screened 300 climate change

mitigation measures at the federal and regional level in Austria, highlights important categories of measures that have been implemented so far, comprising levies on energy, CO_2 pricing, the introduction of energy efficiency standards, increased investment in public transport, energy consultancy and a broad range of subsidies and incentives (for, among others, energy efficiency retrofits, the thermal renovation of buildings, solar PV installations, greening of buildings, e-cars and e-mobility).[15]

There is limited empirical evidence on the social impacts of other Austrian climate policies, particularly from ex-post evaluations (Schneider, 2023). More generally it has been noted that "sophisticated empirical studies are lacking as scholars seem more interested in creating various just transition analytical frameworks than in applying these frameworks to empirical investigations" (Wang and Lo, 2021). An Austrian pilot project suggests that personalized consultation can assist households, especially those with low incomes, in managing rising energy expenses (Seebauer et al., 2021). Subsidies and incentives for energy efficiency retrofits, thermal building renovation, solar energy, and similar measures, can make important contributions to reduce GHG emissions (*high confidence*). Because they require initial investments, however, they tend to benefit wealthier households disproportionally, exacerbating pre-existing inequalities (Lamb et al., 2020b; Seebauer et al., 2021). In cases where thermal insulation and refurbishments lead to higher rents, vulnerable households might be affected negatively. An Austrian case study focusing on low-income, energy-poor households shows that refurbishing rented dwellings can lead to rent increases surpassing energy cost savings, forcing low-income and energy-poor households to leave due to unaffordable rent increases (Berger and Höltl, 2019). Existing inequalities and social exclusion may limit the effectiveness of emissions reduction measures, by curbing adoption rates (Schneider, 2023). International examples show possibilities for designing measures to target low-income households, for example with interest-free loans and progressive subsidies (Lamb et al., 2020b).

At the European level, the European Green Deal includes funding for just transition policies through the Just Transition Fund (JTF) and the Social Climate Fund (SCF). The JTF aids employment, regions and industries during the green transition, supporting fossil-fuel dependent areas. The SCF compensates vulnerable households affected by higher fuel prices from ETS 2 (Kyriazi and Miró, 2023). The JTF allocates EUR 17.5 billion from 2021–2027, with Austria receiving EUR 136 million for Upper Austria, Carinthia, Lower Austria, and Styria, based on the Territorial Just Transition Plan (TJTP) (C/2021/4872; ÖROK, 2022). SCF should provide up to EUR 65 billion (2026–2032) for income support, energy efficient renovations and sustainable transport, with a maximum of EUR 643.5 million going to Austria (C/2021/4872; Wilson et al., 2023). These European schemes can contribute to a just transition. However, scholars have raised concerns about the governance and general setup of the JTF, which might lead to implementation problems, risk the propagation of already present injustice, and create lock-in effects, which reduce incentives for transformation, for example through allowing financing of gas projects (Moesker and Pesch, 2022; Kyriazi and Miró, 2023). The Austrian Chamber of Labor has acknowledged the contribution of the TJTP in Austria's transformation policy, while criticizing its limited scope and governance problems (Soder and Templ, 2022). Details on the measures associated with the SCF are still to be defined, as Member States are required to submit national Social Climate Plans, in which climate action and social compensation measures are set out.

6.8.2. Migration

Climate change and migration linkages

Environmental factors influence migration in complex and often non-linear ways. The strength and direction of the relationship is shaped by economic, socio-political, and demographic conditions which moderate the extent to which households are exposed and vulnerable to climate change impacts (Bardsley and Hugo, 2010; McLeman, 2018) (*high confidence*).

Climate change affects migration through multiple channels, including through its impacts on agricultural productivity (Feng et al., 2010; Cai et al., 2016), food and water security, threats to (traditional) livelihoods and opportunities for income generation (Kaczan and Orgill-Meyer, 2020), socio-political stability and conflict (Schleussner et al., 2016; Abel et al., 2019), and health (Hunter and Simon, 2019; Schwerdtle et al., 2020). These channels are often closely interlinked, challenging the identification and forecasting of migration impacts (Hoffmann et al., 2020) (*medium confidence*).

[15] For evidence on the social impact of carbon pricing, see Section 6.5.1, particularly the subsection on compensation instruments.

In contexts where environmental factors influence migration, they typically have a stronger impact on internal as opposed to international migration (*medium evidence, high agreement*). In many cases, migrants move towards urban centers, contributing to rapid urbanization processes in some regions (Barrios et al., 2006; Henderson et al., 2017; Adger et al., 2020) (*medium confidence*).

Recent literature provides evidence that impacts of climate change together with non-climatic drivers can increase mobility constraints, potentially trapping populations in hazardous places (Black et al., 2013; Nawrotzki and DeWaard, 2018; Zickgraf, 2019). This may result in a vicious cycle of increased exposure, vulnerability, and limited possibilities to escape from the hazards (*medium evidence, high agreement*).

Migration can represent a suitable means for migrants and their communities to adapt to climate change impacts (Black et al., 2011, 2013) (*medium evidence, high agreement*), but it also comes with significant challenges and risks for migrants and their communities. Migration can be maladaptive if it does not lead to long-term benefits and improved conditions (Gemenne and Blocher, 2017; Jacobson et al., 2019; Vinke et al., 2020) (*medium evidence, high agreement*).

Climate impacts on migration to and within Europe

There is mixed evidence that environmental factors influence migration to Europe (Mulligan et al., 2014; Hoffmann et al., 2020; Beine and Jeusette, 2021; Šedová et al., 2021) (*limited evidence, medium agreement*). Studies show that temperature fluctuations and increases can lead to increased asylum applications in the European Union (Missirian and Schlenker, 2017) and raise migration to OECD countries (Cai et al., 2016). At the same time, droughts in Africa were found to decrease irregular migration to the European Union, especially from agrarian countries, suggesting more complex relationships (Cottier and Salehyan, 2021).

Limited evidence exists on the role of environmental factors for migration within Europe, which has been considered primarily as a destination region for climate migrants (Obokata et al., 2014; Piguet et al., 2018). Only recently, European Union institutions have started to engage more closely with the topic (Noonan and Rusu, 2022). The lack of empirical evidence on climate-induced migration within Europe constitutes a major gap in the scientific literature with implications for policy and planning processes (*limited evidence, high agreement*).

Climate impacts on migration to and within Austria

There is no evidence about the impacts of climate change on migration flows within Austria. Instead, Austria is primarily considered as potential migration destination. A recent study examined the immigration acceptance among students in an Austrian university, showing a similarly high acceptance level for migrants who move because of climate change compared to those who move because of conflict (Henning et al., 2022) (*limited evidence, high agreement*).

There is evidence that environmental degradation and impacts of disasters in countries of origin are being taken into consideration by Austrian courts when making decisions about the granting of subsidiary protection. Country-of-origin information about environmental degradation and disaster impacts provided to courts varies in quantity and quality depending on geographical region (Mayrhofer and Ammer, 2022) (*limited evidence, high agreement*).

Planned relocation (otherwise also referred to as 'managed retreat'), has been undertaken in Austria as a flood management policy, however this is seldom joined up to the migration literature. In this context, planned relocation has been defined as "a directed measure that is initiated, overseen and financed by public authorities at different political level, in which a community of private households moves from a risk to a non-risk location where they resettle permanently" (Thaler et al., 2020, p. 2). In planned relocation that has taken place along the Danube in Upper and Lower Austria, deficiencies have been found in knowledge transfer between national, regional, and local authorities as well as citizen engagement (Thaler et al., 2020), and programs have been organized in a top-down manner. Whether households choose to take part in relocation programs depends on several factors: Rational economic calculations, fear of future flood events, place identity, belief in efficiency of future flood preparedness, and status as a long-term resident. Decisions on whether to relocate are taken from an intergenerational perspective, with children's opportunities being crucial (Seebauer and Winkler, 2020a). However, keeping relocation programs open for a long time has been shown to increase uptake (Thaler et al., 2020). Furthermore, the planned relocations failed to address social inequalities and did not focus enough on vulnerable populations (Thaler, 2021). Households who choose not to participate in relocation problems face a different set of challenges of living in now de-populated areas (Seebauer and Winkler, 2020b) (*limited evidence, high agreement*).

Political discourses on climate change and migration in Austria

A great deal of literature points to the dangers of the securitization of the discourse on climate change and migration, which is not likely to lead to increased efforts for climate mitigation as often intended (Bettini et al., 2017) (*medium evidence, high agreement*). Within Austria, the links between climate change and migration are often dismissed as irrelevant until such a point where international migration towards Austria becomes visible. This is partly due to the restrictiveness of Austria's migration politics in general, making civil society actors reluctant to engage in the area of work (Nash, 2023) (*limited evidence, high agreement*). Among parliamentarians at the nation state-level, differing discourses on climate change and migration can be traced back to differing understandings of responsibility and conceptions of national interests (Nash, 2023).

6.8.3. Climate Change Education

Researchers worldwide emphasize and confirm the great potential of Climate Change Education (CCE) in actively promoting a just transition, covering mitigation, adaptation, and transformation education (Anderson, 2012; Lutz et al., 2014; Lee et al., 2015; Otto et al., 2020; Reid et al., 2021; Reimers, 2021). The immense importance of education has also been universally acknowledged by highlighting the special role of SDG 4 'Quality Education' as a key instrument for achieving all SDGs, which is particularly true for Climate Change Education and SDG 13, 'Climate Action'. By identifying CCE as a 'social tipping element', Otto et al. (2020) highlight the prominent role of education, as it opens up the possibility to help activate social-tipping dynamics that can lead to a sufficiently fast reduction in GHG emissions. Not only can education in its various forms (formal, non-formal, livelong, etc.) and facets (e.g., political literacy) (Kranz et al., 2022) support and amplify norms and values, but also inspire behavior change among individuals and lead to social tipping processes, especially when the new generation enters the job market and public decision-making bodies (Otto et al., 2020; Schrot et al., 2021). Hence, by educating key actors in education such as university teachers, teacher educators, in-service teachers, pre-service teachers, environmental educators, and university and school students, they can act as multipliers for climate change knowledge, awareness, and action. As a consequence, they help raise societal acceptance of climate policy measures (e.g., Schelly et al., 2012; Tobler et al., 2012; Andersen, 2018; Stevenson et al., 2018; Brennan, 2019; Kuthe et al., 2019; Thaller and Brudermann, 2020). Beyond that, in order to push climate action right now, it is as important to educate adult multipliers in all societal sectors such as work councils (Arbeiterkammer Wien, 2022), farmers (HBLFA Raumberg-Gumpenstein, 2023), administrative personnel (AdaptBehaviour, 2017), and the general public through lifelong learning approaches (Schrot et al., 2019, 2021).

School and university students and their respective teachers are seen as key 'change agents', defined as strategic multipliers towards climate-friendly competence and action (Skamp et al., 2013; Stevenson et al., 2017; Andersen, 2018; Kuthe et al., 2019; Möller et al., 2021; Winter et al., 2022). Studies show that young people can influence the energy-saving behaviors or climate change awareness of their families and friends in positive ways (Hiramatsu et al., 2014; Andersen, 2018; Brennan, 2019; Parth et al., 2020, 2024; Keller et al., 2022). On the larger scale, the recent FFF movement demonstrates that school students did not only shape the visibility of the topic but also influenced political decisions. It is estimated that within just half a year the movement grew to 1.5 million students in 125 countries, including Austria (Wahlström et al., 2019; Nash and Steurer, 2021). The effects of educational campaigns can be strengthened by participation in FFF (Deisenrieder et al., 2020), but also by a supportive family and community context as well as by media campaigns (Suranovic, 2013; Kubisch et al., 2020). For Austrian students, this was shown to be especially relevant for action-related components of climate change awareness or an enhanced feeling of self-efficacy that might be triggered by perceived collective efficacy (Deisenrieder et al., 2020).

However, CCE, in the framework of Education for Sustainable Development (ESD), is a complex socio-scientific issue that requires the acquisition of 'Climate Literacy', a framework whose key component is an understanding of how humans influence the climate and vice versa (Wise, 2010; Leve et al., 2023). There is growing evidence that teaching and learning CCE in order to reach climate literacy, climate change awareness and climate action, is highly demanding as it has specific challenges: (i) A highly complex and interdisciplinary science with multi-layered interrelationships of effects that complicate understanding, (ii) ethical, political, psychological, and social dimensions, (iii) the constant updating of scientific findings, the still open development of consequences and solutions, and (iv) the resulting public debate, which is controversial and polarized, and can lead to a misinformation about underlying scientific facts (Dawson,

2015; Cook et al., 2018; Rahmstorf and Schellnhuber, 2018; Horn and Bergthaller, 2019; Möller et al., 2021; Winter et al., 2022; Schubatzky and Haagen-Schützenhöfer, 2023). As achieving CCE goals is an extremely complex challenge, close consideration of research results about CCE is vital. These suggest that inter- and transdisciplinary education (and research) settings in combination with moderate constructivist learning settings, like in the Austria-wide CCE research and education program 'makingAchange', promise high learning effects (Rieckmann and Bormann, 2020; Kohl et al., 2022; Bohunovsky and Keller, 2023; Liebhaber et al., 2023; Parth et al., 2024; Rauch et al., 2024; Schickl et al., 2024).

Taking into account the above-mentioned demands and challenges, there is growing evidence that the formal Austrian education system at school and at higher education levels (e.g., university), with its current objectives and structures, does not contribute to a sustainable future and climate-friendly living to the extent necessary, and limits the promotion of action-oriented and participatory CCE (Winter et al., 2022; Bohunovsky and Keller, 2023). In order to achieve a fundamental paradigm shift in Austrian education structures (e.g., whole-institution approaches) and systems towards fostering competences for climate-friendly living and sustainable development, there is high agreement that a transdisciplinary development and implementation of comprehensive CCE concepts at all levels of formal and non-formal (e.g., communities/municipalities, museums, libraries, etc.) education must be promoted and that the contribution of all actors and stakeholders to CCE needs to be fundamentally transformed and intensified strongly and promptly (Martens et al., 2010; Leiringer and Cardellino, 2011; Ryan, 2011; Saltmarsh and Hartley, 2011; Rauch and Steiner, 2013; Sachs et al., 2019; Hübner et al., 2020; Winter et al., 2022; Bohunovsky and Keller, 2023). As a first step, the structural anchoring of climate change contents (physical science, mitigation, adaptation, societal transformation) and CCE concepts in the curricula of all school and university subjects is key, especially in those subjects whose graduates will have a high impact on education (teachers) or public decision-making bodies (legal practitioners, business people) in the future (Otto et al., 2020; Bohunovsky and Keller, 2023). In addition, CCE should be established in the curricula of vocational education and in-service training, especially for teachers (Keller and Rauch, 2021; Bohunovsky and Keller, 2023). Vocational education for sustainable development in Germany (Michaelis and Berding, 2021; Kaiser and Schwarz, 2022; Bohunovsky and Keller, 2023), successful CCE in-service teacher training (Kubisch et al., 2020; Möller et al., 2021) as well as ESD certificate programs for university teachers (Hübner et al., 2020) in Austria can serve as a blueprint.

Systematic research for Austrian school and university curricula is lacking, but in the USA the probability that a student takes at least one climate change class via the core curriculum at the top 100 universities and liberal-arts colleges is estimated at 0.17 % (Hess and Collins, 2018; Hess and Maki, 2019). In a representative study, the vast majority of German in-service teachers indicate that ESD has 'never' (69 %) or 'seldomly' (22 %) been the topic in their teacher training (Grund and Brock, 2018), assuming the same or worse for CCE. Hence it is not surprising that the majority of pre-service teachers as well as in-service teachers lack foundational content knowledge in the field of CCE, often have the same rudimentary or scientifically incorrect understandings of key climate change concepts as their students, and fail to accurately present the scientific consensus on climate change in their lessons (e.g., Papadimitriou, 2004; Boon, 2010; Shepardson et al., 2011; Lambert and Bleicher, 2013; Niebert and Gropengiesser, 2013; Plutzer et al., 2016; Namdar, 2018; Competente, 2019). School textbooks, also in Austria, not only rarely take these misconceptions into account, but often contain scientifically incorrect or outdated content on climate change themselves (e.g., Choi et al., 2010; Kuthe et al., 2019), which can further reinforce erroneous conceptions. Even though some current Austrian school and university curricula suggest taking CCE into account, for example through cross-curricular approaches or in specific subjects such as Biology, Geography or Physics (BGBl. II Nr. 185/2012; BMBF, 2014; Universität Wien, 2016), and even though Austrian teachers report that CCE is very important and that they are willing to teach it, they often do not feel sufficiently supported by their university and in-service education to actualize their transformative potential as change agents (for details, see Winter et al., 2022). They also believe that they will not have enough resources or teaching time to conduct CCE in the future (Winter et al., 2023). In general, it remains unclear whether teacher training programs include not only the promotion of scientific content knowledge about climate change, but also topic-specific pedagogical content knowledge (i.e., didactic knowledge) to address climate change as a socio-scientific issue (Dawson, 2015; Clausen, 2018; Li et al., 2021; Möller et al., 2021). Also, research shows that teachers' political beliefs and values are the greatest predictor of rejection of climate science knowledge, and relevant for the willingness to teach CCE (e.g., Plutzer et al., 2016; Stevenson et al., 2016; Nation

and Feldman, 2021). In terms of CCE teacher professionalization, emphasis should therefore also be placed on affective aspects such as attitudes and values in students and teachers alike (Oberauer et al., 2023).

Currently, inter- and transdisciplinary cooperations, which are pivotal for ESD and especially CCE, are disadvantaged by the Austrian school and university system, which is dominated by discipline-centered structures (Engartner, 2019; Winter et al., 2022). There is evidence that the creation of specific structures for inter- and transdisciplinarity in education is necessary, such as the establishment of appropriate institutes, research centers, professorships ('Brückenprofessuren'), study programs, textbooks, journals, societies, research networks (for an overview, see Bohunovsky and Keller, 2023). To achieve climate-friendly and sustainable living, research literature suggests that CCE should generate system knowledge, target knowledge, and transformation knowledge (Schneidewind and Singer-Brodowski, 2014) and be open to the production of new types of knowledge and competencies (Norström et al., 2020; Chambers et al., 2021).

If the scientific evidence base on the effects of (novel) CCE approaches in the Austrian education system is to be increased, there is high agreement that accompanying research about CCE and evaluation of CCE programs is pivotal, not only in the relevant subjects but also in an inter- and transdisciplinary way (*high confidence*).

6.8.4. Media representation of climate change in Austria

In principle, the climate crisis, as a long-term, global, highly complex process can be only partially directly perceived by individual senses. As a result, most people's knowledge of climate change, and the environmental and weather changes it triggers, comes from (news) media (Lörcher, 2019).[16] Media also informs about causes and effects of climate change (e.g., Bolsen and Shapiro, 2018). However, it is also socially constitutive in the sense that communicative negotiation processes discursively construct and frame which social, political and economic adaptation measures are necessary and feasible to prevent or mitigate climate change, as well as which social groups and institutions are responsible (Nisbet, 2009; Reisigl, 2021). In addition, media is a central platform for various actors to present, interpret and shape debates around climate change and its governance (Tindall et al., 2018).[17] There is only very little research on the media representation of climate change in Austria (Rhomberg, 2016; Theine and Regen, 2023), however, studies from other (German-speaking) countries and comparative cross-country evidence exists.

In Austria, media attention to climate change increased since the mid-2000s both in terms of content (Kathrein, 2015; Narodoslawsky, 2020) and organizationally, as some media outlets have established special beats, pages or special editions on climate topics (Theine and Regen, 2023) (*medium confidence*). At the same time, long-term analyses show that media attention – despite the increase – is still at a low to medium level (Theine and Regen, 2023, based on; Boykoff et al., 2023, 2022) (*limited evidence, high agreement*). In addition, the basic trend of increasing media attention is highly dependent on geographic, social and media-specific conditions (Boykoff, 2013; Schmidt et al., 2013). Regarding the media-specific conditions, media representation of climate change is shaped by different media systems, structural determinants of media organizations as well as wider cultural and political factors (Eskjær, 2013; Theine and Regen, 2023). A country's exposure to the impacts of the climate crisis seems to be only a weakly positive determinant of increasing media coverage (Barkemeyer et al., 2017). Media attention is driven by shorter-term extreme weather phenomena, high stakes political events like the annual World Climate Conferences, protests (particularly by FFF) and less so by long-term climatic changes (Pianta and Sisco, 2020; von Zabern and Tulloch, 2021) (*limited evidence, high agreement*).

Increasing media coverage does not necessarily entail scientifically accurate coverage of the climate crisis and transformative discourses. Internationally, several media-specific processes and structural features have been identified that promote misinformation and false balance. Such processes and structural features are: (i) The ideological stance of the media, (ii) the proximity to far-right political milieus and think tanks (McKnight, 2010b, 2010a; Forchtner et al., 2018), (iii) the unique access of fossil fuel, automotive and other high-emitting industries to influence mainstream media representations via advertisements and source power

[16] The subchapter excludes research on social media and climate change for the following reasons: There is very little research on the Austrian case, existing reviews of international literature (e.g., Pearce et al., 2019) are somewhat applicable to Austria due to shared global dynamics in social media use.

[17] Media and journalism are in a complex relationship with societal actors and state and governance institutions. Ideally, they fulfill a watchdog-role vis-a-vis other power actors, but they clearly have some impact on forming public knowledge and public opinion, and are typically located outside of official state governance (at least in most democratic countries).

(Bacon and Nash, 2012; Beattie, 2020; Schäfer and Painter, 2021), as well as (iv) the impact of the media crisis through reduced resources for (investigative and specialized) reporting (Gibson, 2016; Schäfer and Painter, 2021).

For Austria, the high degree of tabloidization and the affiliation of some media outlets with the ÖVP, the FPÖ and far-right movements likely favors climate change-skeptical positions and climate delay (Magin and Stark, 2015; Forchtner, 2019) (*limited evidence, high agreement*). On the other hand, evidence from Germany, where high trust in public service broadcasting parallels high expectations regarding broad and serious coverage of the climate crisis and of extreme weather events, might also hold true for the Austrian context (Neverlaa and Hoppe, 2023; Reif et al., 2024). One discourse analysis of the public broadcaster's ORF2 program 'konkret' suggests that its coverage engages with climate change in the appropriate manner but also suggests that the focus of the reporting is strongly driven by economic and consumer-oriented logics (Sedlaczek, 2017) (*limited evidence, high agreement*).

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