ENTRANCES

ENergy TRANsitions from Coal and carbon: Effects on Societies

D4.4 Upper Styria Region Case Study Report

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Abbreviations

APA	Austrian Press Agency
CET	Clean Energy Transition
CCT	Coal and Carbon Territory
EAG	Renewable Energy Expansion Act (Erneuerbaren-Ausbau-Gesetz)
ENTRANCES	ENergy TRANsitions from Coal and carbon: Effects on Societies
FG	Focus Group
GDP	Gross Domestic Product
GHG	Green House Gas
IP	Interview Partner

KEM	Climate and Energy Model Region (Klima und Energie Modellregion)
KLAR	Climate Change Adaptation Model Regions for Austria (Klimawandel-Anpassungsmodellregionen)
LD	Linz-Donawitz process
LMA	Labour Market Area
MAF	Multidimensional Analytical Framework
NGO	Non-governmental organisation
NUTS	Nomenclature of territorial units for statistics
PAR	Political Administrative Region
PV	Photovoltaic
R&D	Research & Development
R&I	Research & Innovation
SSH	Social Sciences and Humanities
WP	Work Package
ZSI	Centre for Social Innovation (Zentrum für Soziale Innovation)

Executive Summary

This case study report presents the results of the analysis of Upper Styria, a coal and carbon territory situated in Austria, which was performed in 2021-2022 in the frame of the ENTRANCES project (ENergy TRANsitions from Coal and carbon: Effects on Societies). Upper Styria is a historic steel producing region in a mountainous area in the province of Styria.

Mining is established in the region since roman times, and steel production since the 17th century. The steel industry has gone through different and at times difficult phases. An important restructuring took place in the 1980s, when the previously nationalised steel producer was privatised and important lay-offs of the workforce (nearly 50%) took place. Today a range of production sites of the Austrian multinational steel producer voestalpine are operating in the region. Upper Styria is an important industrial base in Austria, and voestalpine is producing innovative and successful steel and specialised steel products for the world market. Also, the economic base has been diversified and other important companies such as microelectronics, paper and pulp are present.

However, several challenges related to the Clean Energy transition are looming in the region:

- The **decarbonisation of the steel industry**, and the speeding up the energy transition at the provincial and case study region levels need to be tackled with more effort.
- **Soil sealing and related abandonment of housing** in city centres in the region's municipalities need to be stopped and reversed.
- **Social questions around gender pay gap, care system, and image of the region** have to be addressed.
- The above mentioned challenges need to be dealt with to ensure that people stay in the region and to counteract **ageing and outmigration trends**.
- **Weaknesses in coordination and cooperation across governance levels** have to be tackled: they concern coordination and cooperation between the Austrian provinces, between provincial and national levels, as well as between public initiatives for climate change and the energy transition. Federalism and differences at the economic, infrastructural and political levels are seen as challenges and hurdles in efforts to lead the Clean Energy Transition more decisively.
- **Better inclusion of citizens and civil society stakeholders**, awareness raising measures, and support for marginalised and low income groups (e.g. for renovation) will be required to facilitate the Clean Energy Transition.

Some measures have been taken, but the Ukraine crisis has confirmed that advancement is far too slow. Our analysis with the help of a variety of research methods has helped to reveal key trends, as well as challenges and (possible) coping strategies.

Text research has shown that a **mostly technical debate** is taking place around the energy transition in the region. One important and frequently discussed topic is the production of “green steel” and decarbonisation of the steel industry by switching from fossil fuels to hydrogen and electricity produced with renewable energies. Social or gender issues are barely featured. The debate can be characterised as *transition delay*.

Interview research showed consensus among stakeholders that **knowledge for the CET is highly available** in Styria with its universities, research institutes and innovative big industry and SMEs. Resources are available and conditions for experimentation given. But transition strategies are not ambitious (not radical) and stakeholder coordination, as well as weak coordination across governance levels and across CET and climate initiatives and agencies slow down the transition.

Focus group discussion allowed to pinpoint development paths of the Upper Styria, revealing that the crisis of the 1980s still has **repercussions on the current image** of the region. This past image does not at all reflect the current innovative industrial setting. The focus group also shed light on key social issues, such as **lack of renovation of existent housing and related soil sealing** with new construction. A high **gender pay gap**, weaknesses in local transport and in the care sector contribute to ageing and outmigration trends, as do the mentioned housing issues.

Survey data indicate that people have a **strong place attachment to Upper Styria**, that **support for the CET** is given and protest or resistance to it is low. Qualitative street interviews confirmed current worries about energy provision, but also willingness to contribute to the energy transition and to take energy saving measures.

Socio-economic data showed **population trends marked by ageing and some outmigration**; regional policy strives to attract skilled labour with regional advantages such as moderate price levels of housing, or to support the settlement of male and female founders and start-ups with attractive shared space workplaces (Upper Styrian initiave *Come back and create*).

CHAPTER 1

INTRODUCTION

1 Introduction

The project ENergy TRANsitions from Coal and carbon: Effects on Societies ENTRANCES, which is a three-year project funded by the European Union's Horizon 2020 research and innovation programme, addresses the Social Sciences and Humanities (SSH) aspects of clean energy. ENTRANCES is coordinated by the University of A Coruña and is conducted by a consortium of 14 European partners, including universities, research institutes, networks and umbrella organisations.

ENTRANCES' overall goals are developing a theoretically-based and empirically-grounded understanding of cross-cutting issues related to social aspects of the clean-energy transition in European coal and carbon-intensive regions and formulating a set of recommendations able to tackle these issues. The project investigates the challenges facing carbon-intensive regions in transition hinging on the idea that the transition to clean energy should not be considered only as a technological change or an industrial shift but also as a complex and multidimensional process that affects the daily life of local communities. In this regard, the project understands the impacts of the clean-energy transition on coal and carbon-intensive regions in terms of the potential activation or strengthening of the de-territorialisation process, i.e., the process of progressive weakening of ties between a community and its territory, and conversely as an opportunity for triggering their re-territorialisation.

One of the key aspects of the project was thus the development of 13 regional case studies dedicated to just as many European coal and carbon-intensive regions in transition.[1] All the case studies were based on the application of the same Multidimensional Analytical Framework (MAF) within the project to grasp the multi-faceted aspects of the de/re-territorialisation processes ongoing in the regions. This report is the one dedicated to the case study of Upper Styria in Austria that was developed by Centre for Social Innovation (ZSI).

The region of Upper Styria has long been shaped by mining and production of metals. We have investigated in particular the steel industry, which is a main employer in the region with several subsidiaries of the Austrian multinational steel producer voestalpine situated here. Iron and Steel industry is the most significant carbon emitter in the CCT. Steel production started in the 17th century, and in the 19th century it began growing rapidly, from about 20.000 tons in 1820 to more than 80.000 in 1860. It experienced several ups and downs, e.g. the innovative achievement of the Linz-Donawitz (LD) process, or a significant crisis in the 1980s, when important lay-offs of the labour force happened. The steel industry is today an innovative and flourishing business, but it faces the difficult task of decarbonising its production processes and securing its huge energy requirements. voestalpine's plants in the region still use fossil fuels (coal/coke and natural gas) for steel production, but a transformation process is underway leading to energy savings and decarbonisation of the production in the long run up until 2050. A pilot plant using hydrogen is in operation in Leoben-Donawitz, therefore ushering in a new phase in steel production of decarbonised or "green steel", as hydrogen can be produced with energy generated by renewables. Some plants in the region, e.g. the special steel plant in Kapfenberg use electricity for its steel producing processes. At this production site of Kapfenberg, a brand new steel plant has

[1] https://entrancesproject.eu/project-deliverables/

been built and is currently (since June 2022) entering into operation, which will use electricity from renewable energies.[2]

Industrial steel production is an emissions intensive industry and therefore a key target of transformation in Styrian sustainable transition strategies. The steel industry is responsible for the majority of emissions in Styria and has led to disproportionate emissions on a national scale. Styria was responsible for 16.9% of total green house gas (GHG) emissions in Austria as of 2019, while GHG emissions per person in Styria were about 2% above the national average (Umweltbundesamt 2021). The Climate and Energy Strategy Styria (Klima- und Energiestrategie Styria 2030) aims to significantly reduce emissions by targetting the high energy usage in the sector. The goals of the Styrian Strategy 2030+ (dating of 2017) are congruent with the Paris agreement and foresee a reduction of Styrian emissions of 16% until 2020 and 36% until 2030 compared to 1990 levels and an increase of energy efficiency of 30% while increasing the share of renewables to 40%[3]. While energy production in Styria has a high share of renewable, the energy consumption is still very reliant on fossil fuels.

Upper Styria has also a coal production past, but which has ended already in 2004. In spring 2020 the last coal fired power plant in Austria was shut down.[4] It was switched to a stand-by plant based on natural gas. The plant is situated in Mellach, in our PAR Styria. Due to the energy shortages as a result of the Ukraine crisis, plans to re-convert the plant to coal have been put forward by the national Ministry responsible for energy. However the owner of the plant, the Verbund company, expects re-opening only in 2023.

The report is structured into five chapters: Chapter 2 presents the **conceptual, methodological framework** adopted for the development of the case study, including information on how Upper Styria has been operationalised in different interrelated units of analysis. Chapter 3 is focused on **the analysis of Upper Styria as a Coal and Carbon Territory**, i.e. the territory heavily dependent on fossil-fuel-based industries or the extraction of fossil fuels themselves, with the lenses of the socio-cultural and socio-psychological dimensions. Chapter 4 provides an overview of the **socio-economic situation** of the region. Chapter 5 covers the **analysis of the Clean Energy Transition** underway at the regional level through the lenses of the socio-political and socio-technical dimensions. Chapter 6 presents the main **territorial challenges, associated coping strategies and gender-related aspects** and discusses them in the light of all the dimensions included in the study (i.e. socio-economic, socio-cultural, socio-psychological, socio-political and socio-technical dimensions). Finally, conclusions formulated by the case study team complete the Upper Styria case study report.

In addition to the main text, the deliverable also includes an annex.

[2] https://www.bohler-edelstahl.com/en/edelstahlwerk/ & https://steiermark.orf.at/stories/3162807

[3] https://www.technik.steiermark.at/cms/dokumente/12449173_142705670/f9e55343/KESS2030_Web_Seiten.pdf

[4] https://www.verbund.com/de-at/ueber-verbund/news-presse/presse/2020/04/17/letzte-kohle-mellach

CHAPTER 2

CONCEPTUAL AND METHODOLOGICAL FRAMEWORK

2 Conceptual and methodological framework

2.1 Case study objective(s) and organisation

2.1.1 The case study objective(s)

The case study objective can be better understood in light of the research questions of the ENTRANCES project.

1) What are the principal socio-economic, socio-technical, socio-ecological, socio-cultural, socio-political, socio-psychological, and gender-related challenges facing coal and carbon-intensive regions in transition? What coping strategies have emerged in recent years?

2) What variables have been most influential in the appearance of the *deterritorialisation;* i.e., the process of progressive weakening of ties between a community and its territory, and conversely as an opportunity to trigger their re-territorialisation, and how do they interact? What kinds of strategies are the key determinant of success in terms of *re-territorialisation*?

3) What policies or combination of policies would be most appropriate to recover the ties of the territory and community in coal and carbon-intensive regions while fostering their transition toward clean energy?

The three questions as a whole, define the logical itinerary of the project, which starts from an in-depth *description* of the current situation of the regions (RQ1), moves to search the *causes* of the de/re-territorialisation process (RQ2), and identify a set of *policies* for fostering the re-territorialisation of the regions (RQ3).

The main aim of the regional case studies is to answer the first research question (RQ1) of the project in all the regions involved in the project, thus also in Upper Styria. Moreover, the secondary aim of the case studies is to provide the empirical basis for answering the other two research questions, related to the causes of de/re-territorialisation processes (RQ2) and the set of policies needed to activate re-territorialisation (RQ3). However, such two questions will be answered in the next phases of the project respectively through case comparisons (RQ2) and case-related scenario building and policy co-creation (RQ3).

For describing the challenges and coping strategies faced by coal and carbon-intensive regions in transition across different dimensions of change, the main aim of this document is to report the answer that the research has found about the case of Upper Styria.

2.1.2 Structure of the case study: multiple foci and units of analysis

To deal with the complex research question presented above (RQ1) the ENTRANCES case studies have been structured into multiple foci and units of analysis. This articulated approach is necessary to enhance the clarity of the study and avoid conflation of concepts as concerns the challenges and the coping strategies of the coal and carbon-intensive regions in transition. In this

regard, all the ENTRANCES case studies, thus including also the case study of Upper Styria, have been articulated into three research foci and three corresponding units of analysis.

- *RF1: Territorial Change in the Coal and Carbon Territories (CCTs)*. The project decided to focus its analysis of challenges and coping strategies on the territories that are more exposed to the decarbonisation process. To this aim, the concept of Coal and Carbon Territory (CCT) was developed. CCTs are the territories in which the "coal and carbon" features are represented as a distinctive part of the local identity or are a key asset for the income and employment opportunities of the local community. It is worth noticing that, in many cases, the CCTs are not administrative regions. The focus on territorial change in the CCTs has been considered the "fulcrum" or the "core" of the ENTRANCES case studies.

While RF1 helps clarify that the research is focused on the territorial challenges and coping strategies of the CCT, the dynamics of de/re-territorialisation of this territory cannot be fully understood if not in the light of the other two research foci and related units of analysis.

- *RF2: Structural Change in the Labour Market Area (LMA)*. The case study has investigated the change in the socio-economic structure over the last three decades. This is an essential dimension for understanding the underlying dynamics that affected and that still affect the CCT at the structural level. To investigate structural change, *Labour Market Area (LMA)* was established as a secondary unit of analysis. The Labour Market Area was defined as the area including the Coal and Carbon Territory in which a bulk of the labour force lives and works.

- *RF3: The clean-energy transition in the Political Administrative Region (PAR).* If RF2 investigates medium and long period dynamics that are affecting the CCT, the focus on the clean-energy transition ensures that the research considers the incipient change triggered by the purposive transformation of the energy system that is promoted to deal with climate change. Such objectives have been recently accelerated through the European Green Deal. In each regional case study, the clean energy transition has been observed at the level of the Political Administrative Region (PAR), i.e. the administrative region encompassing the Coal and Carbon Territories more closely associated with governing the energy transition through a directly elected legislature.

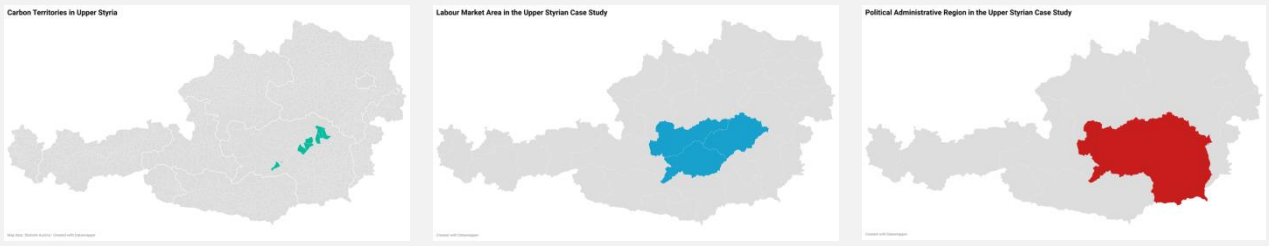
These three research foci and related units of analysis, at least to some extent, overlap with each other. Despite that, they offer different and complementary perspectives in the study of coal and carbon-intensive regions in transition. They jointly contribute to understanding the de/re-territorialisation dynamics ongoing in the coal and carbon territory.

The structure of the case study is mirrored in this report as Chapter 3 will deal with Territorial Change in the CCT; Chapter 4 with Structural change in the LMA; and Chapter 5 with the clean-energy transition in the PAR.

Box 1 - The three units of analysis

Following the structure of the case study, three units of analysis have been delineated in the Upper Styria case as shown in Figure 1.

Figure 1 – Case delineation



Coal and Carbon Territory	Labour Market Area	Political Administrative Region

The CCT has been defined as the NUTS3 regions AT223 & AT226 (due to data availability), and in a more narrow sense as 8 communities located in Upper Styria. We applied the criterion of municipalities with at least 100 employees in the steel sector (not in the metal processing sector; brackets show amount of employees in steel industry in municipality):[5]

- Kapfenberg (> 1000)
- Leoben including Donawitz (> 1000)
- Kindberg (>1000)
- Judenburg (>700)
- Bruck an der Mur (>500)
- Zeltweg (>500)
- Krieglach (>300)
- Sankt Barbara im Mürztal (>300) (see Błąd! Nie można odnaleźć źródła odwołania.).

The Labour Market Area (LMA), relevant for the case study, consists of the three NUTS3 regions AT222, AT223 and AT226, which are generally known as “Upper Styria”.

The key administrative unit, the Political Administrative Region, for the case study is the Austrian province of Styria.

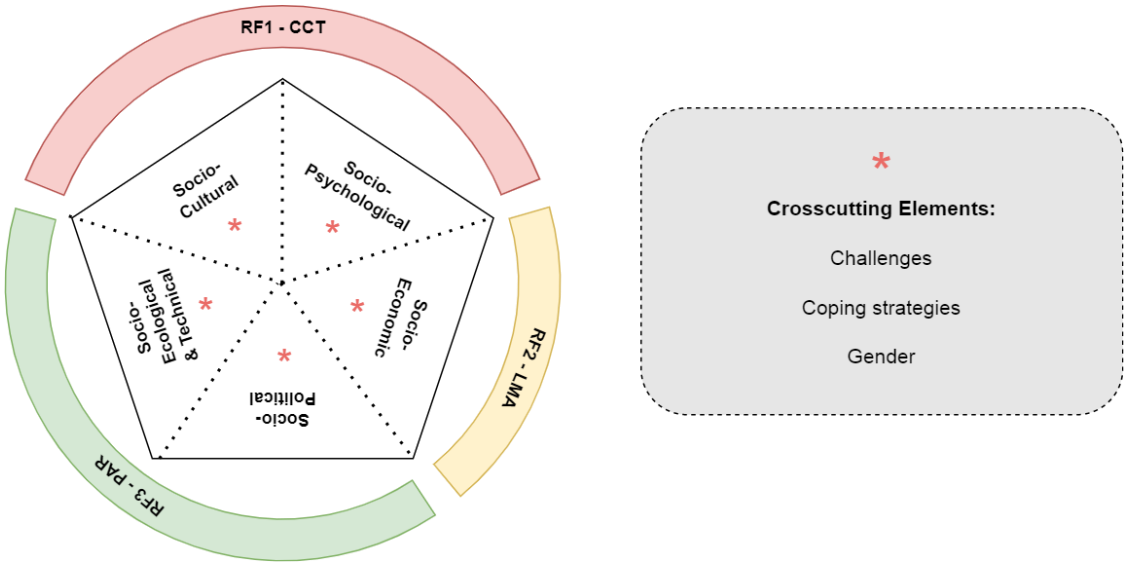
2.2 Overview of the Multidimensional Analytic Framework

For studying the complex and multidimensional dynamics characterizing the processes of territory in transition, ENTRANCES embraces theoretical and methodological pluralism – a perspective in which the adoption of different scientific approaches is not considered as a problem but as an asset – as its research strategy and it relies on a process of knowledge integration (Isgren et al.,

[5] Based on data accessed on 2 July 2021 at https://landkarte.dieindustrie.at

2017). In this regard, the project yearned for adopting multiple approaches without losing their distinctive ontological, epistemic, theoretical, and methodological features (Olsson and Jerneck, 2018). Therefore, a multidimensional analytic framework (MAF) has been adopted. The multidimensional analytic framework is articulated in five components – each relying on a set of specific concepts and methodology – and three cross-cutting elements, as shown in Figure 2. It also shows how the components relate to the above-mentioned research foci and units of analysis.

Figure 2 – Overview of the multidimensional analytic framework: research foci, components and crosscutting elements



In the following subparagraphs, all the different components will be shortly described with their overall approach, the concepts and the methodology adopted. Two final sub-paragraphs will be dedicated respectively to a synoptic table, showing the main features of all the components together, and to the cross-cutting elements.

2.2.1 Socio-cultural component

Domain of enquiry

The socio-cultural component relies on the assumption that a territory – even an informal one as the CCT – is a form of social organisation. The component maps whether and in which way the socio-cultural changes associated with globalisation – such as migrations, technological advancement, financial flows, climate change, etc. – are provoking "stress" in the territorial organisation of the CCT. In this respect, the component interprets stress as a pressure to change for the territorial organisation, rather than as the psychological stress produced by socio-cultural factors. The component relies on a theory of the "stress-strain" element of social organisations (Bertrand, 1963), which is devised to analyse change and stability dynamics "in action" in a certain organisation, in our case in the CCT. The core of the theory is simple but insightful: when conflictual or contradictory needs, ideas or processes arise, processes of disorganisation take place inducing stress on the organisation which therefore necessitates some sort of adjustment. At

the same time, the theory helps us in understanding the stability (or resiliency) of the territorial organisation as all the organisations can tolerate a certain amount of stress. The component identifies the social forces that are exercising pressure at the structural level, the resistance to change – i.e. conflicts or strains generated as a response –, as well as change and stability dynamics in the territorial organisation.

Concepts

Stress-strains. The theory is based on the articulation of the "stress-strain" pair. Stress is an element inherent to the social structure in a given institutional or organisational field, that cannot be observed per se but manifests itself in "strains" of different types such as conflicts, tensions, ambivalences, etc. Therefore, the "strains" can be interpreted also as the manifestation of the stress in action at the structural level.

Strain situation. This is the operational concept adopted for identifying and studying on an empirical base the stress-strain element in the CCT. Three main types of strain situations have been considered: situations of conflicts or disputes (both within and outside the territory), situations of impasses or contradictions, and situations of dependence and related uncertainty. The strain situations are therefore the unit of observation of this component.

Stress vector. It can be defined as a social process that activates stress in the territorial organisation. Stress vectors (or stressor) vary over a wide range of characteristics: for their origins, which can be either from within or from outside; for intensity, as some pressure to change can be stronger than others; for the duration, as some stress-strain can be temporary or contingent while other can be long-lasting in society; for their direction, as each stress vector pushes the territory in a certain direction of change.

Change, resistance to change and ambivalences. The dynamics of change, resistance to change and ambivalence in the CCT are described following four different dimensions of change: the territorial trajectory, by analysing continuities or ruptures; the territorial boundaries, by analysing the distinctiveness or alignments of the territory; the territorial governance by analysing endogenous or exogenous governance; by territorial symbols, analysing both territorial stigma and territorial myths.

Methodology

The analysis of stress-strain was based on a focus group mapping (or participatory mapping) of the strain situations in the CCT. The focus group was composed of local key informants who disclosed their local knowledge of the strain situations generated by a variety of globalisation-related factors. The data collected were transcribed and processed into a consistent set of strain situations. An analysis across all the mapped strain situations allowed us to identify stress vectors, recurring strains and change-stability dynamics characterising the CCT.

2.2.2 Socio-psychological component

Overall approach

The socio-psychological component studies the socio-psychological impacts of the closure of coal mines and carbon-intensive industrial units, i.e., the decarbonisation process, on the lives of individuals living in the CCT. The component moves under the assumption that the economic, social, and political uncertainties caused by the closure of mines and coal-based industrial units

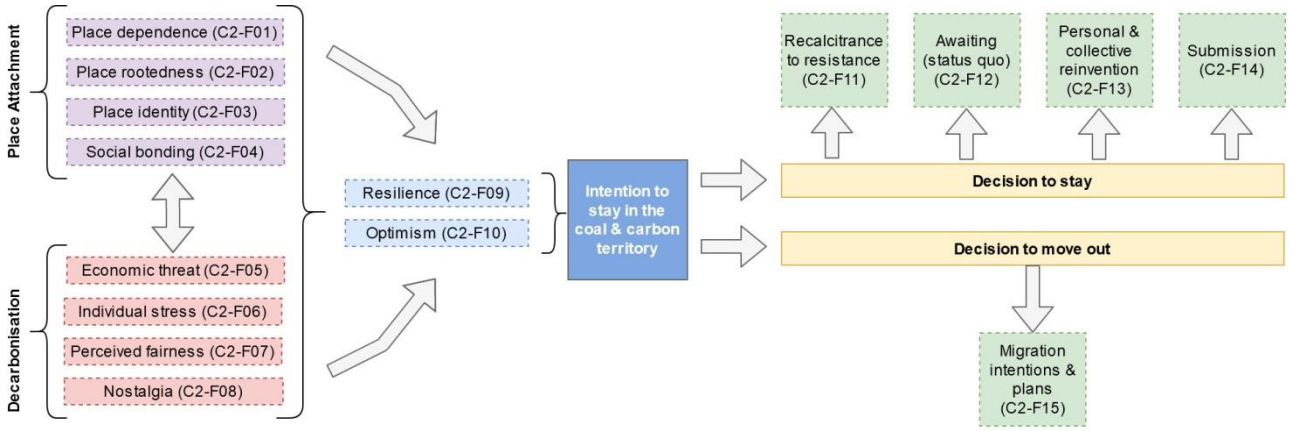
may be a strong source of stress, uncertainty, and internal conflicts for the local population, as it not only constitutes an existential threat to their way of life and their primary source of livelihood but also it may turn out in a dissatisfactory relationship with the territory. The component investigates how place attachment is threatened by stress, uncertainties, and deprivation induced by the decarbonisation process, and what are the main coping strategies adopted by the citizens living in the different coal and carbon territories.

Concepts

Place attachment. The concept of place attachment has been used by scholars to understand the bonds humans share with the physical environment. Leveraging on an integrated model of place attachment (Raymond et al., 2010), the component articulates place attachment in four dimensions: a) place dependence, reflecting the functional dimension; b) place rootedness, reflecting the cognitive dimension; c) place identity, reflecting the symbolic dimension and d) social bondage, reflecting the emotional dimension. *Resilience*. The term resilience, in psychology, refers to positive adaptation in the face of stress or trauma (Luthar, Cicchetti, and Becker, 2000). In the socio-psychological component, the study of resilience is used for achieving a more comprehensive understanding of the response adopted by individuals to the challenges faced by the citizens more directly exposed to decarbonisation in the coal and carbon-intensive regions in transition.*EVLN approach*. The possible copying strategies of citizens are identified in this component based on the “Exit, Voice, Loyalty, Neglect” (EVLN) theory, initially proposed by Hirschman (1970) to study responses to decline in firms, organisations, and states (EVL theory). The theory affirms that when dissatisfaction is experienced in a relation – in our case in territorial belonging - there are a few possible and interrelated coping strategies from the individuals.

The above-mentioned concepts have been organised in a single model composed of several factors, organised in different areas, marked with a different colours in Figure 3.

Figure 3 - Overview of the factors in the socio-psychological model



Starting on the left, Place Attachment and Decarbonisation factors reflect how the two joint processes of deterritorialisation and de-carbonisation are being perceived by the citizens inhabiting the CCT. On the opposite side of the picture, there are the outcomes, i.e., the dependent variables, that the model tries to explain. In the centre, resilience acts as a “moderator” as individuals with high resilience are more able to cope positively with decarbonisation-induced stress.

Methodology

The socio-psychological component was surveyed through a structured self-report online questionnaire consisting of 90 items representing 17 socio-psychological constructs (i.e. the different factors of the above-mentioned model). Most of these items and latent constructs are taken from other studies, where different researchers have applied and tested them in different contexts. All the items have been assessed by the respondent using scales.

2.2.3 Socio-economic component

Domain of enquiry

The socio-economic component focuses on structural change in the economy, i.e., the reallocation of economic activity across different economic sectors (Herrendorf, et al., 2014) and regions. Structural change can lead to a change in a region's economic, financial and demographic composition. The component is thus focused on a descriptive analysis of technological progress, demography, economic inequality, employment and economic activity based on various data sources over the last three decades. The socio-economic component focuses on the Labour Market Area but also relies on the other units of analysis as a reference and as a comparison.

Concepts

In the socio-economic component, ten different factors are taken into consideration. All the factors are investigated mainly from a quantitative perspective. The clean energy transition leads to structural change, which impacts the demography (C4-F01). Further it has direct implications for the depletion of coal reserves (C4-F02), the expansion of alternative energy sources (C4-F03), direct employment and production (C4-F04) in the coal industry and carbon intensive industry, indirect employment and production (C4-F05) effects on other industries. Investments into the stock of capital (C4-F06) will respond to the regional economic development. Further, the clean energy transition can change economic inequality (C4-F07), energy security (C4-F08), technological progress (C4-F09) and migration patterns (C4-F10).

Methodology

For the socio-economic component, an extensive set of data was collected from national sources, mainly national statistical offices and Eurostat.

2.2.4 Socio-political component

Domain of enquiry

The component analyses the narrative battles for the interpretation of decarbonisation and energy transition in the Political Administrative Region of the case study. The component identifies the actors that are forming different “constituencies”: the constituency designing the transition, the constituency coping with the transition, or opposing the transition. Through analysing the narratives of such actors, the component investigates how the constituencies understand the benefits and losses from the decarbonisation process. Finally, the component shows the inclusion and exclusion dynamics resulting from technological change in the region.

Concepts

The socio-political component relies on the theory of *Technological Dramas* (Pfaffenberger, 1992). This approach understands technological shifts – such as decarbonisation – as technological dramas, i.e., a narrative battle among different actors to determine the meaning and implications of the technology. A technological drama is a discourse of technological "statements" and "counterstatements", in which there are three recognisable processes: i) technological regularisation; ii) technological adjustment; iii) technological reconstitution. The three processes can be described as follows:

- *technological regularisation*, a design constituency tries to impose change, i.e., to appropriate the technological process so that its features implicitly embody the political aim of altering power relation

- *technological adjustment*, the impact constituency – the people who lose when a new technology is introduced or when a technological shift is ongoing – engage in strategies that try to compensate for the loss of social prestige or social power

- *technological reconstitution*, the impact constituency tries to reverse the meaning of the technology imposed through regularisation. Differently from technological adjustment strategies, the strategies related to technological reconstitution attack the foundation of technical regularisation, and activate a self-conscious "revolutionary" ideology aimed at producing a symbolic inversion and antisignification of the technological regularisation process.

Methodology

The socio-political component was based on a semantic analysis of public statements and counterstatements of different social actors about the energy transition and coal phase-out. The analysis was carried out at the level of the PAR and was focused on statements and counterstatements of key regional stakeholders in the public debate.

2.2.5 Socio-ecological and technical component

Domain of enquiry

The socio-ecological component provides an overview of the capacity available in the case study region to shape its decarbonisation pathway. The focus on transformative capacity allows us to discern how far a region is actually able to deviate from its current (carbon-intensive) path toward sustainable outcomes.

Transformative capacity is understood in this context as an evolving collective ability to conceive of, prepare for, initiate and perform path-deviant change towards sustainability within and across the multiple complex systems that constitute the regional or urban area undergoing a clean energy transition (CET). As a systemic capacity, it is not attributable to any single actor but rather results from the interactions and orientations of multiple actors in the regional or urban economic development system involved in shaping its decarbonisation pathways. The diagnosis of transformative capacities thus enhances knowledge of key capacities hindering or facilitating

purposeful transformation, ultimately permitting them to be addressed as part of capacity development activities.

Concepts

Transformative capacity is strongly influenced by the governance of the regional decarbonisation or clean energy transition in question. Three **governance and agency** components are critical to the ability of a regional development apparatus to foster the transformability of a system: the inclusiveness and multiformness of governance arrangements (C1); polycentric and socially embedded transformative leadership (C2); and the empowerment and autonomy of relevant communities of practice (C3). These elements are preconditions for the transformability of a system: there needs to be connectivity and responsiveness built into governance, effective leadership able to bring people together around a vision, and actors empowered to experiment and innovate. These three attributes must be developed by stakeholders in **capacity development processes** to enhance their transformative potential, including enhancing understanding of the systems of which they are a part (C4), engaging in participatory visioning and alternative design scenarios (C5), experimenting with novel solutions to social needs (C6) and ensuring that these innovations can be embedded (C7). Ideally, this can be seen as a learning loop, where system(s) understanding helps inform visions and pathways, which in turn orient experimentation, with successful innovations being embedded and better system understanding resulting from this process. These processes should be fed back into governance through social learning (C8) as well as the effective involvement of actors at different scales (C9) and levels of agency (C10).[6]

Methodology

These components were assessed by way of mixed quantitative-qualitative interviews with various stakeholders engaged in the CET. The aim was to obtain and contrast differential stakeholder assessments of transformative capacities. A diverse set of stakeholders were interviewed, representing public, private, third and civil society actors. Respondents were asked to assess statements corresponding to each measure of transformative capacity according to whether and how much they agreed with or disagreed with the statements.[7] They were then asked to elaborate their answers in open follow-up questions, which were subsequently transcribed, coded and analysed.

2.2.6 Synopsis of the five components

The features of the conceptual side of the Multidimensional Analytic Framework are summarised in the synoptic table reported in Table 1.

Table 1 - Synoptic table of the five components of the MAF

Component	Research focus	Unit of analysis	Domain of enquiry	Unit of observation	Methodology
Socio-Cultural	Territorial change	Coal & Carbon territory	Stress strains in the territorial organisation	Strain Situations	Focus group mapping

[6] For full elaboration of transformative capacity and its components, please refer to Wolfram (2016, 2019) and Wolfram et al. (2019).

[7] Possible responses were: 1 – completely disagree; 2 – somewhat disagree; 3 – neither agree nor disagree; 4 – somewhat agree; 5 – fully agree; don't know.

Component	Research focus	Unit of analysis	Domain of enquiry	Unit of observation	Methodology
Socio-Psychological	Territorial change	Coal & Carbon territory	Place attachment, Decarbonisation, Resilience and Coping	Citizens	Online Survey
Socio-Economic	Structural change	Labour-Market Area	Change in the socio-economic structure	The area as a whole	Quantitative data collection
Socio-Political	The clean-energy transition	Political Administrative Region	Narrative battles to determine the meaning and “appropriation” of the energy transition	Statements & Counterstatements	Text research
Socio-Ecological & Technical	The clean-energy transition	Political Administrative Region	capacity available in the region to shape its decarbonisation pathway	Multilevel System interaction	Semi-structured interviews

2.2.7 Cross-cutting elements

The three cross-cutting elements of the Multidimensional Analytic Framework, i.e. challenges, coping strategies and gender, are nurtured and can be better understood in the light of each and all the components of the MAF.

Challenge: In the case study we focus on the challenges faced by the CCT, i.e. from the perspective of the CCT. A challenge can be defined as composed of two elements: (i) a current situation (as the territory makes sense of it); (ii) the specific desired outcome(s) of a process intended to change that existing situation. Please note that a challenge is a social construct as the sense of the current situation only exists in a given social context (i) and that the outcome is desirable by the territory itself (ii). Depending on the state of awareness of the territory, the degree of clarity and definition of the challenges may vary a lot. In this respect, depending on the cases, the territorial challenge(s) may be rather vague or well structured (e.g. in the latter case also including indicators to assess the success in achieving the challenge).

Coping strategy. A coping strategy is defined here as the strategy adopted to cope successfully with a territorial challenge. For each challenge, there can be several coping strategies. Depending on the case, two or more coping strategies may be coordinated with each other, but also in contrast and competition with each other. A coping strategy can be articulated in (i) a vision or orientation for the territory; (ii) a set of actions undertaken to fulfil the vision.

Gender dimension. The gender dimension highlights how a challenge may affect differently men and women, and how gender differences might be relevant to the coping strategies adopted.

2.3 Activities

2.3.1 Desk research

The case study started with a desk research activity. The desk research was aimed at (i) delineating the case study across its three units of analysis (CCT, PAR, LMA); (ii) collecting relevant dates and basic information on the region; (iii) collecting information needed for the implementation of the five components (including, inter alia, also a stakeholder analysis at the PAR level). The desk research allowed analysing of a wide set of sources, including documents and reports, available data sets, previous research and studies, policy documents and others. The results of the desk research have been collected in a State of the Art Report.

2.3.2 Focus groups (socio-cultural component)

Focus groups support qualitative measurement on research issues in which an inter-subjective agreement is needed, and for those issues, different types of actors need to triangulate. The analysis focused on the territorial stress induced by globalisation in the CCT. As “territorial stress” is not directly observable, following the socio-cultural component guidelines, the focus group has aimed at mapping the “strain situations” (i.e. conflicts, impasses, etc.) and related impacts in the CCT.

The focus group was organised and conducted on May 5, 2022 in Leoben (Upper Styria) by the case study research team of ZSI. All six different areas of change were discussed during the meeting. The focus group was composed of two moderators of ZSI, and six participants. Gender

balance was ensured in the research team (one man/one woman) as well as in the group of participants (three men and three women). Two of the participants had to decline their participation in the focus group the very day on short notice and were interviewed individually instead. The interview results have been integrated in the report.

Some of the group members, who took part in the discussion have a sort of “double role” and belong to more than one of the participant categories mentioned below. These participants can be seen as e.g. community leaders and memory as well as knowledge keepers. The column “profile” contains the relevant stakeholder group background of the participants (Table 2). The two interviewees were a local councilwoman who is regarded as community leader and knowledge keeper, and a local historian who is a knowledge and memory keeper especially with regard to the history of the local steel production in Leoben Donawitz.

Table 2 - List and features of focus group participants

Code	Profile	Com Leader	Knowl Keep	Memory Keep	Gender
P01	Coal & Carbon Industry & local councilman	X	X		M
P02	Regional member of a national e-mobility network		X		F
P03	Community Leader (Youth Groups, Women, Religious leader)	X	X	X	F
P04	Civil society leader and local politician	X	X	X	M
[P05	*Local councilwoman (interviewee) & responsible for climate adaptation*	*X*	*X*		*F]*
[P06	*Local historian of steel industry (interviewee)*		*X*	*X*	*M]*

2.3.3 Survey data collection process (socio-pychological component)

The survey was conducted as an online survey in the region of Upper Styria, including NUTS3 regions AT223 and AT226, where the steel industry of Styria is largely concentrated. We started disseminating the survey in October 2021, and did another round of dissemination in April 2022 for gathering more responses. We used the following sampling and collection methods for the survey:

- Publication of survey information in municipal papers of the cities of Leoben, Judenburg, and Kindberg

- Field research: information stands linked to local farmer markets in 4 main cities in Upper Styria were set up for a half day each, and discussions on the energy transition and the survey with individual citizens conducted. October 2021 in Kapfenberg, Leoben, and Kindberg, and in April 2022 in Bruck an der Mur (one more stand was planned for Judenburg, but had to be cancelled due to bad weather conditions). We disseminated folders with survey invitations, and invited citizens to fill in the survey. While this provided valuable insights in the perception of the energy transition by citizens, it did not result in significant response.
- Dissemination via multipliers: Regionalmanagement Obersteiermark Ost (via social media), Mining University, etc.
- E-mailings to individual contacts
- Dissemination at local high schools

Source : picture ZSI, October 2021, survey promotion in Leoben & Kapfenberg

2.3.4 Socio-economic data (socio-economic component)

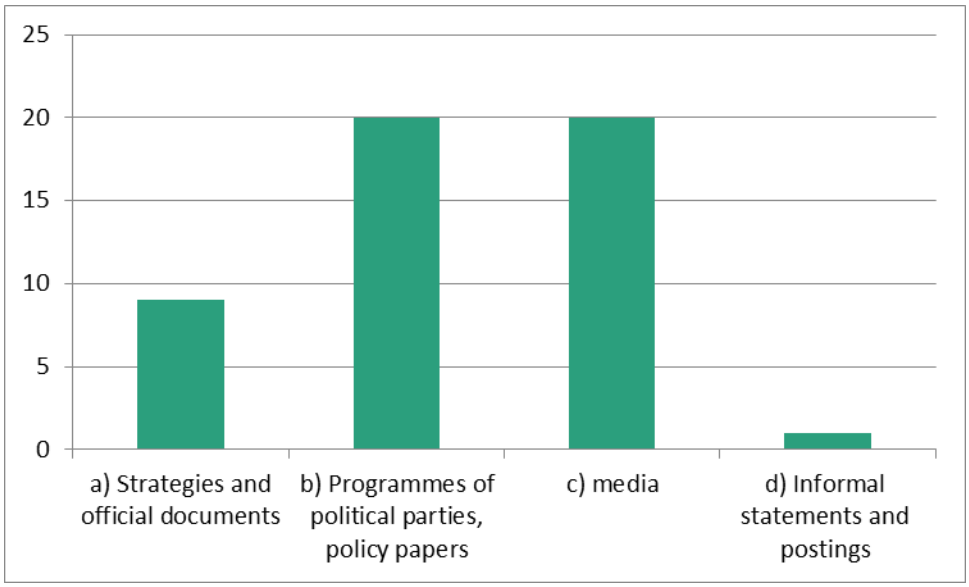
Socio-economic data has been collected from national sources, particularly Statistik Austria. Furthermore, Eurostat data has been used to provide an overview of the region's economic, financial and demographic composition based on a descriptive analysis. Overall the period covered ranges from 1991 to 2021, and was focused on demographic data; economic data; public finance data. The data were collected for the three units of analysis, CCT, PAR, and LMA as well as for upper levels (NUTS-2 region), country and European levels. Sector-specific and region-specific

peculiarities were located and processed. The data will be used further for comparative analysis as well as macroeconomic modelling and simulation.

2.3.5 Text analysis (socio-political component)

Several ***sources for the text analysis*** have been investigated (e.g. media, party programmes, strategy documents), covering the **period** from June 2016 – December 2021. Articles and documents were collected by using code words and search engines like google search, Austrian Press Agency (APA OTS), or Wiso Database.[8] 50 texts were selected for analysis and coded in detail with the help of MAXQDA software for qualitative data analysis. In total 956 statements were coded out of the 50 texts. We have identified many more media articles from different newspapers, but they were often based on the same source (APA or company statements) and provided similar information. We have chosen the most substantial article in these cases and included it in our sample. Figure 4 shows the different types of sources for the text analysis and the number of articles for each class.

Figure 4 – Types of sources for text analysis



Note: The number of articles used to analyse local discourse, narratives and field of power is shown for each source type.
Source: own presentation.

The sources can be described as follows:

a) Strategies and official documents, e.g. Climate and Energy Strategy of Styria 2030, Economic Strategy Styria 2025

[8] WISO database: https://www.wiso-net.de/

b) Programmes of the political parties, policy papers and statements of interest organisations, NGOs, and Trade Unions, e.g. programmes of the main political parties in the province of Styria (ÖVP, SPÖ, FPÖ, Grüne)
c) Media, e.g. Austrian Press Agency (APA OTS), derStandard, Kleine Zeitung
d) Informal statements and postings
e) Social Media, no statement included in sample

2.3.6 Semi-structured interviews (socio-ecological and technical component)

Mixed quantitative-qualitative interviews with various stakeholders engaged in the CET have been conducted. The aim was to obtain and contrast differential stakeholder assessments of transformative capacities. In total, 8 stakeholders were interviewed, representing public, private, trade unions, higher education, science, non-governmental organisations, research institutions and civil society actors. Respondents were asked to assess statements corresponding to each measure of transformative capacity.[9]

The interviews were conducted in the period November 2021 – January 2022. All 8 stakeholders were male. They represented a variety of stakeholder categories, including policy actors, business, trade unions, interest organisations (see Table 3 for overview).

Table 3 - Interview stakeholder categories

	A1 - Environmental policy actor	A2 - Economic policy actor	A3 - Actors representing different scales (local, regional, national/EU)	B1 - Key industry facing decarbonisation / other big players	B2 - SMEs and their representations, e.g. chambers of commerce, skilled crafts	C1 - Social	C2 - Ecological	C3 - Gender	C4 - Other important local stakeholders	D1 - Trade Unions	D2 - (national/international) NGOs, energy and environment	D3 - Scientific and research, social and/or technical in relation to the transition	D4 - Higher or Further Education
Upper Styria	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	-	-	-

[9] Possible responses were: 1 – completely disagree; 2 – somewhat disagree; 3 – neither agree nor disagree; 4 – somewhat agree; 5 – fully agree; don't know.

2.3.7 Data reporting, interpretation and the case study report

The broad set of research activities carried out for the development of the case study implied an extensive data processing and reporting activity. For each of the above-mentioned components, a short report describing the data collection procedure as well as a dataset were produced. This will allow making the data collected available to the public in the future in accordance with the FAIR principles. All the data collected have been interpreted by the case study team with two complementary approaches: through a component-focused interpretation (see Chapters 2-4); in the light of a holistic understanding of the case (see Chapter 5). The results of such an interpretation are reported in the next chapter of the case study reports.

CHAPTER 3

ANALYSIS OF THE COAL AND CARBON TERRITORY

3 Analysis of the Coal and Carbon Territory

3.1 Overview of the coal and carbon territory

3.1.1 Historical development

The region of Upper Styria has a long history of mining and production of metals, where the first excavations are considered to have already taken place in the 8th century when Romans were still present in the territory (Roth, 1984). Steel production in Styria started relatively late around 1660, but in the 19th century the Styrian steel industry began growing rapidly, from about 20.000 metric tons in 1820 to more than 80.000 in 1860. In the late 20th century, however, the industry faced several crises and productivity issues due to open trade rules introduced at the time by the World Trade Organisation which led to increased competition with low-wage economies. This ultimately resulted in massive lay-offs and high unemployment rates: about 46% of workers overall lost their jobs in the region between 1981 and 1991 (Hoffmann, 2015). The overall population of Styria began to shrink between 1971 and 1991, something unthinkable in most other European regions at that time, further illustrating the severity of the crisis (Hoffmann, 2015). To address the crisis, policy makers and industry leaders adopted the economic cluster idea and implementation of distributed leadership styles within those industry clusters, which helped to rebuild the Styrian economy and managed to turn many of the remaining companies into high tech clusters that are still relevant for the Styrian and Austrian economy of today (MacNeill & Steiner, 2010).

A *territorial anamnesis* exercise was performed in the focus group, in which the participants identified several phases in the development of the territory within the time period 1950-2022, which was analysed in the discussion. Three core phases have been identified as mainly challenging for the energy transition ambitions, and they are introduced and shortly described below. These timespans and their effects on ongoing de-territorialisation processes are not necessarily and only linked to the history of industrialisation in the area itself, or the decarbonisation efforts of the steel industry in the region so far. The focus group detected strain situations, challenges and negative impacts connected to structural developments in a variety of *grand challenges.*[10] Key issues are for example housing, or the health care system in several parts of the regions (P01; P03; FG). The failing of structures for the care system has manifold effects on the older population as well as on caregivers and became highly problematic during the COVID pandemic.

Some of the phases detected have a clear starting and ending point, most of the phases described below continue to be relevant, in terms of having shaped certain groups and members of the regional population and their territorial identification. Other topics such as the insufficient and negligent waste management of hazardous materials during the 1970s and 1980s have literally been forgotten for some time, but have gained momentum again as they reappear by posing problems for construction. The three main phases identified cover the topics industrial transition, infrastructural, and agricultural transition and are deeply linked to a successful, stagnant or failed energy transition.

[10] Climate Change & Sustainability, Energy Transition, Ageing, Health Care, Gender & Diversity, Equality, see also Susatinable Development Goals, UN 2022; https://www.un.org/sustainabledevelopment/, [12.05.2022]

Steel industry linked phases – voestalpine's identity-forming function for employees: 1950s - 1980s.

The research area in Upper Styria is deeply rooted in the history of ore mining and steel manufacturing, the latter dating back to the 14th century. Today the collective memory of the different timespans of rise and decline of the region being connected to the territorial industrial transformation certainly differs among the local and regional population depending on sociodemographic factors such as age, educational background, gender etc. In Austria the "image" of the Upper Styrian region along the Mur-Mürz river valley[11] is still connected to the crisis of the state-owned steel industry in the 1980s. At the time the region and its population had to endure visible air and dust pollution as byproduct of the steel production process and inadequate filter systems that were used until the beginning of the 1990s. Leoben, for example was literally a "red town"[12] covered in red dust from the emissions of the steel plant.

Figure 5 - Picture of the production site of voestalpine in Leoben-Donawitz during the 1980s

Source: own picture, with courtesy of Geschichteclub Alpine

Even though this crisis dates back almost 40 years, and the region features today a flourishing and innovative industry, this specific image that was coined for the region still reappears in Austrian's remembrance. Back then in the 1980s and early 1990s several crises and productivity issues hit the then still nationalised voestalpine, which left a lot of workers unemployed with effects on their families and the general regional social fabric. This was due to the enforcement of open trade rules

[11] The authors do not refer to the still often used term „Mur-Mürz furrow" (Mur-Mürz-Furche) due to the fact that this terminology is seen as derogative by the local population. As the focus group participants claimed, "a furrow is not even a geographic expression for a certain kind of landscape or geographical site, but refers to an agricultural term". In addition it is viewed as a term preserving the timespan during the 1980s and early 1990s when The Upper Styrian region suffered from socio-economic decline and crisis of the state-owned steel industry. (FG Upper Styria P01, P02; P03; P04 2022).

[12] Interview with participant P06, 05.05.2022

by the WTO which led to increased competition with low-wage economies and "exposed the local industry as overmanned and inefficient" (MacNeill & Steiner, 2010). This is still known as the crisis of the nationalised industry and memories of this time still sit deep in the local population. While this crisis hit many regions in Austria, Styria, and especially Upper Styria, were hit especially hard. The reduction in the work force was dramatic for the region and shapes the perception of Upper Styria within Austria until now. About 46% of all workers overall lost their jobs in Upper Styria between 1981 and 1991 (Hoffmann, 2015). In the time between 1971 and 1991 the steel company Böhler for example reduced its number of employees in the region from 11.400 to 3.900, voestalpine reduced theirs from 16.500 to 6.400. A quote/citation of one of the focus group participants pointed out: *No wonder, as long as these memories and perceptions continue to live on among those who are not locals, we will always have to defend ourselves and say: "no, it is not like that anymore!" And if you have to defend yourselves continuously/over and over again, then it becomes a labelled old times stigma that stays alive. (FG P04, 05.05.2022)*.

Other than the outcome of the text research results the participants of the focus group revealed a rather challenging and more processual situation of the main player in the regional steel industry, namely voestalpine. Even after the main crisis at the end of the 1980s, the different production sites were having financial and economic unstable times up until today. These ups and downs are aligned to a fluctuation of employees and had effects on the regional labour market, affected regional mobility and internal migration flows. Depending on the specific global economic situation one or the other production site is making profits while for example other voestalpine subsidiaries in the region may be having a harder time.

***Faulty/"Wrong structures"[13] and their present implications* - Late 1980s and beginning of the 1990s - structural and infrastructural failures**

In close connection to the efforts being made so far in decarbonizing the regional industry – as Upper Styria is one of the massive CO2 emitters nationwide (Ruzicka, 2015) – infrastructural investment in fossil fuel energy sources and gas pipelines have shaped not only industries' needs for energy consumption for decades but are now affecting the regional population as a whole. With the beginning of the Ukraine war in February 2022 the topic energy resources and energy consumption demands heated up again. *In the municipality we are massively confronted with the topic since the beginning of the [Ukraine] war! The whole population is talking about nothing else than energy supplies!*[14]

The phase of implementing infrastructures depending on fossil energy resources (gas and oil pipelines) detected by the focus group participants are not only seen as failures made decades ago, but as "structural mistakes"[15] that hinder seriously taken efforts in the decarbonisation process

[13] Quotation focus group participant P03.

[14] Quotation focus group participant P01, german: *Wir sind in der Gemeinde massiv konfrontiert mit diesen Themen. Die ganze Bevölkerung redet seit Beginn der Ukraine Krise über nichts Anderes mehr als das Thema: Energieversorgung*

[15] The term *"structural mistakes"* expressed failures in regional and national policy strategies that are controversially discussed in Austria's media since the beginning of the Ukraine war. Former politicians, like the former chancellor of the social democrats Christian Kern repeatedly stated that political decisions made over the last decades have been supporting the present dependence from Russian gas imports. As a result industry and private households heavily rely on fossils while at the same time the expansion of renewables had been delayed. Herbert Eibensteiner, CEO of voestalpine has opened a debate on

in various fields. One of the main reasons is seen in past and present national and regional policy failing. The funding structures and funding system, which are the responsibility of the Styrian government lack the ability to support the population in its individual capacity to enhance the energy transition (cf. FG Upper Styria 2022). Funding programmes for private households such as financial support for changing from oil heat systems to PV are mismatched. Information management and support for the civil society is missing or badly managed, as the focus group participants stated (ibid.). Another field of concern is limitations of the public transport system, which has been thinned out in some of the rural areas and which has also had effects on internal migration phenomenons, especially on youth migration. Further reasons that hinder an acceleration towards a sustainable energy transition are the missing technological solutions, be it as stand-alone technology be it that the energy infrastructure is not technologically aligned with renewable energy technologies.

voestalpine - Technology leadership: towards *Green Steel*: early 2000s to 2022

voestalpine has been working on the technological transition to green tec steel[16] production since over more than one decade. This of course is no stand-alone feature, as Europe's steel industry is working on emerging technologies to fulfil its goal of decarbonisation at least until 2050. voestalpine as the main steel producing company in Austria has taken a proactive approach to this issue and is currently developing technology that allows for the production of "Green Steel" with Hydrogen produced by renewables. This shall help to ensure the future competitiveness of Austrian steel production on a national, European and global scale. However, many hurdles are still in the way, the technology is not yet fully developed and even when it is, producing clean Hydrogen via renewables will require a much larger renewables infrastructure than Austria can currently provide. Technological leadership is seen as one of the most important points to keep up with global markets and to ensure the preservation of jobs in the long run (FG P01).

Industrialised and globalised agriculture and effects of the construction boom and soil sealing: 1970s - 2022

Next to the enormous energy consumption of the steel producing industrial sector, the agricultural sector consumes energy at high rates, and notably the water consumption in agriculture is massive. The focus group discussed the regional effects of the industrialisation of agriculture[17] during the last four decades and its manifold negative impacts and effects on nature, landscape, health and water supplies. The focus group raised concern about the effects that especially fertilisers already have on the general water and drinking water supplies. The globalisation of agriculture in terms of using fertilisers and monoculture farming was highlighted as counterproductive not only to efforts in the energy transition in the Upper Styrian area generally but with regards to the transformation of the regional landscape as well. As the participants claimed, mitigation actions to reduce the green house gas emissions have not been implemented

Austria's failing crisis policy claiming that Austria's industry is not involved in energy preparedness concepts or worst case scenario in case Russian gas imports would be diminished or stopped. See also: https://www.derstandard.at/story/2000136022051/moeglicher-gasstopp-unternehmenbeklagen-fehlenden-notfallplaene-der-regierung, [25.05.2022]

[16] At present a unanimous definition of the term "green steel" is being discussed controversially, most notably it refers to a steel producing process with the lowest carbon footprint currently possible.

[17] Cf. Union of concerned Scientists, 2008. The Hidden Costs of Industrial Agriculture.

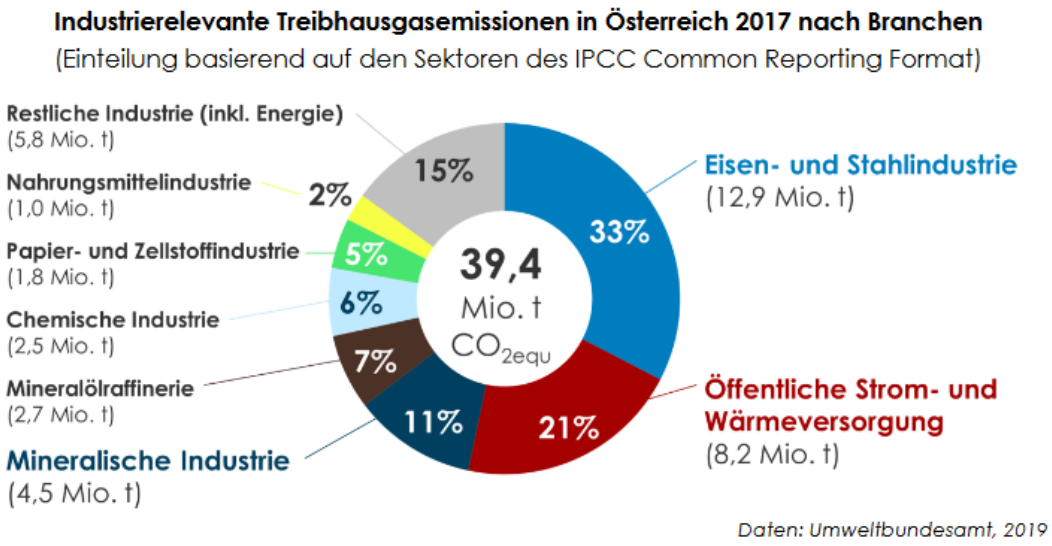
thoroughly enough with regard to farming. Former agricultural or forest areas had been way too quickly converted to residential land. The attraction of single family houses (*Häuslbaue*r) dating back to late 1970s and early 1980s in the area is still a steady trend and has not lost its appeal for many of young families in the region.

3.1.2 Ecological and environmental situation

The overall environmental situation in Upper Styria, and in particular the impact of the steel industry, has improved significantly since the 1980s. At the time the region was marked by important emissions, e.g. of “red dust”. Street interviews of citizens in Upper Styria, conducted in October 2021 and April 2022 have confirmed this improvement; pensioners with whom we discussed remembered the times of important dust emissions and mentioned the significant improvements of quality of life as compared to the past. But waste and pollution can still re-appear as a current problem deriving from improper storage of hazardous industry waste in the 1970s and 1980s and affect multiple areas, e.g. during construction projects as was mentioned by participants in our focus group discussion.

With its industry, Upper Styria contributes significantly to CO2 emissions. The Austrian steel industry has an unproportional impact on Austria´s emissions, since the industry is large compared to the country´s size and population. Overall, Austria produced 7.4 million tons of raw steel in 2019, which amounts to more than 830 kilos of raw steel per inhabitant (Bank Austria, 2020: 8). As a comparison, the steel industries of France and Great Britain produce 14.5 and 7.2 million tons of steel respectively. Also, 90% of Austria´s Steel is produced with the more energy intensive basic oxygen process, also called the Linz-Donawitz procedure (named after the location of the two main Austrian steel producing facilities); on European average only 59% and worldwide only 72% of Steel are produced with this more energy intensive procedure. This emission pattern is visible in the sector specific emission statistics of the Austrian environmental agency, where Iron and Steel production (light blue) are featured as the single most prominent category responsible for 33% of industrial CO2 emissions, which is more than all of public electricity and heating supply produce (22%). This accounts for all of the Austrian steel industry, but it is mostly concentrated in the NUTS2 region Upper Austria and the NUTS3 regions of our case study in Upper Styria, showing their overproportional impact on Austrian CO2 emissions.

Figure 6 - Industry relevant emissions in Austria 2017 by sector[18]



Other Styrian pollution and ecological issues are related to vehicle traffic and mobility, and to land use planning and soil sealing. Natural hazards such as flooding and mudslides are obviously an issue in a region marked by mountains and by the valleys of the rivers Mur and Mürz.

The Styrian climate strategy states that according to climate scenarios for Styria until 2100 in the "business as usual scenario" the medium air temperature in Styria will rise by 4° Celsius, rainfall, while staying relatively constant on a yearly basis, will increase by 24% in winters and be reduced throughout the rest of the year, there will be half as many freezing days (73 instead of 146), which will hit especially Upper Styria hard, while the number of days with extreme heat will rise significantly as well, especially in the southern parts of Styria.[19]

Environmental activism is not very strong in Upper Styria, although the *Fridays for Future* movement is present and representatives of the younger generation have mobilised. Their role was seen ambigious in our focus group discussion. Even though it was common understanding that efforts in environmental protection need to be supported, for some participants it was not a convincing or striking argument that students taking part in the demonstrations were acting out of their own strong beliefs but rather used the Fridays for Future movement in order to avoid going to school (FG Upper Styria 2022; P01). Their behaviour, as it was mentioned by one of the participants seemed not consequent in relation to the goals they were promoting: while claiming to act against climate change and therefore being part of the weekly organised demonstrations, one could see the young students at the train station *"all rare earths [cell phone] and plastic [drink bottles] in their hand"*, which seemed as a contradiction to one focus group member who stated that this is *"everything they demonstrate against"* (ibid, P01, 01:21:20). Other participants

[18] Wirtschaftskammer Österreich, Industriellenvereinigung, 2019.

[19] See https://www.technik.steiermark.at/cms/dokumente/12449173_142705670/f9e55343/KESS2030_Web_Seiten.pdf

highlighted the honest effort of a few young in the region of turning climate change round, and who organised to go to the regional capital for the demonstrations.

A skepticism towards certain forms of renewable energy can be observed; e.g. some citizen mobilisation is happening against a hydropower plant planned close to Leoben along the river Mur, and a few years ago a biogas plant in Leoben had to shut down due to complaints of citizens. However, these perceptions may have changed in the current situation of energy scarcity. Overall in Styria there is also some mobilisation against a pumped hydropower plant and skepticism towards wind energy.

3.2 Socio-cultural component

3.2.1 Summary of results

The focus group methodology included six different categories of analysis, which were developed to examine individual or group challenges and potential stress-inducing conflicts, referred to as *strain situations*: 1.) *Financescapes*: examines the impact on the regional population caused by potential disinvestment, private investment in the region, and top-down projects 2.) *Technoscapes*: investigates effects of digitisation and technological changes.3.) *Ethnoscapes*: investigates effects of health and ageing, youth migration etc. that might have stress related impacts. 4.) *Ideoscapes*: investigates phenomenons such as populism and global environmentalism. 5.) *Naturescapes*: which identifies stress related effects caused by the pandemic or global warming. 6.) *Mediascapes*: highlights the perception and possible stress induced effects of regionally prevailing media discourses.

The method was applied in order to enrich insights into mere technological and economical phenomena of the clean energy transition (CET) process through investigating the many effects of regional socio-cultural stress related dimensions connected to the CET. These effects, investigated based on the above mentioned six different possible “areas of challenges”, i.e. “strain situations” highlight 1.) Long-term, mid- and short-term effects of challenges faced by different societal groups of the regional population in the Upper Styrian region. 2.) The gathered data provides insights into individual and group afflicted conflicts and stress related developments in the investigated area. The aim of the focus group study was to obtain results on de-territorialisation processes that might be linked to a delay, stop or a reverse of the clean energy transition.

The main results are summarised below. The following paragraph is dedicated to an overview of the strain situations mapped during the research, which constitutes the main unit of observation of this component.

List of the strain situations mapped

A total of 40 strain situations (indicated by ≈) were mapped during the focus group. A list of the strain situations and related features is provided in the table below. Table 4 shows the strain situations mapped, classifying each strain situation in relation to (a) type of the strain situation; (b) areas of change and related stress factors; (c) position in territory; (d) position in time that marks the year in which the strain situation started.

Table 4 – List of the strain situations mapped

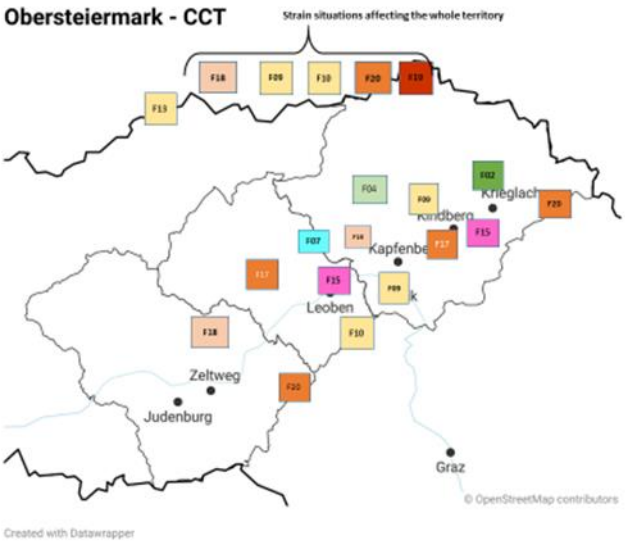
≈	Name	Type	Area	Factors 1st	Factors 2nd	Geo	Time
1	Key issue – energy transition technologies	impasse	Techno-	F20	-	Whole territory	1980s
2	Insufficient Public transport system	Endo Conflict/dependence	Finance-	F10	-	Hönigsberg	ca. 2015
3	Depopulation of small valleys	Endo conflict	Ethno			Mur-Mürz valley	ca. 2015
4	Energy supply, War in Ukraine	Exo conflict	Nature	F21		Whole territory	2022
5	Missing tech solutions in (infra)structural systems fail current carbon reduction strategies	Exo Conflict	Finance	F09		whole territory	1980s
6	Emotional anger –– Atomic power "sold" as green energy	Exo conflict	Techno	F20		Leoben, Kindberg, Bruck, Kapfenberg	2021/2022
7	Centralisation –	Endo Conflict	Techno/Nature	F20	F18	whole territory	1990ies
8	slowing of energy autarky	dependence	Techno	F20		whole territory	2020
9	Digitisation – lost childhood	Exo conflict	Techno	F16		whole territory	2020
10	Mainstream Media as opinion leader	Exo conflict	Ideology	F14		*W.t.*	2015
11	mismatch of renewable energy funding	dependence	Nature	F21		Leoben, Kindberg, Bruck, Kapfenberg	2022
12	Transparent funding processes for green energy – no greenwashing	Exo conflict	Finance	F10		W.t.	
13	Defining sustainability	Endo conflict	Techno	F20			2015
14	Infrastructures, esp. gas excludes other energy sources and vice versa (see Nr 5)	Endo conflict, dependence	Techno	F20		*Hönigsberg*	1980s
15	Wind power plants – *tech vs nature*	Endo conflict	Techno	F20		*Kindberg, Pretul, Stuhleck*	2010?
16	Estrangement – automatisation	Exo confict	Techno	F17		w.t.	2010
17	Transformation of job profiles – danger of unemployment	Exo conflict	Finance	F09		w.t.	2018
18	Increase of population	Contradiction	Ethno	F03		Mürzzuschlag	2019?
19	Mismatch of qualification and demands – youth employment	Endo conflict,	Techno/Ethno	F16	F01	*w.t.*	2020
20	Downsizing of regional public transport system -	Endo Conflict	Finance	F200		Hönigsberg	Middle of the 1980s

♒	Name	Type	Area	Factors 1st	Factors 2nd	Geo	Time
	train/bus infrastructures						
21	Intertwined or linked phenomenons: depopulation of small villages	Exo conflict/dependence/impasse	Finance	F09	F10	Hönigsberg	Early 1990s
22	Youth outmigration	Endo conflict	Ethno	F01		Leoben, Bruck, Kapfenberg, Mürzzuschlag. Hönigsberg, Langenwang	2020
23	Tourism - locals avoid the areas	Exo conflict	Ethno	F04		Präbichl, Hochschwab, mountain area),	2014
24	Over tourism	Endo/Exo conflict	Ethno	F04		Grüner See (Hochschwab, mountain area)	2015
25	"Starvation" of Public transport structures		Finance	F13		*Neuberg an der Mürz*	Midst of 1990s
26	Disinvestment	Exo conflict	Finance	F13	F11	Kapfenberg	2022
27	Rural sprawl	Endo conflict	Ethno	F01		*Mürztal, Ennstal*	2010
28	Property vacancy	Exo conflict	Finance	F11		Hönigsberg, Kapfenberg	2017
29	Die-off of local centers	Endo conflict	Finance	F13	F11	Kapfenberg, Neuberg	2015
30	Regional policy decision-making processes	Endo conflict	Multiple	F09	F13	w.t.	1990s
31	"Inherited" waste-pollution	Exo conflict	Multiple	F18		w.t.	1950s
32	Natural hazards	Endo conflict/dependence	Nature	F18		w.t.	1950s
33	Floods	Endo conflict/dependence	Nature	F18		Liezen/Bruck, Kindberg/Aumühl	1950s
34	Negative effects of industrialised agriculture	Exo conflict/impasse	Nature	F18		w.t.	End of 1990s
35	new concepts of recycling	Exo conflict	Nature	F18		w.t.	2015
36	Ageing, care and nursing crisis	Exo conflict/dependence	Multiple	F02	F19	Krieglach, Langenwang,	2020
37	Downsizing of regional medical health care	Exo conflict	Multiple	F09	F19	Kapfenberg, Mürzzuschlag	1980s
38	Global environmental activism	Endo/exo conflict	Ideologies	F15		Kapfenberg, Kindberg, Krieglach	2019 – beginning of 2020
39	Regional industrial steel crisis, *labelled old times stigma*	Endo conflict	Territorial stigma	F07		w.t.	Since 1980s
40	Nostalgia	Endo conflict	Ideologies	F08		Differs over regional areas	Since 1960s

Distribution of the strain situation in the geographical map

Figure 7 shows the location of the strain situations in the map of the CCT. 17 out of 40 mapped strain situations affect the whole Upper Styrian/CCT area. Most of the strain situations are distributed across the eight municipalities and industrialised areas of the CCT, concerning particularly Leoben, Kapfenberg, Bruck, Kindberg, and Krieglach. The more remote areas in the mountain valleys and areas around the CCT municipalities show slightly different regional strain situations, such as limitations on health and elderly care, migration from cities to remote areas, and overtourism in specific spots.

Figure 7 – Distribution of the strain situations in the geographical map



Sources: ENTRANCES Focus Group Discussion.

Distribution of the strain situations in the time map

The focus group approach was additionally based on a mapping exercise in terms of time periods and regional historical events that participants considered particularly relevant and that they felt had a significant impact on current regional socio-cultural and socio-economic dynamics. Table 5 shows the starting year of the strain situations mapped, and the duration of the strain situation. The mapping results revealed that most of the current regional challenges have their origin in the 1980s and were described as short sighted politically based mismanagement decisions (cf. FG Upper Styria 2022), whereas the regional and local populace was not given a say.

Table 5 – List of strain situation

Years	Phase	Strain Situation	Duration (years)
1950s to 1970s	1. Postwar period	Conflicts related to effects of climate change, such as natural hazards (floods) (〰 32) aggravating during the last 20 years due to intertwined conflicts, e.g rural sprawl (〰 27) or industrial agriculture (〰 34)	45 until today
	over	Strong identification with the social democrats and voestalpine, conflict related to old-time nostalgia (〰 40)	20
1970s	2. Soil sealing - ongoing	Multiple linked Conflict: soil sealing and boom in single-family homes (real-estate boom) as a result of regional policy decision-making processes (〰 30)	50
		Die-off of local centers (〰29)	20
1980s – early 1990s	3. voestalpine steel crisis - over	Conflict in the wake of the steel crisis of the former nationalised industries (〰39)	10 - 15
Late 1980s and 1990	4. Failing and wrong infrastructural decisions in the field of energy supply public transport (〰 25) and health care– ongoing	Conflict over established gas infrastructures that aggravate and delay energy transition, Missing tech solutions in (infra)structural systems fail current carbon reduction strategies (〰 5) Conflict over the downsizing of regional medical health care – late effects as a consequence of the care crisis (〰 36), (〰 37) in 2020	40 until today
1990s	5. intensive and monoculture agriculture harms drinking water supplies and affects landscape - ongoing	Conflict over industrial agriculture (〰34)	30 until today
2018	6. Labour market mismatch	Multiple and intertwined conflicts, e.g. Youth outmigration (〰22)	4
		depopulation (〰21)	4
		Mismatch of qualification and demands – youth employment (〰19)	4
2000 until 2022	7. Care and nursing crisis - ongoing	Conflict as a consequences of cutbacks in the care sector conflict became striking in the wake of the COVID pandemic (〰36)	10
	8. Disintegration of village structures intensifies social isolation	Conflict over regional policy decisions (〰30) disinvestment building vacancy versus real estate's construction boom loss of local social contacts	22

Sources: ENTRANCES Focus Group Discussion.

3.2.2 Interpretation

For each of the factors considered in the research - which identifies a class of possible stressors in the territory -, a set of specific stress vectors - i.e. actual change process producing stress in the territory - can be identified by analyzing the strain situations mapped. While the strain situations have been represented using the "strain" symbol (e.g. ≈05), the stress vectors will be coded in progressive order and marked using another special symbol (↗05). The following presents a selected overview of stress factors detected.

Stress vectors

- **Slow energy transition:** Two main vectors of change have been identified. The first stress vector ↗01 points to missing suitable conditions and above all available public information (≈08) to enhance energy efficiency and reduction of energy consumption for the regional population. A potentially easy phase out from oil and gas heating systems in favour of PV technology has recently been made difficult and slowed down. The second stress vector ↗02 underlines the concerns of the focus group partcipants with regard to a lack of structured governance and constant and unpredictable changes in funding structures (≈12). Insufficiencies in the federal and regional funding structures and mechanisms create hurdles in the energy transition process and make it harder for common people to be a part of this transformation (≈11).

- **Energy dependency:** The participatory mapping revealed great concerns about the dependency on Russian gas. Two further stress vectors (↗03 and ↗04) were identified. The problems and challenges (strain situations) that have arisen with the Ukraine war in February are seen on a European if not global level. ↗03 is linked to an exogenous conflict over established gas infrastructures that aggravate and delay the energy transition. Furthermore missing tech solutions in infrastructural systems fail the current carbon reduction strategies (≈5). One of the focus group members stated: *"25 years ago I was a local councilor, when CO2 was not yet an issue and gas was the environmental technology par excellence"* (FG Upper Styria 2022; P04). Vector ↗04 is directly related to the need to raise awareness in society about the urgency of the energy transition (≈4, ≈6) which is highlighted with the statement of another participant who claimed: *"People need to get it in the end, we need a lifestyle other than that of optimal consumption"* (P01; ibid).

- **Energy autonomy:** A further vector (↗04) directed to efforts in becoming more independent from centralised fossil fuel infrastructures can be seen as less stress inducing (≈1). On the contrary it was positively mentioned that the regional industry leaders, e.g. voestalpine and voestalpine Böhler offer their waste heat for local energy supply.

- **Youth outmigration – migration flows:** While on the one hand youth outmigration is a common phenomenon (≈22), return migration is also noticed. Especially young families get settled in single family homes at the outskirts. Age structure varies greatly from place to place. This stress vector ↗ 05 combines several linked phenomena and is challenging for the region.

While on the one hand communities such as Mürzzuschlag have a high percentage of younger inhabitants, others like Langenwang are “over-aged” communities. Leoben also suffers from youth out-migration even though the local council has been putting efforts in attracting the younger population. In and outward migration is closely linked to multiple stress related factors, such as the “sellout” of real estates to private investors has led to manifold consequences and is e.g. linked to the vanishing and loss of regional groceries and local supplies (〰 29), e.g. local post offices, restaurants and small cafes or pharmacies in the town centers (Bruck, Köflach, Leoben, Kindberg) to the benefit of shopping malls at the outskirts. This, in turn, has made shopping without a car in some parts of the CCT almost impossible. Besides, urban flight set in and the regional town centers have been deserted over the years, an interplayed development that is hard to reverse now (〰21, 〰26).

- **Housing and soil sealing:** The current situation of housing and soil sealing has manifold effects on the regional population and is detected as an important stress vector (↗06) that has had its starting point in the 1970s but has been continuously aggravating in the last decade. Empty apartment buildings (〰28), the flight from the municipality’s centers and local towns towards the outskirts are phenomenons that contribute to abandoned city centers and intensify the soil sealing problems in the region. The structural problems are seen as one’s own making, in so far as regional management decisions are in the hands of the local majors (〰30).

Stress-strain

Conflict and disputes. The analysis of the strain situations allows us to single out a set of recurring conflicts within the Coal and Carbon Territory. A series of stress effects cannot always be clearly assigned to a single category, but must be viewed against the background of complex systemic interrelationships and likewise located. Important issues concern topics such as soil sealing effects (〰 29) as a result of the single family home construction boom, structural and infrastructural development including public transportation (〰25), private investors and their contribution to building vacancy (〰29) and other side effects such as the diminishing of local small groceries and restaurants (〰21). In the wake of these effects some sort of “domino effect” set in that has been initiating the succession of multilayered other events, such as regional migration, dependency from Russian gas, soil sealing and monoculture farming and its effects on drinking water quality and water supplies. The focus group partcipants described these phenoma as out of their hands and see themselves being left alone by politics.

Impasses and contradictions. Again many of the impasses mapped in the research are related to the effects mentioned beforehand. Particularly contradictory is e.g. the topic public transportation sector. On the one hand important infrastructure investments are ongoing for the region, such as a new steel mill in Kapfenberg (voestalpine Böhler) and an important tunnel project (Semmering Basistunnel) will speed up train connections from the capital Vienna to the CCT region (〰 30). On the other hand this is in contrast to some weaknesses in local public transport, e.g. no direct S-Bahn train connection between some of the municipalities which in turn makes it difficult to switch to public transport (〰 25).

Dependence and uncertainties. Through the analysis of the strain situations, we have identified different forms of stress by dependence and uncertainty. These are closely related to the dependency on fossil energy. The phase of implementing infrastructures depending on fossil

energy resources (gas and oil pipelines) detected by the focus group participants are not only seen as failures made decades ago, but as “structural mistakes” that hinder seriously taken efforts in the decarbonisation process in various fields (≈1, ≈5, ≈6, ≈8). One of the main reasons is seen in past and present national and regional policy failing. There is a lack of bridging technologies (≈1) to accelerate the phase-out of fossil fuels. The support system for renewables is in some cases too complex or is being outsourced to other agencies, which leads to further delays (≈5). Against this background, the public has the impression that there is little or no participation in the energy transition. This is also a circumstance that creates feelings of stress (≈6, ≈8).

Strategies for coping with territorial stress. Ways and forms of coping with territorial stress seem to be less organised via e.g. civil society organisations, but rather driven by individuals or regional actors such as regional management or KEM (climate and energy model regions). How the challenges are dealt with on an individual and societal level undoubtedly depends not only but strongly on regional policies and the scope for action and decision-making.

Change, resistance to change, and ambivalence

a. Territorial trajectory: between continuity and rupture.

The image of the region is still connected to some extent to the past phase of crisis of the steel industry in the 1980s. This past image contributes among other issues to the fact that the younger generation tends to leave the region. But the economic situation is today completely different, and the CCT features a flourishing industry not only in specialised steel production but also in other fields (e.g. semiconductors, paper industry, etc.). The key to keeping this industry successful is securing its provision with energy and the energy transition overall, and its capacity to train, keep and attract skilled labour.

b. Territorial boundaries: between distinctiveness and alignment.

The investigated CCT in general has a very strong emphasis on innovation. *Green tech* and a strong focus on sustainability, climate and energy are overall important topics in the Styrian science, research and economic strategy. This image is also reflected in the focus group statements. At the same time, however, the region is described as *montanistic* and not far-sighted enough in terms of innovative and open world attitudes. A certain ambivalence, but also disappointment about half-hearted or too little rapid progress with regard to central political processes, both at the regional and national level, is noticeable.

c. Territorial governance: between endogenous and exogenous.

Like all other provinces in Austria, Upper Styria has a strong tradition of local self-government through mayors and municipal councils. The ability to steer territorial development is not exclusively but strongly influenced by regional and municipal governments. What becomes apparent is that the focus group participants have mixed impressions about support for the energy transition from higher political levels, from the regional and federal government respectively. On the one hand, very solid funding tools are available for renewable energies, but only since recently and a certain instability in funding was mentioned by the focus group. On the other hand, the participants felt to be left alone from politics concerning energy transition efforts in the region, especially for the local industry. These efforts seem to have no political “top priority” and might

result in negative outcomes. The current energy crisis has indeed important effects on the steel industry; it endangers the necessary energy provision and the whole industry branch, which is in general innovative and disposes of a diversified product portfolio.

d. Territorial symbols: between myth and stigma.

The crisis of the state-owned steel industry in the 1980s and memories of this time still have an impact on some parts of the local population today. Also, Austrian-wide this crisis image is still present among the population above 50 years. This stigma is primarily socio-economic, recalling times of restructuring the local steel industry, related job losses, high unemployment and social consequences, as well as significant financial deficits, which had to be covered by the state as owner of the steel industry. To a far lesser extent it is also an environmental stigma, linked to pollution of traditional steel production in the early 1980s, which was lacking appropriate emission control. The stigma is perpetuated mainly from the outside of the CCT; from inside the picture is mixed, reflecting some pessimistic views on the region, but there is also a tendency to counter the stigma and promote a positive image of a successfully restructured region with a flourishing and innovative industry.

How deep the memories have been integrated on a personal and individual level depends very much on age, socio-economic status, if and in which ways people were personally affected, e.g. through family and friends who got unemployed. If and to what extent the 1980s Styrian steel crisis shapes the perception of Styria within Austria until now differs, but it still seems to transport an image of a region that is not very attractive for its living conditions. The younger generation accordingly still tends to out-migrate. New territorial symbols or regional images are related to the Styrian region as a “showcase” for technological development. This also includes voestalpine’s image which is directed to green steel and emerging technological solutions to boost the energy transition. Besides the discussed negative effects of overtourism, the Upper Styrian region and its population takes pride in the mountainous landscape and nature. The Upper Styrian region is described as a region with a lots of potential, be it in terms of technological leadership, sustainable tourism, as contributor to a new emerging start up scene, e.g. in Kindberg and elsewhere.

3.2.3 Gender dimension

In the region, a double-edged picture emerges with regard to gender justice. Backward-looking structures that put women at a disadvantage are countered by committed and self-empowering ways of acting. While on the one hand the regional male wages are the second highest in Austria, the gender pay gap in Upper Styria has tremendously widened: Women in Styria earn on average 19.8 percent less than men for the same work. Lower wages for women, no possibility of full-time jobs or lack of childcare places affect young women. While committed women's groups have mainly older female members, at the same time it is better educated young women and mothers who leave the region due to suitable job offers and a lack of childcare facilities. This is also reflected in the migration of young people mentioned above. A major issue is old-age poverty among older women; often a result of a lack of insurance periods due to working as a housewife and mother.

3.3 Socio-psychological component

The transformation of the energy system and the decarbonisation process are expected to have a noticeable impact on the socio-psychological wellbeing of the inhabitants of coal and carbon-intensive regions across Europe. In this component, we have measured the long-term and short-term impacts of the decarbonisation process on the socio-psychological wellbeing of the people and de/re-territorialisation of the affected regions. It can provide crucial support to policymakers and investors, helping them to make informed decisions on immediate and appropriate measures and actions to retain the population and maintain the demographic, social and economic configuration of these regions, while achieving a sufficient level of decarbonisation in the coming decades.

Our main objective is to measure socio-psychological stress in the general population of the territories more directly challenged by the ongoing decarbonisation process, conventionally referred to in the project as the Coal and Carbon Territory (CCT). Through a quantitative survey, the project aims at creating new knowledge about the impact of different decarbonisation policies implemented in the CCT on people's socio-psychological well-being and their coping strategies to deal with this transition.

3.3.1 Summary of results

Profile of respondents

Sociodemographic characteristics of the respondents from the Upper Styria case study survey are shown in Table 6. Among the total number of 62 respondents in the survey, males were slightly overrepresented (i.e., 56.55% males and 43.45% females) compared to the sex ratio of the region (i.e., 50.78% males and 49.22% females) displayed in Table 10 – Population data for year 2020. Regarding the age distribution of the respondents, the majority came from the age groups 16-30 and 46-65, 50% and 30.7% respectively, while age groups 31-45 and 65+ comprised just 14.5% and 4.8%, respectively.

Education level of respondents was spread with around 33.87% having a university degree or higher while 46.77% have a Secondary and 16.13% a Professional education. Only 2 respondents, or 3.23% of the sample, have only completed Primary education. Half of the respondents (i.e. 50%) have been living in Upper Styria for more than 20 years, while only 11.29% have been living there for 10 years or less. 24 respondents (i.e. 38.71%) reported living there for 11-20 years. A majority of respondents are native to the region (i.e., 74.19%) while only 3.23% of respondents were born abroad, i.e. born outside of Austria. Foreign nationals, however, comprise 11%[20] of the regional population, thus this demographic is underrepresented in our sample.

35.48% of the respondents are living with dependencies. The majority, i.e. 64.52%, indicated, however, that they were not living with dependents. In terms of occupation, the largest group of respondents were inactive/in education (i.e., 37.10%), followed by public sector (i.e., 17.74%), the industry sector (i.e., 14.52%), and the services sector (i.e., 11.29%). 9.68% of respondents were retired, only 1 respondent (i.e., 1.27%) was unemployed, and no respondent from the agriculture sector participated. Only 3.23% of the respondents are currently working in carbon industries, while 20.97% indicated they had previously been employed in carbon industries.

[20] Statistik Austria, 2020. Population at beginning of year starting with 2002 (Uniform territorial status 2020).

Table 6 – Sociodemographics of respondents: Upper Styria case study survey (N = 62)

Sample Size	62 Complete cases							
Gender	Males (35, 56.55%)				Females (27, 43.45%)			
Age	16-30 (31, 50%)	31-45 (9, 14.5%)	46-65 (19, 30.7%)		65+ (3, 4.8%)			
Education	Primary (2, 3.23%)	Secondary (29, 46.77%)	University (21, 33.87%)		Professional (10, 16.13%)			
Occupation	Industry (9, 14.52%)	Agricul-ture (0)	Services (7, 11.29%)	Public Sector (11, 17.74%)	Unemployed (1, 1.61%)	Retired (6, 9.68%)	Inactive/ education (23, 37.10%)	No Answer (4, 6.45%)
Work in Carbon Ind.	Yes (2, 3.23%)				No (60, 96.77%)			
Worked in Carbon Ind.	Yes (13, 20.97%)				No (49, 79.03%)			
Marital Status	Not Married (33, 53.23%)	With Partner (6, 9.68%)	Married (20, 32.26%)	Divorced/ Sep. (2, 3.23%)			Widowed (1, 1.61%)	
Living with dependents	Yes (22, 35.48%)				No (40, 64.52%)			
Nativity	Born in CCT (46, 74.19%)	Born in another province (14, 22.58%)			Born outside country (2, 3.23%)			
Duration of Stay	0-5 years (7, 11.29%)	6-10 years (0)	11-20 years (24, 38.71%)		20+ years (31, 50%)			

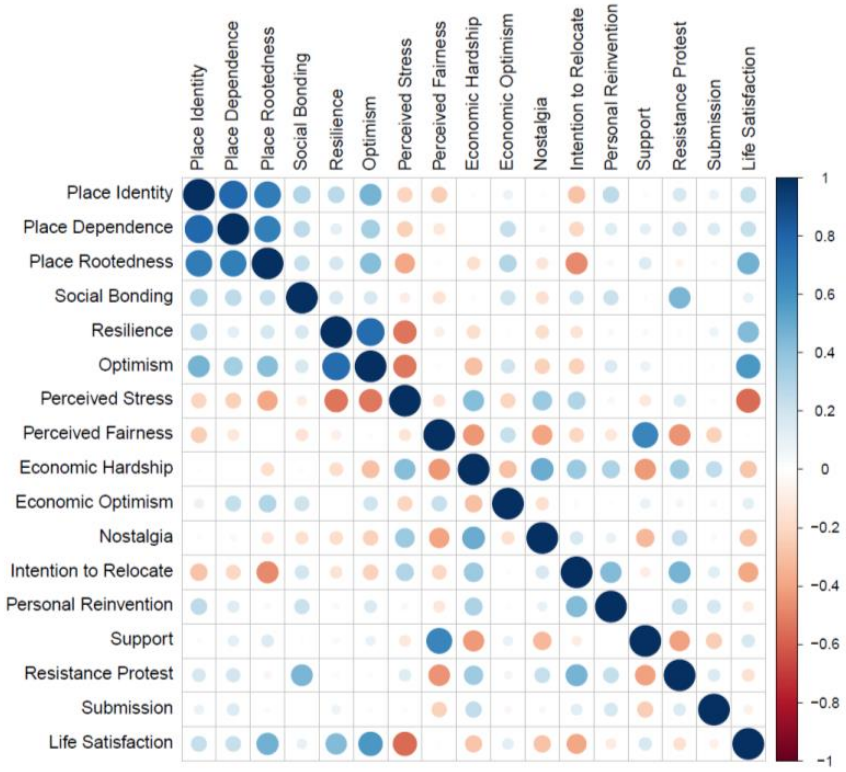
Source: ENTRANCES Upper Styria case study survey

3.3.2 Interpretation

Correlation among different factors related to socio-psychological component

In the case of Upper Styria we found a strong positive correlation between the different elements of place attachment, including place identity, place dependence and place rootedness. Similarly, we found a strong positive correlation between the factors “Resilience” and “Optimism”, which we used as moderators in this study. There is a strong negative correlation between “Life satisfaction” and “Perceived stress”.

Figure 8 – Correlation among different factors related to socio-psychological component



Sources: ENTRANCES survey data.

Mean score with standard deviations for all constructs

All items formulated to operationalise the socio-psychological constructs were first examined for missing values and their distributions. The internal consistency of the measures (i.e., set of items formulated to reflect the underlying construct) was examined using standardised Cronbach's alpha. The mean scores for each of the constructs were then computed by taking the average of respective items. Table 5 shows the number of items, means and standard deviations for each of the constructs, together with reliability for the measurements. All measurements, except measures for Place Rootedness, Optimism, and Submission, showed acceptable to good internal consistency, i.e. standardised Cronbach's alpha ranging between 0.68 and 0.95 (Tavakol & Dennick, 2011).

According to the mean scores for the socio-psychological constructs, the respondents of the ENTRANCES Upper Styria case study survey indicated a strong Place Identity (mean = 4.02) as well as Place Rootedness (mean = 3.91), albeit their Place Dependence (mean = 3.07) was more neutral and Intention to Relocate low (mean = 2.42 among Coping Strategies). Respondents positively view the actions to address the energy transition in the region (Resistance and Protest, mean = 2.06) and support it themselves (Support, mean = 3.94). They also indicated fairly strong Resilience (mean = 3.81), Life Satisfaction (mean = 3.75) and Optimism (mean = 3.77). When it came to their perception of the economy, they indicated a slight Economic Hardship (mean = 2.66)

and tended to be rather neutral towards Economic Optimism (mean = 3.00), while also disagreeing with options for re- and upskilling (Personal Reinvention, mean = 2.7). Perceived stress levels were a bit on the higher side with a mean of 2.84. On average, the respondents did not strongly disagree with any of the constructs.

Table 7 – Mean score and standard deviations for all factors (N=62)

Factors/ Latent constructs	Sub constructs	Mean score	Standard deviation	Cronbach's Alpha
Place Attachment	Place Identity	4.02	0.97	0.95
	Place Dependence	3.07	1.09	0.92
	Place Rootedness	3.91	0.61	0.67
	Social Bonding	3.34	1.04	0.81
Moderators	Resilience	3.81	0.7	0.82
	Optimism	3.77	0.83	0.67
Decarbonisation Impacts	Perceived Stress	2.84	0.7	0.93
	Perceived Fairness	3.37	0.86	0.81
	Economic Hardship	2.66	0.88	0.88
	Economic Optimism	3.00	0.71	0.87
	Nostalgia	2.74	0.85	0.92
Coping Strategies	Intention to relocate	2.42	0.91	0.89
	Personal reinvention	2.7	0.93	0.82
	Support	3.94	0.96	0.88
	Resistance and Protest	2.06	0.87	0.82
	Submission	3.25	0.8	0.26
Life Satisfaction		3.75	0.9	0.87

Sources: ENTRANCES survey data.

Note: Cronbachs' Alpha provides a measure of the internal consistency of a test or scale indicate (Cronbach 1951); it is expressed as a number between 0 and 1. Internal consistency describes the extent to which all the items in a test measure the same concept or construct and, hence, it is connected to the inter-relatedness of the items within the test. The alpha score below 0.7 is not acceptable.

Regional differences in mean scores for different factors

A comparison of the mean scores of the different constructs accross our case studies covering several EU regions, indicates the following: people from Upper Styria have higher-than-average place-rootedness, as well as perceived stress and fairness from decarbonisation impacts. Economic optimism, personal reinvention, life satisfaction, and in particular support for the energy transition are also higher-than-average, reflecting an economically flourishing region. It may be also due to a bias towards the younger generation in our sample. Only Resistance and protest are significantly lower-than-average.

Table 8 – Z score and STEN for all factors

Factors/Latent constructs	Sub constructs	Z-score	STEN
Place Attachment	Place Identity	-0.16	5.18
	Place Dependence	-0.29	4.92
	Place Rootedness	0.30	6.10
	Social Bonding	0.01	5.52
Moderators	Resilience	-0.13	5.24
	Optimism	-0.06	5.38
Decarbonisation Impacts	Perceived Stress	0.30	6.10
	Perceived Fairness	0.60	6.70
	Economic Hardship	-0.44	4.62
	Economic Optimism	0.39	6.28
	Nostalgia	-0.19	5.12
Coping Strategies	Intention to Relocate	0.21	5.92
	Personal Reinvention	0.42	6.34
	Support	0.89	7.28
	Resistance and Protest	-0.79	3.92
	Submission	-0.13	5.24
Life Satisfaction		0.37	6.24

Sources: ENTRANCES survey data.

Note: The Z-score provides an indication of how far from the mean a data point is, more technically it is a measure of how many standard deviation below or above the population mean a raw score is .The STEN scores (Standard Ten) shows results using a simple standardised scale from 1 to 10 that have a normal distribution. They have a mean of 5.5 and a standard deviation of 2 and are then rounded to the nearest integer. To interpret the STEN scores, all case studies will focus on STEN scores below 4 (which should be interpreted as low compared to the case studies as a whole) and above 6 (the high scores). All STEN scores around 5 show that the case study is not very different from the other ENTRANCES case studies.

Gender Dimension

The differences of assessments among women and men are not very important in Upper Styria. Men perceive more economic hardship and feel more Nostalgia for the region, while women show stronger support for the CET and a higher life satisfaction than men. Other factors such as place attachment, and intention to relocate do not differ much.

Table 9 – Gender differences in mean score for all constructs

Factors/ Latent constructs	Sub constructs	Mean score		T-test (df 504)	P-values
		Men	Women		
Place Attachment	Place Identity	4.114	3.898	0.884	0.381
	Place Dependence	3.086	3.046	0.143	0.887
	Place Rootedness	3.907	3.921	-0.092	0.927
	Social Bonding	3.271	3.426	-0.579	0.565
Moderators	Resilience	3.910	3.677	1.298	0.200
	Optimism	3.739	3.820	-0.389	0.699
Decarbonisation Impacts	Perceived Stress	2.820	2.874	-0.294	0.770
	Perceived Fairness	3.329	3.426	-0.447	0.656
	Economic Hardship	2.577	2.778	-0.884	0.380
	Economic Optimism	2.957	3.056	-0.561	0.577
	Nostalgia	2.793	2.667	0.584	0.562
Coping Strategies	Intention to Relocate	2.400	2.444	-0.192	0.849
	Personal Reinvention	2.524	2.926	-1.721	0.091
	Support	3.857	4.037	-0.753	0.454
	Resistance and Protest	2.050	2.083	-0.145	0.885
	Submission	3.300	3.185	0.585	0.561
Life Satisfaction	Life Satisfaction	3.703	3.800	-0.427	0.671

Sources: ENTRANCES survey data.

Note: Mean-score indicates the mean score for all constructs. Mean score close to 5 shows higher value for all constructs and mean score close to 1 shows lower value for all constructs.

3.4 Conclusion

Our limited sample of respondents shows that in Upper Styria there is good support for the Clean Energy Transition and only low willingness to resistance and protest. People are well rooted in their region and dispose of good life satisfaction. Stronger perceptions of economic hardhip point to fears of job losses in key energy and CO2 intensive industries, such as the important steel industry in the region.

Our field research activities and direct promotion of the survey in four CCT municipalities allowed us interaction with local citizens and gathering of qualitative data on their perception and opinion of the energy transition. We can suppose to have had at least 40 talks with citizens per each of the four municipalities where we had put an information stand, whereby about 20 were in-depth discussions – 80 in-depth discussions. Following key findings we briefly summarise:

- **Energy transition** is under way and industry and many citizens are actively contributing to it. Local industry is providing its waste heat for district heating in the main municipalities. Many

citizens are installing PV systems, switching to pellet heating, and to a lesser extent yet to e-mobility.

- **Environmental situation**: elderly people are reminiscent of the environmental problems connected to the carbon industry and appreciate the improvements that have been made already: “In the past red dust from the steelworks was covering our homes; this environmental situation has improved a lot.”
- **Energy saving and citizen involvement**: citizens come up with a range of energy saving suggestions, if they are consulted on it. For example it was suggested that lighting of monuments could be reduced from whole night to only evening hours, etc.
- **Dependency on energy provision**: the Ukraine war has made citizens aware of the urgency of the energy transition and created significant worries about energy provision, leading to comments such as: “We are afraid every day that gas will be cut off.” “We are just installing a wooden stove to be on the safe side for the winter heating.”
- **Worries about and negative views of the energy transition** were also voiced by several citizens. This concerned price increases of gasoline and energy that were expected (even before the Ukraine war, probably due to the introduction of carbon pricing in Austria that was just about to be discussed and decided at the political level in autumn 2021). Another frequent concern was about renewable energy and e-mobility technologies, in particular about recycling of wind turbines and e-car batteries. Finally the impact of taking steps for the energy transition in Austria was questioned, as compared to big international actors: “What can we in Austria do, what does it bring in terms of benefits as compared to big polluters such as China.”

CHAPTER 4

SOCIO-ECONOMIC SITUATION

4 The socio-economic situation

4.1 Introduction to the socio-economic situation

This chapter provides an overview of the socio-economic situation of the region. Important factors for economic development are population dynamics, labour force, capital stock and technological progress.

We refer to the three different delineations of the region, namely the Coal Carbon Territory (CCT), Labour Market Area (LMA) and Political Administrative Region (PAR), as described in chapter 2.1.2 Structure of the case study: multiple foci and units of analysis. The delineations correspond to the nomenclature units of territorial statistics (NUTS).

The socio-economic component focuses on structural change in the economy, i.e., the reallocation of economic activity across different economic sectors and regions. Structural change can lead to a change in a region's economic, financial and demographic composition. This report provides a descriptive analysis of technological progress, demography, economic inequality, employment and economic activity based on various data sources.

4.2 Determinants of economic development

An important indicator of economic development is real gross domestic product (GDP) per capita.[21] Real GDP per capita (Y/N) can be decomposed into three components, i.e. labour productivity (Y/L), employment rate (L/E) and share of population in working age (E/N):

$$\frac{Y}{N} = \frac{Y}{L} \times \frac{L}{E} \times \frac{E}{N} \tag{1}$$

where Y is real GDP, N population, L employed persons and E working-age population.[22]

Labour productivity (Y/L) depends on technological progress and capital intensity (Solow, 1956; Solow, 1957). On a sub-national level, there is no data available to analyse the capital stock for the CCT and LMA delineations. Gross fixed capital formation (GFCF) is only available for the PAR and country delineations. In addition to private investments, also investments into the public capital stock influence the development of labour productivity. The public capital stock is important for the growth trajectory of a region (Baxter & King, 1993). Technological progress depends on research and development (Romer, 1990; Jones, 2005; Lucas Jr, 2009). Further, technological progress also depends on human capital determined through individual qualifications (Uzawa, 1965; Lucas Jr, 1988; Mankiw, et al., 1992).

There has been an increase in labour productivity in the CCT over the last two decades in line with increase at the LMA, PAR and country levels. As of 2018, labour productivity in the CCT was around 22% higher than EU28 average in 2018, however still lower than the national average

[21] Gross domestic product is not created to measure welfare. It measures the transaction value of goods and services over a specific period (see Eurostat 2014, p. 146). Other measures such as mortality, leisure and inequality show a high cross-country correlation with GDP (see Jones and Klenow 2016). Therefore, GDP is a good proxy for welfare despite its apparent shortcomings. Nevertheless, one should use various indicators to finally assess the welfare of a region (see Fleurbaey 2009).

[22] The population in working age refers to the persons aged 15-64 years. Expected effects of legislated pension reforms will increase the participation rate of older persons in the future.

(Figure 9a). Labour productivity in both the LMA and PAR remained below the CCT. However, for the LMA, the gap nearly closed with a difference of less than 1%, while for PAR the disparity rose to about 7 percentage points.

The total population in the CCT declined 8% between 2002-2018, while the EU28 population saw an increase of 5%. During the same period, the population of the LMA experienced a 7% decline whereas PAR and country level population both increased, 4.5% and 10% respectively (Figure 9b)[23]. The population decline in the CCT and LMA with a simultaneous population increase in the PAR region is likely the effect of urbanisation[24]. The evolution of the total population indicates a negative development with respect to the socio-economic factors in the CCT and LMA.

The age distribution of all delineations are indicative of an ageing population with an increase in the median age of about 10 years for all delineations, however as of 2018, the CCT has a higher share of elderly people compared to the national level. The ageing population is a trend seen in many developed countries as a result of lower fertility rates and longer life expectancy.

The working age (15-64 years) population in the CCT decreased by 2.5% between 2014-2018 (Figure 9c). There was a similar decline in the LMA (2.1%), whereby in PAR the working age population increased by 1% and even 3% at the country level. At the EU28-level, the increase in the last years is almost negligible, but projections indicate a fall in the working-age population (European Commission, 2021). The share of the population of working age to the total population in the CCT (E/N) fell to 56.6% in 2018 in comparison to 59.3% in 2002. On the other hand, employment has increased 9% in the CCT since 2002. Between 2014-2018, the employment rate (L/E) followed a slight upwards trend for all delineations, however it is more pronounced for the Upper Styrian delineations compared to country and EU28 (Figure 9d). In the CCT and LMA, this could partially be explained by a decrease in working age population: we observe a sharp decrease in working age population from 2016 to 2017, which coincides with a higher employment rate.

GDP per capita in the CCT relative to the EU28 value shows a convergence trend (Figure 9e). GDP per capita is very similar for the CCT and LMA over the entire period, where both saw a significant rise in GDP per capita between 2003-2009. PAR follows a similar trend of growth however there was also a slight convergence trend: in 2018, the GDP per capita of PAR was 9% higher than the CCT, compared to 11% in 2002. At the country level, GDP per capita was 16% above EU level in 2002 and increased to 22.5% above EU in 2018.

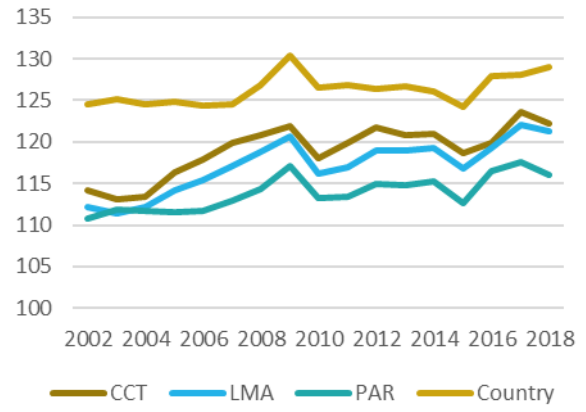
Since 2000, all regions experienced a period of GDP growth (Figure 9f). In the CCT, GDP grew 59% however, it was the lowest compared to all other regions. GDP in the PAR regional delineation and Austria saw the highest growth, with GDP approximately 80% higher in both delineations in 2018 compared to 2000. The EU28 and LMA delineation both observed GDP growth of 64%.

[23] Note that many socio-economic variables at the regional level have a publication delay of at least two years. Therefore, all figures are shown until 2018, although e.g. for population data is available until 2020

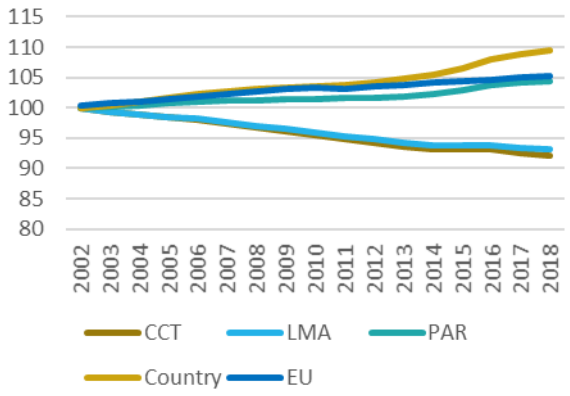
[24] Urbanisation refers to the population shift from rural to urban areas. In the report on the socio-cultural component additional reasons and background information on population decline, outmigration and ageing population are provided, such as gender pay gap, image of the region, lack of appropriate housing.

Figure 9 – Economic overview

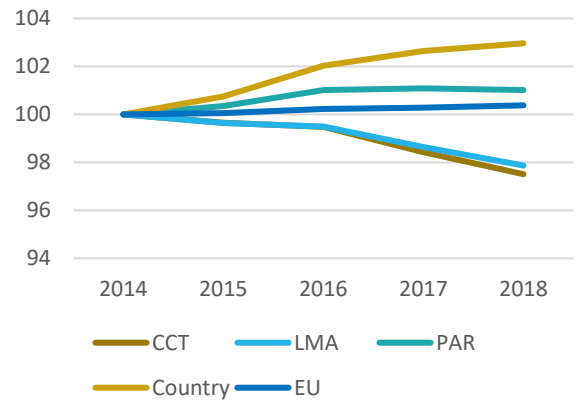
a) Labour productivity (*Y*/L) (EU28=100)



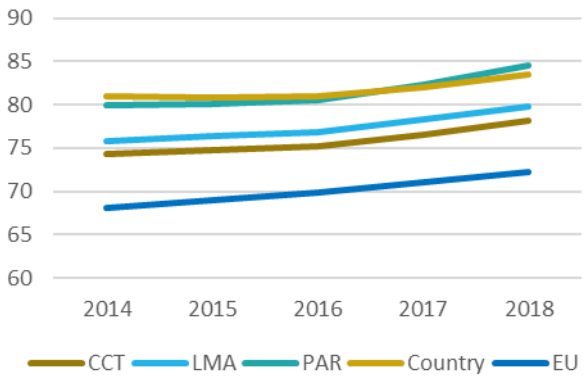
b) Population (*N*) (2002=100)



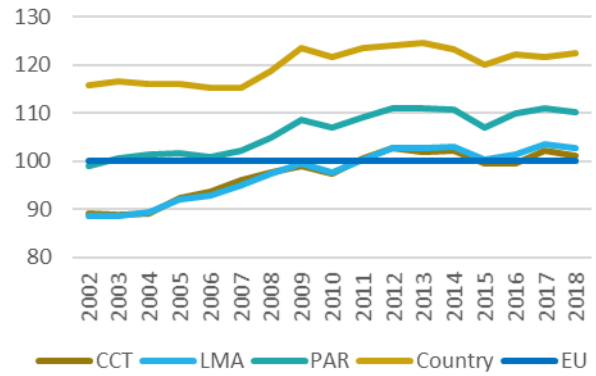
c) Working-age population (*E*) (2014=100)



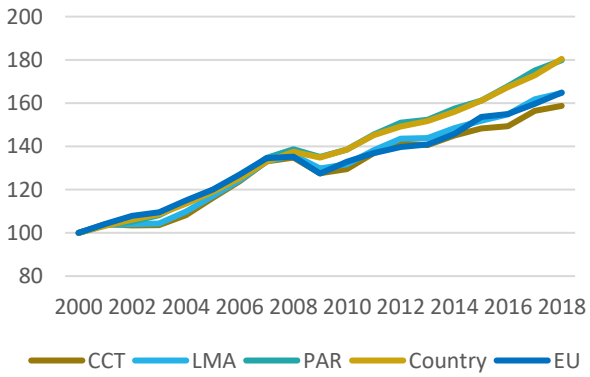
d) Share of employed persons (*L*/*E*)



e) GDP per capita (*Y*/*N*) (EU28=100)



f) GDP (*Y*)



Source: Statistik Austria (Uniform territorial status 2020).
Note: Gross regional product according to ESVG 2010, NUTS2+NUTS3 in Mio. Euro

4.3 Sectoral structure

Overall gross value added in the Upper Styrian CCT amounted to 115.3 billion EUR in 2018. The total amount is based on a contribution of about 5.2% from agriculture, 2.4% from mining and utilities, 24.8% from manufacturing, 5.9% from construction, 23.9% from retail and information technology, and 9.6% from finance and 28.1% from other services (Figure 10b).[25] Compared to EU28, the sectoral composition of the CCT has a higher share of manufacturing (Δ10%) and a lower share for retail and information technology and finance (Δ7% for each). Compared to 2000, the current sectoral composition in the CCT experienced a downward shift from contributions in agriculture, retail and information technology, and manufacturing to higher contributions in other services (Δ5%) (Figure 10a). Similarly, in the EU28 contributions from manufacturing and agriculture decreased the most, however finance saw the largest increase followed by other services.

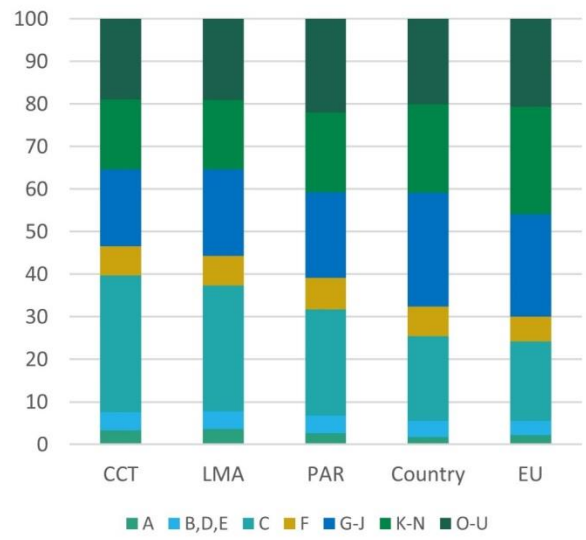
The carbon industry in the Upper Stryrian region was hit by several crises in the 1970s and 1980s on account of open trade rules, leading to a massive reduction in employment during the 80s and 90s. Since then, the industry and the region have been slowly rebuilding and during the last decade, the region experienced a 6% increase in employment and increasing its share of employment approximately 5% (Figure 10c).

All aggregate sectors exhibit positive labour productivity growth similar to the carbon industry from 2000 to 2018. Figure 11a to Figure 11e show that labour productivity, i.e. the ratio of sectoral output to employed persons, in the agriculture sector grew more than in any other sector in Upper Styria, independent of the considered delineation. These gains in labour productivity are closely followed by the manufacturing sector for all delineations except the EU28, which experienced high labour productivy gains in all remaining sectors. Agriculture and construction sectors employed fewer persons in 2018 compared to the year 2000 in the CCT and LMA, however for PAR and country it was only the agriculture sector which saw a reduction in employed persons. No sectors had negative growth in the respective period for all delineations. Figure 11f shows that the manufacturing sector contributed with 21.7 percentage points to the overall growth of more than 50 percent in the CCT. Therefore, the economic development in the CCT from 2000 to 2018 was mainly driven by the development in the manufacturing sector, which is a stark difference to the economic development at both national and EU level which only saw 12.2 percentage points and 7.5 percentage points, respectively, and more significant contributions from Retail and IT (G-J), Finance, real estate and other professional services (K-N), Other services (O-U).

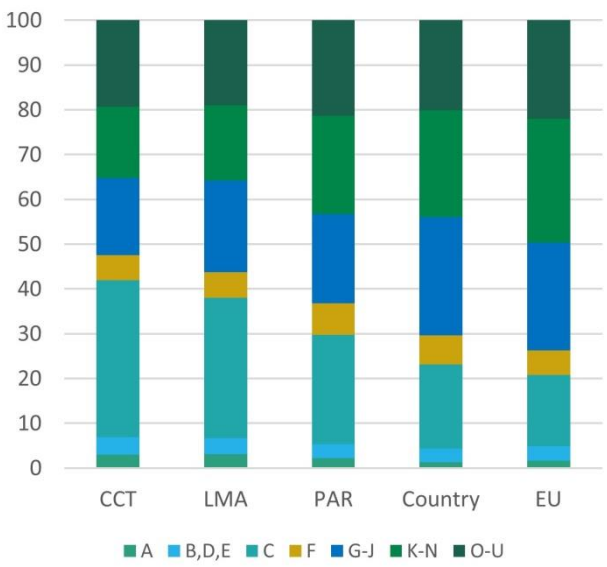
[25] All sectors follow the European Classification of Economic Activities (NACE), Eurostat (2008).

Figure 10 – Sectoral structure

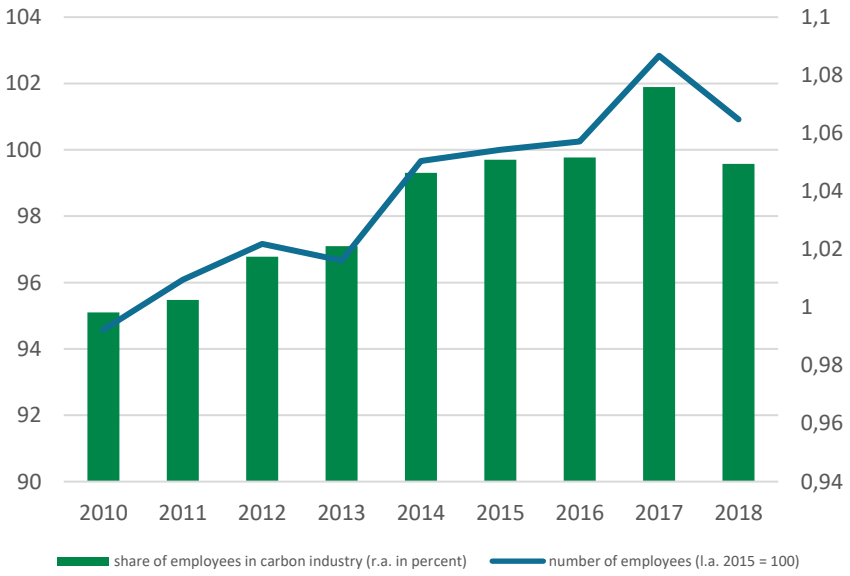
a) Gross value added in 2000 (in percent)



b) Gross value added in 2018 (in percent)



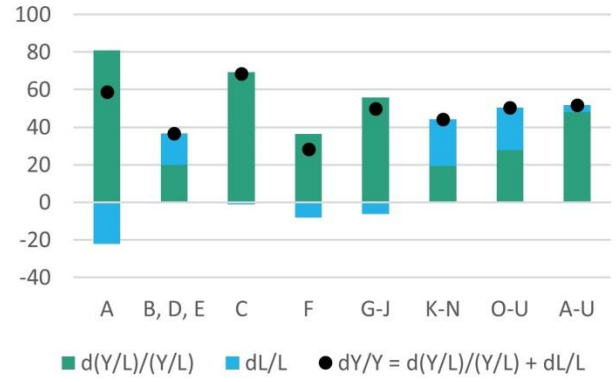
c) Carbon industry overview



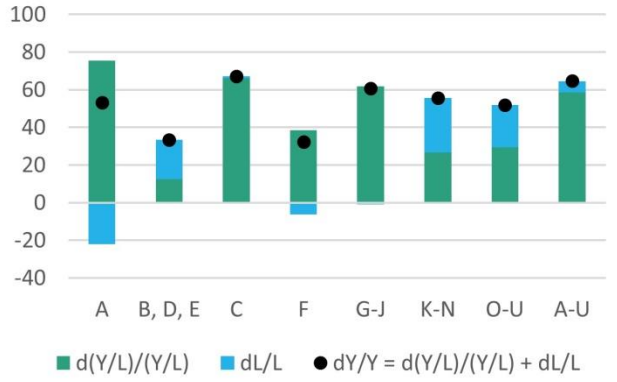
Source: Statistik Austria.
Note: The sectors are classified by: A Agriculture, forestry and fishing; B,D,E Mining and Utilities; C Manufacturing; F Construction; G-J Retail and IT; K-N Finance, real estate and other professional services; O-U Other services (Eurostat 2008).

Figure 11 – Growth decomposition (2018-2000)

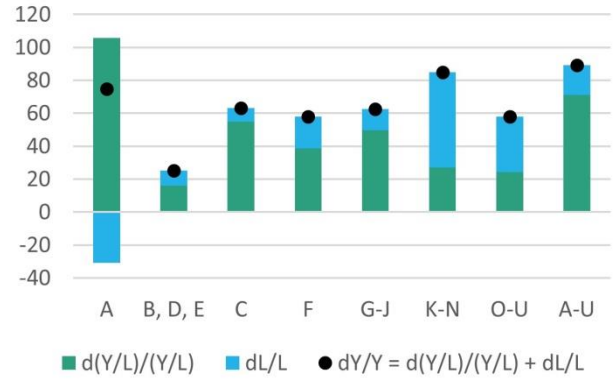
a) CCT (in percent)



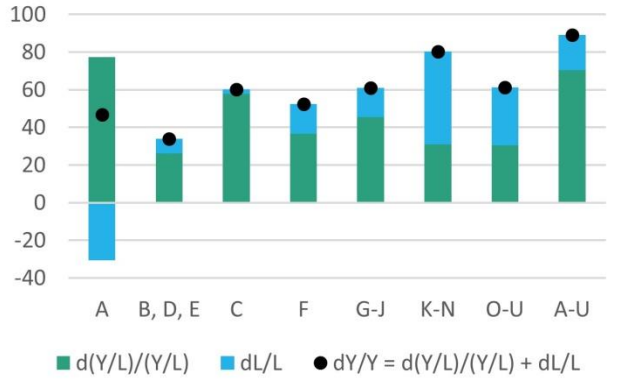
b) LMA (in percent)



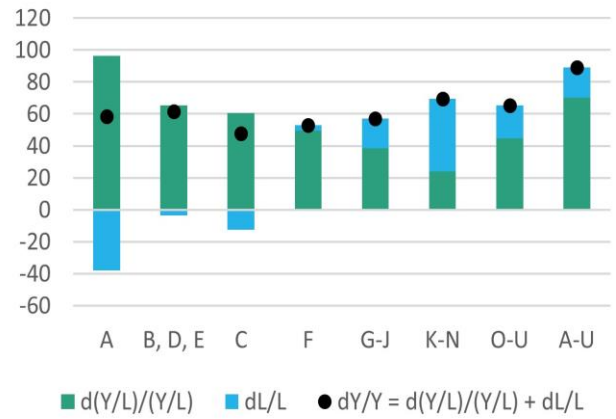
c) PAR (in percent)



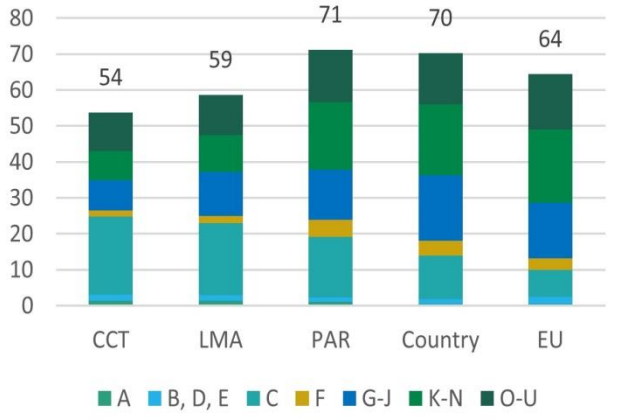
d) Country (in percent)



e) EU (in percent)



f) Regional gross value added growth contribution by sector (in percent)



Source: Statistik Austria.
Note: Sectoral growth (dY/Y) is decomposed into labour producivity growth (d(Y/L)/(Y/L)) and labour growth (dL/L). The growth contribution by each sector (i) is the initial share of the sector (Y_i/Y) in the year 2000 times the sectoral growth rate between 2000 and 2018 (dY_i/Y_i). Abbreviations for the sectors are provided in Figure 10 – Sectoral structure and tabulated in Table 11.

4.4 Income distribution

On the sub-national level, harmonised data for the income distribution on a household or individual level is not available for all European case studies. However, it is possible to analyse the development of the functional income distribution in the region. The income approach states that GDP in a region is the compensation of employees (labour income), the gross operating surplus, mixed-income (e.g. compensation of owners), taxes on production and imports minus subsidies on production.[26] Figure 12a depicts the labour share defined as labour income divided by total gross value added as a key economic indicator for the distribution of income (between labour income and capital income).

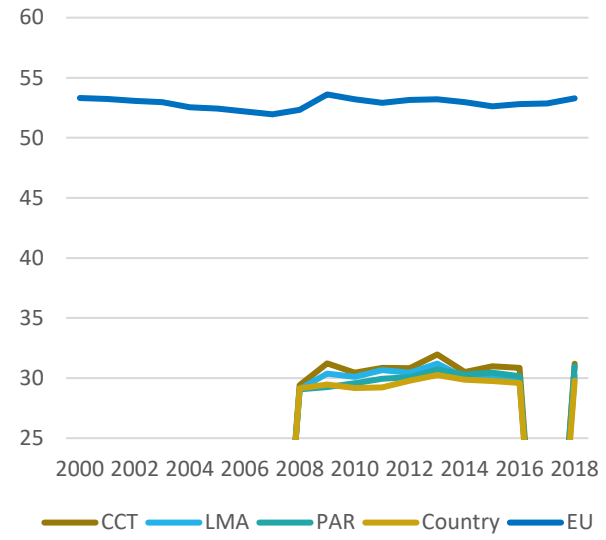
The data on labour share for country and Upper Styria is only available for 2008-2016 and 2018. Compared to the labour share at the EU28 level, which hovered around 53% since 2000, labour share in the CCT was much lower, hovering around 30% for the data available. Compared to the other delineations, the CCT has the highest labour share but only by a small percentage – all delineations besides the EU28 level remain within 2% of each other.

Figure 12b depicts the disposable income per capita, respectively. There is no disposable income per capita data available for the CCT and LMA delineations. The remaining delineations – PAR, country, and EU28 – show a persistent upward trend in disposable income. PAR and country level developed in sync with both realizing a 62% increase in disposable income per capita by 2018, whereby the EU28 saw a smaller increase of 54%.The ratio between disposable income and GDP measures the tax burden and amount of redistribution in the respective regions. The share of GDP which remained in the region declined from 74% at the beginning of the 2000s to just under 70% in 2018, converging with the national level.

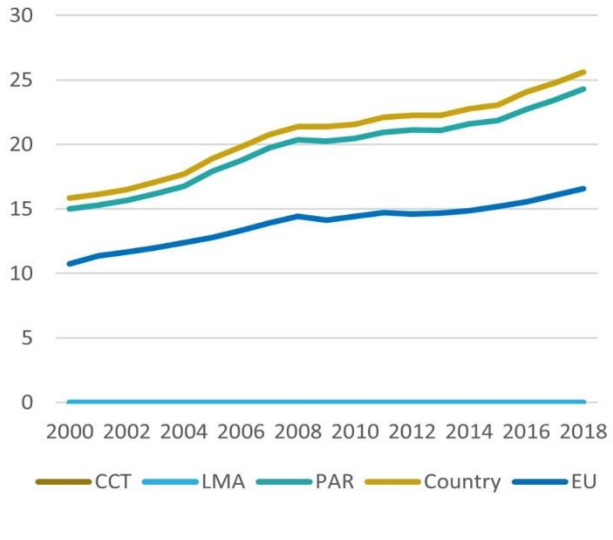
[26] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Income_approach

Figure 12 – Income distribution

a) Labour share in percent



b) Disposable income per capita (in ths. Euro)



Sources: Statistik Austria.

Note: Labour share is the labour income divided by total gross value added.

4.5 Gender dimension

The gender pay gap is an important challenge in Upper Styria. While men have a relatively good salary from industry jobs, women earn significantly less. This puts a certain pressure on migration, as women may search better paid jobs elsewhere in Styria and Austria and whole families with kids and husbands tend to accompany them.

Population data in Table 10 show similar shares for female against male population over the different territories, which are also in line with overall Austrian shares (50.8% female against 49.2% male). Demographics indicate an ageing trend in Upper Styria with 47.6% of population over 50 years, as compared to the province of Styria with 43.6% over 50 years.

Table 10 – Population data for year 2020

	CCT	LMA	PAR
Population total	257 638	337290	1 246 395
…female	130 893[27] 50.8%	171 576 50.9%	630 823[28] 50.6%
…male	126 745[29] 49.2%	165 714 49.1%	615 572 49.4%
Share of people over 50 years	47,8%[30]	48,56%[31]	43,61%[32]

Source: Statistik Austria.

4.6 Conclusion

Over the last two decades, the regional economic inequality between Austria and Upper Styria declined, which is reflected by convergence in labour productivity. The numbers suggest that the regions converged due to a decline in population leading to a convergence of GDP per capita. Labour producticvty converged marginally. Upper Styria exhibits a rather steady economic development in parallel to the entire country. The contribution of the manufacturing sector is extraordinarily high. Moreover, the region experienced growth in GDP as well as labour income, converging with EU28 level, but is still lower compared to the respective Austrian growth rate. However, there was still an 8% population decline in the carbon region since 2002, while the PAR, country, and EU28 experienced a population increase.

Despite the economic crises of the 1970s and 1980s, which hit the carbon industry in Upper Styria particularly hard leading to massive unemployment and outmigration, the region overall has seen improvements in many socio-economic dimensions. With an outlook on decarbonisation in the region, there are many strategies in place at the municipal, state, and federal levels to guide the transition to reduce carbon emissions significantly. At the same time, the federal state of Styria has an economic strategy to run in congruence with the decarbonisation strategies to ensure the region remains economically viable.

[27] https://statcube.at/statistik.at/ext/statcube/openinfopage?id=debevstandjbab2002
[28] https://www.statistik.at/web_de/statistiken/menschen_und_gesellschaft/bevoelkerung/bevoelkerungsstruktur/bevoelkerung_nach_alter_geschlecht/index.html (The same source for all other NUTS2 statistics)
[29] https://statcube.at/statistik.at/ext/statcube/openinfopage?id=debevstandjbab2002
[30] https://portal.statistik.at/statistik.at/ext/statcube/openinfopage?id=debevstandjbab2002
[31] https://portal.statistik.at/statistik.at/ext/statcube/openinfopage?id=debevstandjbab2002
[32] https://portal.statistik.at/statistik.at/ext/statcube/openinfopage?id=debevstandjbab2002

CHAPTER 5

ANALYSIS OF THE ENERGY TRANSITION IN THE POLITICAL ADMINISTRATIVE REGION

5 Analysis of the Energy Transition in the Political Administrative Region

5.1 Overview of the energy transition policies

5.1.1 Political system and context

The key administrative unit in this case study is the Austrian province of Styria – a NUTS 2 category; this is equivalent to the PAR definition in ENTRANCES. Austria is a federal state, with 9 federal provinces; the province of Styria is one of them.

The case study region Upper Styria is embedded in the province of Styria. Upper Styria is composed of three NUTS 3 regions: AT222, AT223, AT226. There is no political or administrative entity governing the sub-region of Upper Styria.

The political regime in Styria consists of the following elements:

- Provincial Parliament (Landtag)
- Provincial Government (Landesregierung)
- Provincial Governor (Landeshauptfrau/ Landeshauptmann)

5.1.2 Decarbonisation process

The Upper Styrian case study specifically highlighted voestalpine's efforts to become climate neutral, therefore, decarbonisation strategies investigated in the presented research are only focusing partly on the provincial climate and environmental strategy. voestalpine's management has taken a proactive approach to this issue. Currently the company is developing technology that allows for the production of "Green Steel" with hydrogen produced by renewables. First pilot plants, such as *SuSteel* at Donawitz/Leoben received EU funding.

voestalpine is commited to reach the climate goals by decarbonising the steel production route by 30 % until 2030 and become climate neutral by 2050. The company has been working on the technological transition to green tec steel production since over more than one decade in order to ensure the future competitiveness of Austrian steel production on a national, European and global scale. The future production of "green steel" also has economic reasons as the future competitiveness of voestalpine's steel production relies heavily on technological adaption through innovation. This of course is no stand-alone feature, as Europe's steel industry is working on emerging technologies to fulfil its goal of decarbonisation at least until 2050. However, many hurdles are still in the way: on the one hand, the technology to be implemented has not yet been developed to market readiness. Producing clean hydrogen via renewables on the other hand will require a much larger renewables infrastructure than Austria can currently provide.

5.1.3 Public participation

In close connection to the efforts being made so far in decarbonizing the regional industry, infrastructural investment in fossil fuel energy sources and gas pipelines have shaped not only Austria's industries' needs for energy consumption for decades, but are now affecting the regional population in the research area as a whole. With the beginning of the Ukraine war in February 2022 the topics energy resources and provision, and energy consumption demands heated up again in the local public discourse.

The energy supply in Upper Styria, especially for the local industrial sites is mainly provided by fossil fuels, e.g. gas. There is still a lack of infrastructure for renewable energies or technologies for feeding in renewables or heat storage systems. Despite the fact that Austria as well as Styria has a high share of hydropower at its disposal, there is resistance against the construction of another hydropower plant in the region, which could make the energy supply for the public more sustainable and independent of fossil energy.

The Styrian government tries to support the energy transition via funding for e.g. installation of PV panels for single-family homes. Neverthless the execution lacks the ability to support the population in its individual possibility to enhance the energy transition, as the funding procedures are regarded as rather complex. As a result of the war in Ukraine, the demand for solar energy has increased significantly in Austria. Currently, the demand for PV is overheated and there is a lack of technicians to install the systems.

Results from the focus group conducted for the Upper Styrian case study, revealed that funding programmes for private households such as financial support for changing from oil heat systems to PV had been mismatched or were even cancelled in April this year due to organisational problems. As far as information for subsidies for the general public is concerned, the complaint is that information on this is difficult to obtain. In addition, applications for subsidies, e.g. for private PV systems, are time-consuming and complicated. Other spheres of concern are shortcuts of the public transport system that has been thinned out in some of the Upper Styrian rural areas. These circumstances have multilayered effects on regional migration flows, especially in regard to youth migration. Further reasons that hinder an acceleration towards a sustainable energy transition are the missing technological solutions, be it as stand-alone technology be it, as mentioned above, that the energy infrastructure is not technologically aligned with renewable energy technologies.

5.1.4 Clean-energy transition (CET)

The clean energy transition process shows a positive development, this counts in particular for the efforts made in the research area Upper Styria and the province Styria as a whole. Styria has a leading role in Austria when it comes to renewable energies: more than 20 per cent of the energy use is covered by hydropower, biomass and solar energy. The Climate and Energy Strategy 2030, approved by the Styrian Government in 2018, follows the regional tradition of energy plans and strategies since 1984, when Styria had been the first European region to do so."[33] Political processes that drive the energy transition are generally attributed to the Greens in Austria. In

[33] Land Steiermark, 2018. Climate and Energy Strategy 2030.

Styria, however, the Austrian People's Party (ÖVP) also has a strong interest in energy transition in the steel industry due to its closeness to industry.

Main stakeholders involved in the CET are first and foremost voestalpine, research units (Universities like Montan University Leoben and Technical University Graz, University of Applied Sciences - FH Joanneum, Research Units like Joanneum Research), and diverse regional companies, the *Green Tech Cluster* and innovative start-ups. Styria has a leading role in R&I and technology development at the European level. Green Tech and a strong focus on sustainability, climate and energy are therefore overall important topics in the Styrian science, research and economic strategy.[34] Even though funding procedures are seen critically when it comes to low-threshold access, the regional population is given opportunity to receive subsidiaries to support decarbonisation and climate neutrality. Among other initiatives to boost the climate goals is the national programme “Climate and Energy Model Regions” launched around 2010, which supports all regions in their target to become independent of fossil fuel.[35]

When it comes to control and enhancement of technological change to tackle the clean energy transition, scientific and technical expertise play an important role and collaborative networks between science, regional business and industry representatives have been boosting the transition efforts. There is a shared understanding and belief in technologies as beacons of hope on the path to a climate-sensitive future in Styria.

The *Styrian Social Partners* (Trade Unions, Chamber of Labour, Economic Chamber, Federation of Austrian Industry, Provincial chamber of Agriculture) are trying to find common ground for tackling the current and future challenges in the CET. Even though social partnership is not anchored in the Austrian constitution, the social partners wield great influence as regards political opinion forming and decision-making.

5.2 Socio-political component

5.2.1 Summary of results

The socio-political dimension investigated *narrative battles* of the interpretation of the energy transition ongoing in coal and carbon-intensive regions. The focal point was given to the analysis of possible conflicts connected to the clean energy transition and the de-carbonisation of coal and carbon-intensive regions. In theoretical terms, this was based on the concept of the *technological drama*. A framework that analyses the political consequences of the introduction of a new technological artefact or system in a social setting as the outcome of a narrative battle to determine the meaning and implications of the technology. In the case of Upper Styria the core technology is *green-tec-steel*.

Following such an approach, the interpretative battle ongoing in coal and carbon-intensive regions on issues like climate change, energy transition, decarbonisation, just transition, phase-out, etc.

[34] Land Steiermark, Forschungsstrategie Steiermark 2020 (2013). Land Steiermark, Wirtschafts- und Tourismusstrategie Steiermark 2025 (2016).
[35] Cf. Climate and Energy Fund, 2018.

were analysed as a *discourse*, in which different actors produce *statements* and *counterstatements* to negotiate their side and *reading* of the clean energy transition.

This allowed to identify how local actors and key stakeholders are aggregating around different "constituencies" for

- regulating (IMPOSE)
- adapting (COPY/Adjust))
- or opposing the clean energy transition (RESIST)

The local and regional discourses on energy transition are strongly influenced by the steel producer and local industry leader voestalpine. Scrutinised discourses are highly technical at first sight with a strong focus on technological solutions to bring the transition to *green steel* to live (IMPOSE). However, with regard to the important position of the company as employer, it also has a deeper socio-economical and socio-political impact in the Upper Styrian region.

If we look at political statements on the energy transition at the national level, the Greens as well as the ÖVP are frequently represented in the media. The Greens put strong efforts into the execution of the Energy Efficiency Act (2014), the Renewable Energy law and its regulation (2019). The Green party hold the fossil fuel lobby accountable for the slow and *watered-down* execution of the laws in Austria.[36] The Greens' influence on climate change policies in Austria is undeniable, but has more importance on the national level and in urban areas than at the provincial and regional levels.

With regard to the CCT territory and region investigated, the Greens position in Styrian policymaking concentrates on city centres (e.g. provincial capital Graz) and on topics such as energy efficiency in housing, campaigning against the increase in building density in cities and support the transition to electro mobility and the expansion of public transport.

The People's party (ÖVP), with its Christian-democratic and liberal conservative background, traditionally and historically shapes Styria's political landscape. Upper Styria, in contrast, has a traditionally industrial and working class orientated Social democratic background. Interestingly, these differences in political positions have no negative impact on the regional decarbonisation policy strategy. The investigation of local and regional public discourses on energy transition showed no indicator of strong political controversies. While the influence of the right-wing populist's Freedom party FPÖ in Upper Styria is still high, being the third strongest party in the region, yet, text research results have shown that regional party members are not openly agitating any sort of "climate denial" (RESIST) discourse, but rather give explanations for fossil lock-in. While the Freedom party is in favour of the transition to green steel production, the entire party advocates maintaining conventional infrastructures and technologies for fossil fuel usage, especially for the public.

The results have shown that regional media discourses are shaped by calls for action, massive investment in future technologies, precisely spoken, in technical solutions to enable the CO2 neutral transition to hydrogen steel production processes by 2050, and a commitment to reach the

[36] C.f. https://www.nachrichten.at/storage/med/xmedia/287034_Wahlprogramm_lang_NRW2017.pdf, [17.10.21]

climate goals till the mid of this century (IMPOSE). *"With the gradual switch to electric blast/arc furnaces, CO2 emissions could be reduced by around one third after 2030, i.e. three to four million tons per year, voestalpine stated at the end of 2020"*.[37]

As voestalpine is the most important employer in the region, its economical standing has also great influence on local and regional socio-political and socio-economic dynamics. For this reason the company's commitment to a green steel transition and the public communication on future strategies are closely related to its perceived values and hence its commitment to the employees and the local community.

Issues, statements and conflicts

Discourses related to the energy transition are particularly technology-driven in the regional and national media landscape. These technology discourses give insight into striving for solutions in the transition process towards green and renewable energy. With regard to the industry, the question is not whether the shift to innovative low-carbon or zero net carbon energy solutions is necessary but by what means this has to be done and how challenges can be overcome. *"There is a clear commitment to decarbonisation in the [Austrian] steel industry."*[38]

Influential stakeholders such as the Austrian Energy Agency (AEA) see the increase of energy efficiency measurements as key to tackle the climate goals on a global level. If the expansion of renewable energies such as photovoltaics, for example in North Africa, is promoted for the production and export of green hydrogen, it is also necessary to convert the energy supply on site in general or to promote the transition if necessary.

Defining Constituencies

The following list provides an overview of the major stakeholders ("constituencies") and their influence in the decarbonisation process based on the results of the media discourses in the region Upper Styria and the province of Styria.

Constituency 1: Technological Regularisation (IMPOSE)[39]

Main stakeholders that are involved in imposing not only technological regularisation, but also adaption and acceleration of decarbonisation (e.g. through but not explicitly technological innovation) come from industry and large enterprises, namely from voestalpine. Stakeholders are also part of research institutes and/or Austrian Energy Agency and E-control (at national level), or are policy makers from the province's environmental departments.

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[37] ORF, 2021: Klimakrise. Suche nach „grünem Stahl", https://orf.at/stories/3201517/, [04.12.2021]. *Mit dem schrittweisen Umstieg auf Elektrohochöfen könnten die CO2-Emissionen nach 2030 um etwa ein Drittel, also drei bis vier Millionen Tonnen jährlich, vermindert werden, gab die voestalpine Ende 2020 an. Langfristig strebt der Konzern an, den Einsatz von Wasserstoff im Stahlerzeugungsprozess sukzessive zu erhöhen und bis 2050 die CO2-Belastung um insgesamt mehr als 80 Prozent zu senken, wie es Ende 2020 hieß*.

[38] Ibid.; O.e.: „Das klare Commitment zur Dekarbonisierung ist in der Stahlindustrie gegeben".

[39] Based on the text analysis 24 documents (N=50) with 225 coded segments were identified belonging to constituency 1 - Technological Regularisation (IMPOSE).

- scientific and technical experts in the field of Austria's steel production, R&D and Industry Leaders
- Steel producing Industry (voestalpine)
- Austrian Peoples Party (ÖVP), The Greens (Die Grünen) [on the national and provincial levels]
- Social Partners
- Research and Development (R&D), Research and Innovation (R&I), such as Green Tech Cluster, Joanneum Research
- Montan University Leoben and Universities of Applied Sciences
- Provincial Government (Land Steiermark)

Constituency 2: Technological Adjustment (COPY)

- Media (regional Newspapers)
- Parts of industry and business representatives

While discourses on socially, politically and technologically driven changes in energy transition highlight benefits and advantages, other stakeholders react with *behavioural adjustment* towards this socio-technological transformation. Responsible parties (constituencies) then adapt to such times of changes. Discourses on technological adjustment (COPY) turn out to be less visible in the public media.[40] Main feature to be found in these narratives can be described as *reasonable doubt*. Articles and reports do not strictly point out possible failures but leave the readers with a subtle discomfort concerning an on time breakthrough of emerging technologies and their broad roll out in the future. Whether such technologies will function/work as *game changers* is somehow presented as questionable. Narrative and discourses on technological adjustment are sometimes closely intertwined with technological regularisation discourses. This means that both narratives appear in the same newspaper article.[41] Statements do not argue against technological solutions and the need for political regularisations in fighting global warming, but are more doubtful that the progress is fast enough.

Constituency 3: Technological Reconstitution (RESIST)

- Members of the Freedom Party of Austria (FPÖ)
- Members of the Austrian Federal Economic Chamber

Discourses on technological reconstitution were investigated in close connection to "climate delay" discourses. In the political arena they mostly appear based on two opposite arguments. While the

[40] Out of N=50 text samples, only 13 covered narratives linked to technological adjustment, and in total 83 segments were coded.
[41] Cf. ORF 2021; https://orf.at/stories/3201517/, [05.12.2021]

Greens, both on national and provincial level, regularly critizise the downplaying of climate change in favour of economic interests, the conservative peoples party at provincial level states that “panic” and shere “alarmism” is of no use and will endager economic and social stability. As “the energy transition needs to be ecologically and socially fair and sensitive” the ÖVP opposes policies that affect individualism (e.g. no ban for car owners who live in rural regions, no forced transition/switch to public transport in these areas).[42] Hence climate delay discourses (RESIST) play a much bigger role in discussions about green mobility, infrastructural changes and challenges or in the context of plastic packaging waste. These challenges are sometimes discussed highly controversial, holding a mandatory transition against a plead for co-existence of renewables and fossil energy sources .

Stakeholders who take part in a reluctant or even dismissive socio-technological discourse are in the minority.[43] Main proponents who are in favour of a decelerated transition and the maintaining of conventional technological processes, especially when it comes to the areas of individual transport (e.g. pro diesel fuel privilege[44], against the ban of internal combustion-engines) and heat supply to households with fossil natural gas, are e.g. members of the right wing populist Freedom Party of Austria (FPÖ).

Constituencies, the local field of power and outcomes

Research, scientific expertise, collaborative approaches and innovative spirit and a clear commitment to decarbonisation, characterise the public media discourses on energy transition in Styria. Main discourses that emerged in the media coverage are likely centred on technological optimism and regional, national and global competition, especially when it comes to the steel producing sector and the main industrial players in the field.

5.2.2 Interpretation

Discourses on regional competition are closely related to expert debates on emerging technologies. Styria’s main steel producing company voestalpine is e.g. ensuring its regional competitiveness by investing in so called *breakthrough technologies* and is collaborating in R&D lighthouse projects.

Negative outcomes of the green steel transition are discussed in connection with migration of companies to low-wage countries, job losses in the steel sector and an increase of electrical energy costs. A big part of the discourse strands detected deal with economic effects of the CET. These discourses revolve around the topics *Regional, International & Global Competition*. Only few media reports covered potential negative consequences of the de-carbonisation strategies for the steel producing or industrial sector. If, then these are taken up with reference to stakeholders from industry and economy who depict a possible delocalisation of steel production to non-European countries (carbon leakage) and negative effects on European competitiveness. Controversies over

[42] Cf. STVP-Steiermark-Agenda-Version-Website, S. 23: 25
[43] Out of 50 text samples only nine articles with 32 coded segments covered narratives related to technological reconstitution.
[44] Note: tax benefits for diesel.

greenwashing strategies and climate delay discourses (RESIST) are more likely to be found regarding Austria's mineral oil sector and less in debates on the green steel transition.

Media narratives currently draw an overall positive picture of the challenges, but miss a deeper discussion of e.g. possible barriers in the implementation or effects of the transition process on all societal levels. From this viewpoint the research area represents a framework of *re-territorialisation*, which means that the carbon-intensive region Upper Styria reinvents its role and territories in the context of a new climatic regime.

Styrian representatives of Austrian Peoples Party (ÖVP) and Greens (Die Grünen) both claim to be in favour of the transition goals, the former strives for targeting research funding to ensure new job opportunities and strengthen Styria as business location, the latter is i.a. for funding of emerging technologies to avoid greenwashing effects.

Political statements are highly comparable to the official statements of stakeholders from the steel company or from economic experts. The emerging impression is one of convergence and commitment, both on side of politics as well as on side of the steel industry. Future effects on the employment situation or labour market effects due to the decarbonisation process in Austria and especially in Upper Styria are rarely discussed on a deeper level in the public media yet.

It has to be assumed that the transition process follows a top down strategy and is, next to political legislation and framework conditions, strongly guided by industry leaders themselves. From a more critical standpoint, it has to be mentioned that media narratives currently draw an overall positive picture of the challenges but miss a deeper discussion of e.g. possible barriers in the implementation or effects on all societal levels. It is undeniable that the search for green steel and low-carbon production technologies of the steel producing industry is also a reaction to the increasing global pressure, as "the steel industry is the second largest emitter of CO2"[45] worldwide.

5.2.3 Gender dimension

As regards the media sources selected for the analysis it has to be stated, that the gender dimension was almost completely blanked out. This has to do, in particular, with the fact that the discourses are almost entirely technical and technological, and that in Austria still only few women have established themselves in the tech- and energy area in particular. On the other hand, debates in which gender justice would be a topic, such as the future change and challenges in education and work due to the energy transition, are still hardly to be found in Austria.

[45] Cf. ORF 2021. O.e.: *Während der Öl- und Gassektor bereits seit Längerem in Sachen Klimakrise kritisiert wird, wächst nun auch der Druck auf die globale Stahlindustrie, „grünen" Stahl zu produzieren […].* https://orf.at/stories/3201517/, [04.12.2021].

5.3 Socio-ecological and technical component

This section provides an overview of the transformative capacity of the region to shape its decarbonisation pathway. The focus on transformative capacity allows us to discern the extent to which a region is actually capable of deviating from its current (carbon-intensive) trajectory towards sustainable outcomes. Transformative capacity is understood in this context as an evolving collective ability to conceive of, prepare for, initiate and perform path-deviant change towards sustainability within and across the multiple complex systems that constitute the regional or urban area undergoing a CET. As a systemic capacity, it is not attributable to any single actor but rather results from the interactions and orientations of multiple actors in the regional or urban economic development system involved in shaping its decarbonisation pathways. The diagnosis of transformative capacities thus enhances knowledge of key capacities hindering or facilitating purposeful transformation, ultimately permitting them to be addressed as part of capacity development activities. Wolfram (2016) identifies ten interdependent components to assess the transformative capacity of a region. These components are selected based on a literature review. Transformative capacity is strongly influenced by the governance of the regional decarbonisation or clean energy transition in question. Three governance and agency components are critical to the ability of a regional development apparatus to foster transformability of a system: the inclusiveness and multiformity of governance arrangements (C1); polycentric and socially embedded transformative leadership (C2); and the empowerment and autonomy of relevant communities of practice (C3). These elements are preconditions for the transformability of a system: there needs to be connectivity and responsiveness built into governance, effective leadership able to bring people together around a vision and actors empowered to experiment and innovate. These three attributes must be developed by stakeholders in capacity development processes to enhance their transformative potential, including enhancing understanding of the systems of which they are a part (C4), engaging in participatory visioning and alternative design scenarios (C5), experimenting with novel solutions to social needs (C6) and ensuring that these innovations can be embedded (C7). Ideally, this can be seen as a learning loop, where system(s) understanding helps inform visions and pathways, which in turn orient experimentation, with successful innovations being embedded and better system understanding resulting from this process. These processes should be fed back into governance through social learning (C8) as well as effective involvement of actors at different scales (C9) and levels of agency (C10). These components were assessed through mixed quantitative and qualitative interviews with various stakeholders engaged in the CET.

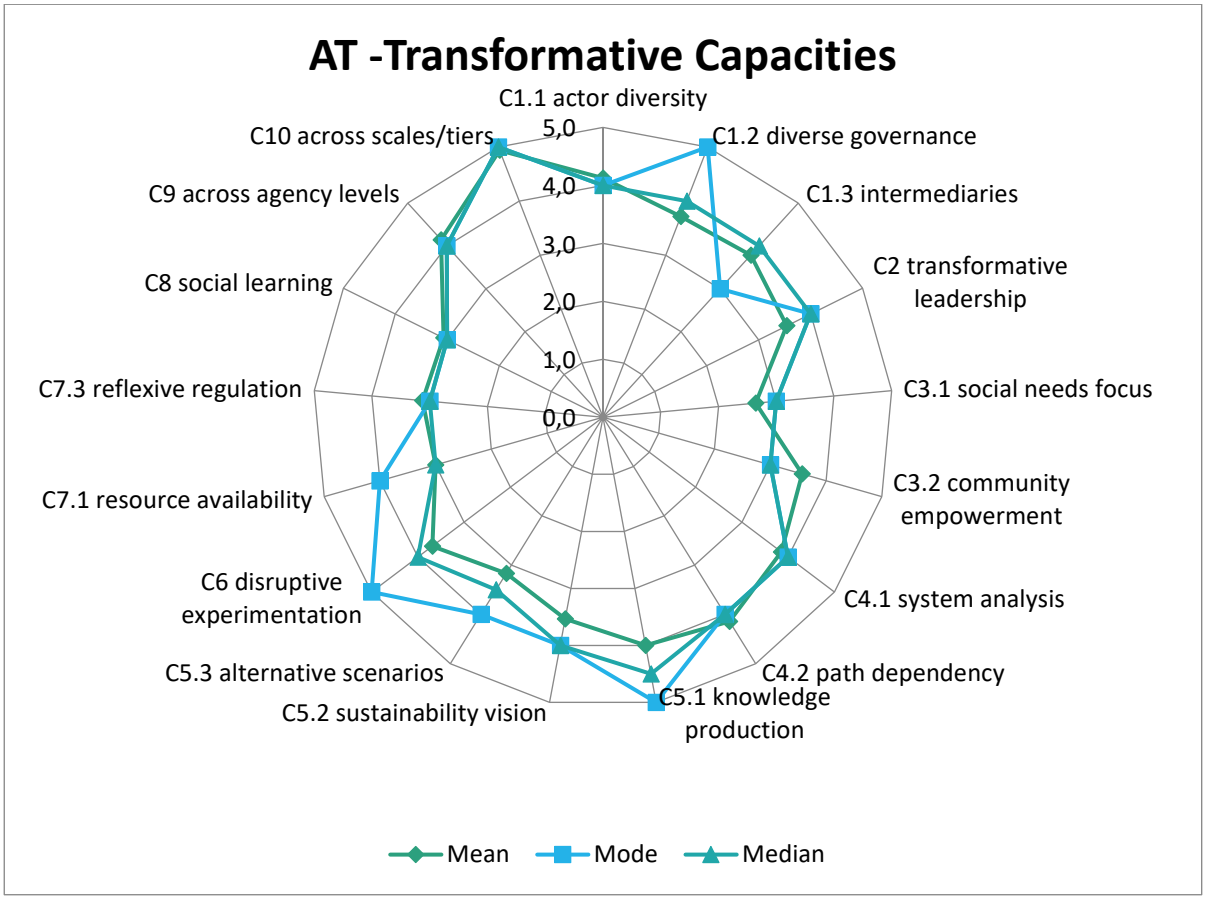
5.3.1 Summary of results

Overall Assessment

The below chart summarises respondents' assessments of components of transformative capacity in the region. Due to the wide range of responses, all measures of central tendency are included.[46]

[46] Some respondents answered Likert-scale questions with half units, e.g., "between 3 and 4". While means are unaffected by this, to produce accurate representations of the modes and medians, it was necessary to adjust these figures, with all results lower than 3 rounded down and all results higher than 3 rounded up, to indicate the direction of the respondent's estimation. This permits the data to be used as intended, for illustrative purposes (and as a visual stimulus and boundary object) rather than for statistical purposes.

Figure 13 – Stakeholder assessment of transformative capacity



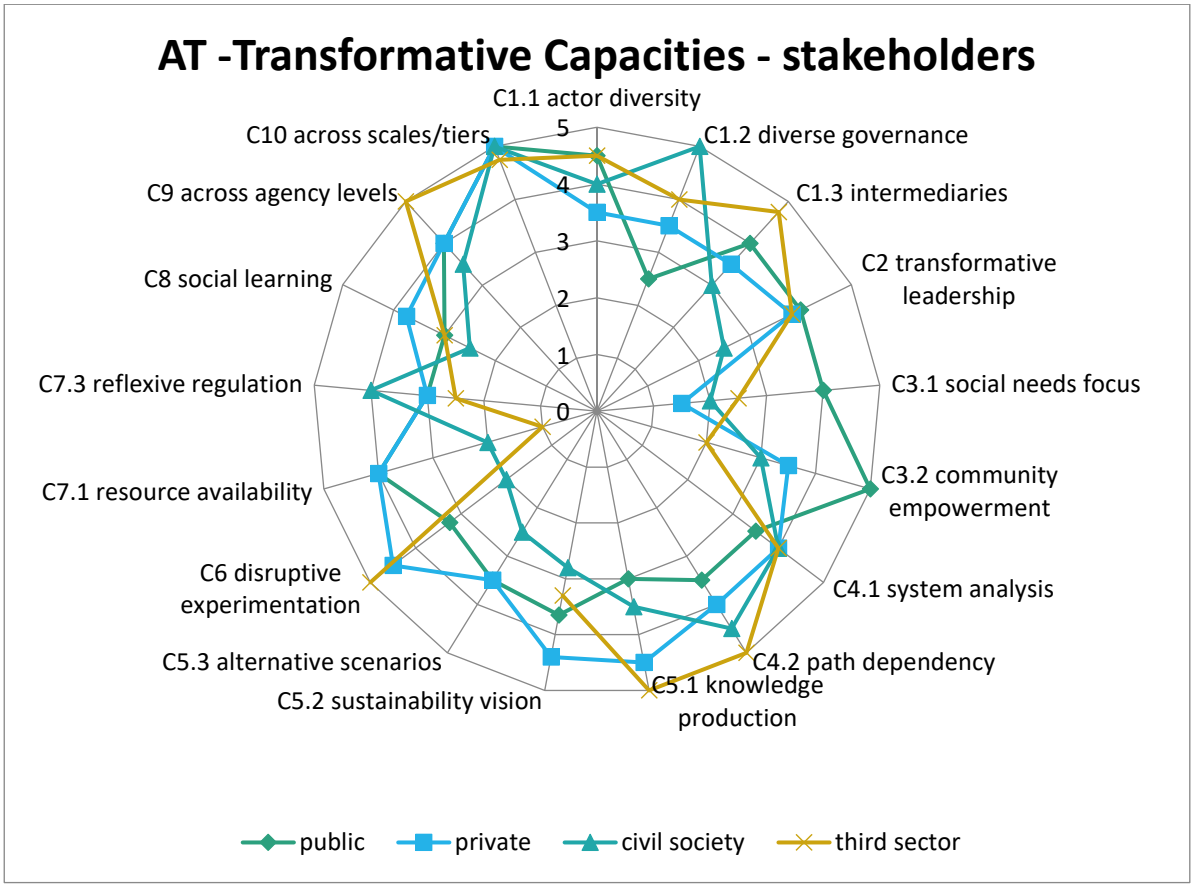
Source: Based on ENTRANCES interviews conducted for the case study.

Respondents assessed as highly important the necessity of dialogue and coordination across scales, across different governance levels from EU, federal, provincial down to regional. Knowledge production also received high scores, reflecting the availability of a mining university and of innovative companies in the CCT. The energy transition does not yet have a strong social needs focus in Upper Styria in the view of interview partners and got the lowest mean of all items. Social learning, reflexive regulation and community empowerment were also on the lower side.

Differences between Stakeholders

The data were split inductively by stakeholder type, according to the following categorisation: public sector (e.g. public agencies), private sector (business and its representatives), civil society (NGOs), and Third Sector (trade unions, research).

Figure 14 – Transformative capacity by stakeholder type



Source: Based on ENTRANCES interviews conducted for the case study.

There was consensus among stakeholder groups on the high importance of cooperation and coordination across scales /across governance levels. Interesting differences can be observed between the stakeholder groups on community empowerment, which was assessed as well established and important by public sector and to a lesser extent by private sector representatives, while third sector and civil society representatives were far more sceptical about the current situation. Resource availability showed a similar pattern.

5.3.2 Interpretation

Governance and agency

C1. Inclusive and multiform governance

Actor diversity. Interviewees voiced their opinion that the governance of the CET has been proceeding with regards to inclusion of stakeholders from nearly all societal levels, from citizens and civil organisations to the Social Partners, a consensus seeking consolidation of experts, who represent employees, economy, trade union, economic and industrial players. Local and regional Energy agencies are seen as intermediaries in the process of the CET. A major role is attributed to the companies (e.g. steel industry), as one expert was saying: *"The leverage for the energy*

transition is in the hands of the companies."[47] In Styria, he added, there are furthermore wider established networks, most notably from industrial, tech and innovation sectors, vividly working on the CET and bringing their expertise to the table.

The *Green Energy Lab* and the *Green Tech Cluster and Green tech Valley*[48], located in Styria, e.g. gather more than 250 members such as SME and Large Business Companies, Industry, researchers, Start Ups, developers and many more. At Green Tech Valley innovative and emerging as well as disruptive technologies are developed to enhance hydropower, solar, biomass and recycling.[49]

The importance of an enhanced (structural) integration of citizens in the CET was, however, unanimously seen as important.

Diverse governance. Hurdles and challenges for the CET can be observed in the coordination between different actors and especially governance levels (e.g. between provinces, between province and federal government levels). One expert elaborated: *"The topic [the CET] goes from supra-regional to local down to the energy regulars' tables*[50] *and energy and model regions. A lot is happening in this area. But I think that the real challenge is to make the "translation" between the levels and I would also wish for a bit more interdisciplinarity."*[51]

Another challenge to be addressed concerns more bottom-up governance, as we note top-down policy making in first place. New forms and ways to meet the citizens' demands and needs are seen for example in the implementation of *Energy Communities* on regional and national level, which were facilitated through legal reforms in 2021.[52] One expert stated: *"That's why I'm also pinning my hopes a bit on the energy communities, because I hope that the communities will recognise the potential to say, I can make a citizen tariff, for example."*[53] Other effort in this direction are tried via the Regional Managements or the KEM (climate and energy model regions).

Other structural problems pertaining and hindering consistency efforts in energy transition are seen concern lack of resources for policy implementation. One expert stated: *"I have been observing for years that structures are created with a good objective, but then insufficient capacities are created for implementation. Or a sufficient environmental analysis beforehand is missing and also talks with people, who are crucial for this so that it can also work well are missing."*[54]

Intermediaries. Key individuals, e.g. from NGOs, the energy agencies, the regional management etc. take part in the CET and act as "boundary spanners" and "knowledge brokers" between sectors, action domains and scales. Yet, the importance of intermediaries in terms of their

[47] Stakeholder Interview IP 6, Pos. 34.
[48] The idea for the green tech valley goes back to the 1970s and early 1980s. Founders were searching for future based green technologies in opposition to the then "modern" energy technologies such as nuclear power and fossil fuels.
[49] Cf. https://www.greentech.at/standort-geschichte-des-valleys/, [26.06.2022].
[50] Energy regulars' tables (Energiestammtische) offer the wider and civil society the opportunity to actively take part in the energy transition. They are held by individuals from the civilian population and are open to all interested parties.
[51] Stakeholder Interview IP 6, Pos. 54.
[52] https://energiegemeinschaften.gv.at/
[53] Ibid.
[54] Stakeholder Interview IP 1; Pos. 11

influence on design and implementation of the energy transition is rather low in real terms. The alignment to bring different or even opposing actors in this process together is not so much in their hands. Steering and governance processes lay much more in the hands of the "big players". For example, the four largest energy suppliers have long since joined forces across federal state borders: *"They know about the demands and needs of the state in regard to the CET, and we as energy supplier have to execute them."*[55]

C2. Transformative leadership

The commited and joint problem-solving and shared decision-making processes lie in the hands of long term experts in the field of the energy transition. As the interview results show those directly involved in the CET, who oversee its steering, the development of measures to be taken as well as the implementation of the political guidelines are in the hands of the main interest groups (e.g. social partnership organisations) and key stakeholders (e.g. policy makers, energy utilities, industry). Interestingly, especially Start Ups, R&I departments at energy utility companies and in the (steel producing) industry sector are considered to have great potential in this leadership processes. Austrian and Styrian companies are considered as being "very innovative" and a lot is happening in the R&D area".[56] Companies are already aware that their processes need to become climate neutral in the long run, the interviewees stated.[57]

Based on individual statements hurdles, gaps and missing links in the "translation" of local issues into regional/national/global arenas and processes were mentioned. The following excerpt gives an insight into explanations why leadership processes might fail*: "In the climate and energy sector, I think that is currently the biggest shortcoming. Namely, the coordination and the interfaces and responsibilities are not precisely defined. I would like to see a federal process, i.e. from the municipality, region, state and then federal level. That a proper process is set up on how decisions are made, both strategically but also for project decisions. And that this process is also used to coordinate and set up projects at whatever level, but please without bureaucracy! In other words somehow a modern coordination process."*[58]

Federalism and differences at economic, infrastructural and policy level are seen as challenges and hurdles in the efforts to lead the CET more decisively. Furthermore regional policy lacks a faster potential to quickly integrate civil society's demands with regard to the CET. The expert from the regional public sector stated that he sees the gap *"especially in the translation and its speed into politics, into administration, into implementation, that's where I see the gap in terms of deadlines and responsibilities."*[59]

Besides, civil society action and the integration of manifold stakeholder legal prerequisites have been slowing down the CET process. Specifically the Environmental Impact Assessments (EIA)[60] cause delays in the expansion of renewable energy. The legal process for the construction of wind turbines alone can take up to eight years; (assessment including construction and commissioning). Other problems appear when GHG emission reduction goals collide with the demands and/or fears

[55] Stakeholder Interview, IP 6, Pos. 22, 15.12.2021.
[56] Stakeholder Interview, IP 5, Pos. 21.
[57] Cf. IP 2, IP 4, IP 5, IP 6.
[58] Stakeholder Interview, IP 1, Pos. 47, 25.11.2021.
[59] Stakeholder Interview, IP 1.
[60] German: UVP - Umweltverträglichkeitsprüfung

of environmental protection, such as the protection of forestry of rare bird species that are in the centre of harshly led controversies of proponents and opponents of each stakeholder group.

C3. Empowered and autonomous communities of practice

Social needs focus. Social issues have been in general a bit neglected in the past, which was confirmed by our interview partners: they ranked social needs as the issue least addressed in the energy transition. But with exploding energy prices, the Austrian government has started to act and decided in September 2022 a limitation on electricity prices of € 0.10 per kwH for 2900 kwH per year and household; the excess consumption will have to be paid at market prices.[61] Social issues have been seen differently by stakeholders, and the viewpoints and descriptions of the interviewees strongly align with their organisational background of their respective interest groups. Employer representatives used social arguments (e.g. avoid social hardship) to advocate continuity of fossil fuel use, such as oil heating, diesel cars, and use of synthetic fuels for mobility. An employee representative stressed the importance of renovation of housing for low income households and for curbing CO2 emissions, but that rents must not explode as a result: *"...it's better to provide [affordable and energy-efficient] housing and thus create the opportunity for these [groups of people] to participate directly in the energy transition."*[62]

Community empowerment. Styrian and Upper Styrian municipalities and their citizens can receive financial funding and support via various public funding programmes, e.g. *e5 programme*, a programme directed toward energy efficient communities and municipalities. The programme also provides consultancy for individual households in terms of decarbonisation of heating systems, energy saving and mobility. Regional employers have also recognised that they can play a vital part in the clean energy transition. An interesting and sustainable approach to meet the social needs of employees is the voestalpine initiative to support the installation of PV systems for employees, which is implemented in cooperation with a national electricity provider, a regional power company and the Styrian government. The power companies offer a special employers tariff and support is also given in the processing for regional funding.[63]

[61] https://orf.at/stories/3284221/, 07.09.2022.
[62] Stakeholder Interview, IP 2, Pos. 75, 26.11.2021.
[63] Stakeholder Interview, IP 8, Pos. 35.

Capacity Development Processes

C4. System(s) awareness and memory

Baseline analysis and system(s) awareness. There was consensus that more efforts are needed to bring together the levels that are currently treated separately, i.e. to place technical and infrastructural solutions, centralisation versus decentralisation (policy) in the context of the social, i.e. to integrate stances, routines and individual/social as well as corporate values into systemic approaches. One interviewee appreciated the attempts made so far, yet systemic thinking and co-evolution is not accomplished by all involved groups in the CET: *"There are already groups that have this kind of systemic approach in mind, but there are still some decision makers and stakeholders who are not yet thinking completely systemically."*[64] Besides there would still be a shortcoming as regards the *"cultural or social and behavioural psychology perspectives"*. The expert referred to the KEM and KLAR[65] as good practice examples, *"because they also offer workshops such as 'awareness raising' for the broader public - these concepts integrate the psychological and sociological aspects more strongly*".[66]

Recognition of path dependencies. Critical comments were made in the area of the political willingness to act, which was perceived as inconsistent or slow. This especially appears to be so when it comes to the implementation of legal specifications or rules issued by the national and regional government. *"It seems to me"*, an interviewee from the third sector expressed, *"that politicians always come up with something that is then still not implemented after the end of a legislative period, everything is piecemeal/fragmentary."*[67] The economy sector and especially CO2 emitting industries for instance have been criticising insufficiently formulated and implemented regulations.

C5. Sustainability foresight

Knowledge production. This factor was ranked highest by the respondents, and the principal availability of knowledge from universities, research institutes, and companies underlined. When it comes to feeding back knowledge into political processes and decision making, the results of the interviews tend to be more critical. Knowledge exchange would work better on federal state level, this due to the tact that *"this is perhaps something typical for Austria. Because everything is concentrated in Vienna, and the short distances are always an advantage for something like [the CET]."*[68] Another statement underpins this argument: *"When it comes to what is missing, I think it is much more about 'awareness' not so much about 'knowledge'."*[69]

Sustainability Vision. Interview results show that Styria's regional sustainability vison is regarded as explicit, e.g. set out in a binding document such as the Climate and Energy Strategy of the Styrian Government. It was to a lesser extent seen collectively produced (some involvement of

[64] Stakeholder Interview, IP 1, 2021-11-25, Pos. 76
[65] Cf. KLAR: „Climate Change Adaptation Model Regions for Austria - KLAR!" is a pilot programme funded by the Austrian Climate and Energy Fund. The programme offers several modules via a process-oriented approach for municipalities to raise awareness for climate change adaptation and implement concrete actions on regional level, https://klar-anpassungsregionen.at/fileadmin/user_upload/Downloads/FactSheet_en_2021.pdf, [29.06.2022]
[66] Ibid.
[67] Stakeholder Interview, IP 3 , 01122021, Pos. 50
[68] Stakeholder Interview, IP2, [1:11:57.9]
[69] Stakeholder Interview, IP 7, [1:03:31.0]

stakeholders was perceived as 'window dressing'), containing motivational aspects and clear orientation. It was not seen as radical, and low scores were allocated to this item. This can be explained by the consenus oriented policies in Austria, based on social partnership. Large companies and their executive boards in the industrial sector have furthermore developed own strategy plans to target the decarbonisation and transition goals until 2035.[70] Learning from strategy monitoring was also assessed critically; a stakeholder remarked that *„monitoring is surely happening, but I am sceptical of learning effects, because there are for sure interest groups that are 'blindfolded`"*. [71]

Alternative scenarios. Alternative scenarios, e.g. with regard to the above mentioned electricity provision are especially orientated towards a quicker phase out from fossil energy resources. The expert from the energy sector estimates that *"one-third of electricity/energy production is also likely to go to the customer side of electricity production in the long term"*.[72] There are also already proposals, e.g. researches from Switzerland, on how the energy transition and the switch to renewables could be accelerated. One possibility is for example seen in the contribution from the farming sector. The necessary infrastructure is already in place and effects such as further expanded soil sealing could be avoided: The energy expert cited a recent study from Switzerland: *"To create the entire energy transition to 100 % renewables in all sectors, 5 % of the agricultural area could be enough and therefore it is logical to [integrate] farmers as 'new energy service providers'".*[73]

Hurdles and challenges are seen when it comes to policy communication. While the carbon-emission pricing measures was determined in the Austrian parliament and will be executed in autumn this year, barely anything is done to support the transition to public transport. On the contrary, the expert said, *"citizens receive refunding so that driving their cars stays affordable."*[74] Contradictory actions from politics like these most likely aggravate the transition process.

C6. Disruptive experimentation

Styria is a leading region in terms of innovation in Austria and Europe with its companies, SMEs, start-ups, universities and research institutes, including strong expertise on renewable energies especially on hydropower. It is therefore well placed for disruptive experimentation, and some testbeds have been established, e.g. the Green Energy Lab. However, for implementation of such disruptive experimentation there was some hesitation among respondents. A more systemic reflection was provided by a stakeholder with a company background: *"Everything that is technical and whenever you can put something into figures, this, we do easily. But the company is ultimately an organism with real people, employees, and there we are certainly not so strong. […]. Remote work, was previously unthinkable and now it is normal because of the Covid Pandemic. But to*

[70] Stakeholder Interview, IP 8.
[71] Stakeholder Interview, IP 4.
[72] Ibid., Pos. 10.
[73] See also https://www.blw.admin.ch/blw/de/home/nachhaltige-produktion/umwelt/energie.html, Switzerland's energy policy is being realigned. Energy is to be increasingly saved and produced in a renewable way. Agriculture can also make a contribution to this: There is untapped potential in improving energy efficiency and producing electricity and heat from biomass, wind and solar energy (Bundesamt für Landwirtschaft BLW 2022).
[74] Stakeholder Interview, IP 6, Pos. 12.

speak the truth, these changes were not coming from us, the company. It was the other way round, it was not a new approach rather a reaction in the wake of the pandemic."[75]

New solutions and ideas that are particularly relevant to the energy transition are not explicitly related to technics and technologies, social practices have to be considered as well. As society and demands of younger people and potential employees are undergoing a change, companies have become aware that they not only have to adopt to these challenges but rather be part of a social transition that also has direct effects on the future of the energy transition. A concluding quotation form the mentioned stakeholder interview is intended to support this: *"Before, we had employees who were here for their entire working lives, now the times of employment in the company are also going down, because young people have a different mentality. And, the competition for employees is increasing in Upper Styria, in the past we were clearly No. 1, meanwhile we can no longer claim that."*[76]

C7. Innovation embedding and coupling

Access to resources for capacity development and reflexive regulation are both important to embedding innovations.

Resource availability. Resources for capacity development are available through the Austrian Climate and Energy Fund and a range of other support tools. The long awaited Renewable Energy Expansion Act (EAG) and tax reform further contribute to it. Some critical issues related to the policy framework were highlighted by respondents: tax reform was not formulated consistently enough and positive effects in this opinion are not really measurable. The government still has avoided to touch on privileges of certain lobby groups (e.g. transport, farmers) and end tax advantages for diesel ("diesel privilege), and an interviewee stated critically *"there is absolutely no reason why diesel should be cheaper than gasoline!"*[77] Another aggravating factor is a certain fight for resources among groups that contribute to the CET, such as in the field of renewable energy. One of the interview partners gave an illustrating example: *"The experts in renewable energy say, "We have to put everything on PV!" and the next one says, "No, wind energy is the best!" and again the next one says, "Hydropower!", they fight in the same field, everyone pursues exactly his technology and they literally fight among themselves and I say, "Stop it, you are all the good guys!" Yes, that's an example where I think to myself, the advocates [of their respective technologies and ways of access], well they are also organised in associations, […], they all defend their own association purpose."*[78]

For the steel industry, the introduction of carbon pricing in Austria with autumn 2022 poses a challenge. The business representative referred to the high CO2 standards in Europe, e.g. Austria and Germany as compared to other regions such as America, Russia and China. These differences in the standards could endanger the competitiveness and for some industries it might not be feasible to keep up their company locations in Austria.[79]

[75] Stakeholder Interview, IP 8, Pos. 132.
[76] Ibid.
[77] Stakeholder Interview, IP 4, Pos. 87.
[78] Stakeholder Interview, IP 6, Pos. 123.
[79] Stakeholder Interview, IP 5, Pos. 5.

As regards the access to resources to enhance inclusion and participation as well as vision- and scenario-development, socially disadvantaged groups were way too little seen as important part in driving the clean energy transition.

Reflexive regulation. The Renewable Energy Expansion Act was long awaited in Austria and finally approved in 2021. It provides an important basis for the CET and for resource availability.

Relational factors

C8. Reflexivity and social learning

Interviewee remarks were mostly pointing to the monitoring of the CET. More available and real time data[80] would be needed to successfully strive for the goals of decarbonisation on all mentioned socio-economic as well as cultural levels. Even though monitoring is conducted regularly as part of the *Styrian Climate and Energy Strategy*, the evaluations seem not sufficiently time sensitive or results are not properly used for guidance, steering and eventually future scenarios: *"We need numbers, data, facts to know which measures are useful and which should be continued, but also which are not needed at all. So, we can certainly do a lot better in the evaluation."*[81] The stakeholder from the energy sector proposed that open source *"data should be available online and dynamically, so that people can check online where we stand. Because then it will have an impact on the players, honestly, who reads that afterwards, except statisticians."*[82] In the industrial sector the CET is in the centre of talks and regular knowledge exchange at national and regional level. Specifically the exchange with the trade unions was highlighted, due to the fact that the transition has already been evoking fears of upcoming challenges in the industrial workplaces.

C9. Cooperation across human agency levels

Topics related to decarbonisation and the transition to clean renewable energy systems are mostly in the hands of experts and key stakeholders, a closer integration of civil society and citizens seems currently less developed both at regional as well as at national levels. The understanding that *"electricity has to come from somewhere, because it doesn't just come from the socket"*[83] has been missing in society as a whole as an interviewee stated. *"If we want to achieve the energy transition and get away from fossil fuels, we need a renewable expansion. Here I would wish for more understanding from all groups."*[84]

Other interviewees claimed that marginalised groups need to be better integrated in the transition process. It was stated that the CET comes with a certain cost and for this to be implemented, it needs to start with the broad population, how can people be supported who have less money available, and how can we help those who do not have the opportunity to participate in the CET.

C10. Cooperation across political-administrative levels

The cooperation across political-administrative levels was assessed as highly important by the respondents, and the EU level was allocated a significant guiding role in the CET. The collaboration on the provincial level of Styria is working well among energy suppliers, industry,

[80] Cf. IP 6.
[81] Stakeholder Interview, IP 5, Pos. 154.
[82] Stakeholder Interview, IP 6, Pos. 137.
[83] Stakeholder Interview, IP 5, Pos. 109.
[84] Ibid.

diverse interest groups (especially the Social Partners), which all have strong links to regional policy makers. To a far lesser extent experts from NGOs, e.g. environmental groups take part in these complex stakeholder processes.

Federalims and its weaknesses in coordination, as well as a slow speed of implementation of CET measures were perceived as most important hurdles. The weak or lack of coordination between the nine Austrian provinces, and between the national and the provincial levels will have to addressed. As one respondent put it *"I just don't see this cooperation between the provinces, that they say, okay, our contribution comes from below, but there is then a common federal goal to which one commits oneself. It is simply due to federalism that everyone has to define its goal as low as possible so as not to look bad."*[85]

The lengthy coordination processes among key stakeholders and negotiating of trade-offs slows done the CET. A private sector stakeholder formulated that *"the problem is that there are always new goals in the energy transition that are decided somewhere, i.e. at the EU level, national level, at the World Climate Conference, at the state level. However, this [the CET] requires planning and legal certainty, especially for the companies. That is a very important point. We [the representatives of the business community] are waiting for energy efficiency laws, the Climate Protection Act, the Renewable Heat Act, which is hanging over the companies like a sword of Damocles. They don't have any planning and legal certainty, you don't know exactly where things are going. It would be good if things could move a little faster."*[86]

5.3.3 Gender Dimension

There are only very few women among the key stakeholders of the energy transition in Styria. All our eight interview partners were male. We have contacted a female director of an intermediary organisation, but she declined taking the interview. Social justice and inclusion issues are not or only to a rather limited extent addressed in specific decarbonisation strategies, e.g. of the steel industry or the level of the province of Styria.

However, the Styrian Government has recently (in 2020) strengthened its effort and introduced a specific *Women and Gender Equality Strategy of Styria*. More than 700 individuals, such as "multipliers, researchers and practitioners in the area of gender equality as well as counselling of girls, women and men, representatives of the social partners, business and industry representatives, as well as the members of the Styrian Partnership for Integration" took part in a several months lasting process and "concerted action" striving to promote gender and equality efforts.[87] The prospective scope of gender equality takes into account that the "manifold issues relating to women's and gender equality policy are cross-cutting political topics" with multi-layered links to "economic and employment policy, social and health policy, education and science policy, as well as family policy".[88] A sustainable improvement in gender equality must therefore start at all levels, the provincial as well as the federal government and the European levels (ibid., 4).

[85] Stakeholder Interview IP 2, Pos. 9.
[86] Stakeholder Interview.
[87] Land Steiermark. Steirische Frauen- und Gleichstellungsstrategie 2020: 4.
[88] Ibid.

5.4 Conclusion

Overall Styria and Upper Styria dispose of rather high transformative capacities for the CET. Knowledge production was rated highest, resources and strategy documents are available. Steering and implementation of the CET in Styria is seen in the hands of experts in energy transition, technologically driven change, organisational change management and experience in policy strategies. Established networks, most notably from industrial, tech and innovation sectors try to enhance the CET in a collaborative manner. Tools for disruptive experimentation are available. NGOs, the energy agencies, the regional management etc. take part in the CET and act as "boundary spanners" and "knowledge brokers" between sectors, action domains and scales. Regional employers have recognised that they might and can play a vital part in the clean energy transition. Community empowerment in the Upper Styrian region goes also hand in hand with environmental efforts coming from local industrial players. The findings reflect that regional policy supports a development pathway that is in principle commited to the clean energy transition.

However, some weaknesses persist and have to be addressed:

- **Coordination and cooperation across governance levels** has to be improved, especially between the provinces, between the provincial and national levels, and between individual initiatives and public agencies for the CET, climate adaptation, and regional economic development.
- **Involvement of citizens and civil society actors** needs improvement. Interviewees urged for better communication and "translation activities" to enhance bottom up actions of citizens, especially on local and regional level. Also, more care for social aspects was highlighted and support for marginalised and low income groups for the CET suggested. New forms and ways to meet the citizens' demands and needs are seen in the implementation of Energy Communities, which were facilitated through recent regulation.
- **CET needs more speed**; the involvement of diverse and rather heterogenous groups of stakeholders leads to slowing down the CET process. Requirements must be enforced more quickly at national and regional level. One of the biggest described barriers are long term Environmental Impact Assessments (EIA) which are causing troubling delays in the expansion of renewable energy (wind, solar, water energy resources).

The final quotation makes it vividly clear what fundamental socio-economic and cultural coherences, challenges, but also potentials and opportunities are associated with the energy transition: *"Energy and the associated changes are actually almost too cheap, measured by what the energy transition is, what the transition can do and what it ultimately offers. The value has not been recognised socially at all, that is only starting now from my point of view. Precisely because it is only now that it is receiving a social price and where people are also becoming aware that if they want to change economic practices and behaviours, and above all the energy transition plays a role in this, everything will then change as well".*[89]

[89] Stakeholder Interview, IP 2, Pos. 5.

CHAPTER 6

CHALLENGES, COPING STRATEGIES & GENDER

6 Challenges, Coping Strategies & Gender

6.1 Challenge 1: Decarbonisation of steel industry

6.1.1 Challenge description

Current situation

Decarbonisation of the steel industry is a huge challenge for Upper Styria. It requires technological solutions, which are researched and piloted with a possible switch to hydrogen, and the implementation of energy efficiency measures. However, the high volume of energy required for the steel production cannot be covered in a short time horizon from renewable energy sources. voestalpine has developed concise and binding strategy documents to implement the phase-out of CO2-intensive production in an economically viable manner and with a view to the employees in a socially responsible manner.[90]

The Styrian government conducts - besides their position paper on the Climate and Energy Strategy - stakeholder workshops on a regular basis to reinforce and support the implementation of the Climate and Energy strategy on the regional level.[91] An interview excerpt gives a graspable insight into hurdles of how to consolidate common and usable strategies and why the path towards decarbonisation even on a high awareness level still remains a challenge: *"The awareness among the individual stakeholders is definitely there. Now it's more a question of speed and the type of implementation; these are the central issues. It's not so much the goal that's in question, that also varies in the federal states, but rather the path and the speed. And from the stakeholders' point of view, you have to see 'the burden of the past'. What has worked in the past is something that people would like to preserve. The difficulty lies in deciding what to get rid of without destroying something on which a consensus had already been reached in the past."*[92]

Desired outcome

The desired outcome is production of green steel (CO2 neutral steel), and securing the production, the sites and employment in the CCT.

6.1.2 Coping strategies

Coping strategy 1: R&I into new production technologies

Research and Innovation (R&I) into new technologies are being piloted. In particular, a pilot plant for hydrogen has been built at the site in Leoben-Donawitz. Involvement in national and EU funded R&I projects is actively pursued. First carbon neutral steel has been delivered to clients.

Coping strategy 1.2: Energy saving

Energy saving measures are actively pursued by voestalpine and annual targets formulated (e.g. 2% energy saving per year).

[90] Stakeholder Interview, IP 8.
[91] Stakeholder Interview, IP 2.
[92] Ibid.

6.1.3 Gender dimension

The Transformation is expected to open up more opportunities for female employment in the male dominated steel industry.

6.1.4 Discussion

The Austrian steel industry (voestalpine) is serious about the decarbonisation, but it will be a long way to achieve it. Investment and transfrormation will need to be speeded up. However, the industrial upscaling of new technologies and the required volume of renewable energy will be very difficult to solve in the short run.

6.2 Challenge 2: Soil sealing & housing renovation

6.2.1 Challenge description

Current situation

The responsibility of local spatial planning is with the elected mayors and elected municipal councils in Austria, which has a strong impact on questions of the energy transition. As many spatial planning decisions in Austria are taken by local municipalities, these decisions are often influenced rather by personal relations of mayors or short sighted ideas of economic growth than overarching planning strategies. This has led to an enormous amount of sprawl all throughout Austria, where the yearly new land consumption is among the highest in all of Europe.[93] A report by ZERsiedelt, a project by the Austrian Agency for the Enviroment and Technology (ÖGUT) for example came to the conclusion, that taking away some planning responsobilities from municipalities is a necessary change to avoid further sprawl.[94] Since municipalities don't carry all costs related to plot designation and since mayors are often dependent on the votes of applicants, this leads to situations where designations are not made in accordance with regional planning goals (ibd). Given that traffic is one of the major causes of Austrian emissions, and one of the few that keeps growing, and given how much personal vehicle use is related to sprawl and land-use decisions, municipalities have an important part to play in the implementation of a major goal of the energy transition[95] and climate mitigation. By designating new developments only in central municipal areas and in parts of the municipalities that are reachable via public transport, or are at least viable for connection, individual traffic could be limited massively. Further, municipalities can impact the local energy use, some of them run their own energy agencies, and by switching to renewables they can further impact the transition.

Desired outcome

Stop of soil sealing in the region, and upgrades of city centres through renovated existing housing would be desirable outcomes.

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93 See https://www.eu-umweltbuero.at/assets/EU-Umweltbuero/EU-Factsheets/2017-1-Factsheet-Boden-interaktiv.pdf

94 ÖGUT, 2011. Projekt ZERsiedelt, 4.

95 Umweltbundesamt, Bundesländer Luftschadstoffinventur 1990-2018, 99.

6.2.2 Coping strategies

Coping strategy 1: renovation

There is rather a lack of coping strategies. High quality renovation of existing housing in main municipalities would be required, to make these attractive places to move to (besides the current argument of lower rents).

Coping strategy 2: energy efficiency measures

Energy efficiency measures have been devised by the government, and advisory bodies, e.g. in the form of energy agencies are available. The measures need to be targeted at the lower income classes, so as to avoid abandonement of housing and energy poverty.

6.2.3 Gender dimension

Lack of proper housing leads female partners in families tend to leave the region. They usually take the family with them, which reinforces outmigration trends.

6.2.4 Discussion

The issue of soil sealing is connected in Upper Styria to lack of appropriate housing in main municipalities of the region. It has to be urgently addressed with renovation of abandoned housing, making these energy efficient and providing enough space for families. This should lead in future to reducing outmigration trends. Energy saving and energy efficiency measures are far less present in the debate on energy transition, than the expansion of renewable energy sources and production.

6.3 Challenge 3: better governance of the CET

6.3.1 Challenge description

Current situation

Weaknesses in coordination and cooperation across governance levels have been mentioned by interview partners as critical issues to be solved. They concern coordination and cooperation between the Austrian provinces, between provincial and national levels, as well as between public initiatives for climate and energy. Curing these issues is needed so as to speed up the CET.

Desired outcome

A better coordination and cooperation across governance levels is the desired outcome, so as to speed up the energy transition.

6.3.2 Coping strategies

Coping strategy 1: improving coordination of initiatives

Efforts have been taken to better coordinate public initiatives around climate and energy, e.g. in the frame of KEM and KLAR initiatives. However, between provinces and province-national level, the weak coordination persists.

6.3.3 Gender dimension

Most key stakeholders in the governance of the CET are male, as was demonstrated in our interviews for the socio-technical component. All eight interview partners were male.

6.3.4 Discussion

Starting from lower level initiatives, more pressure should be built up towards provinces and national level to enhance cooperation efforts.

CHAPTER 7

CONCLUSIONS

7 Conclusions

The region of Upper Styria has long been shaped by mining and production of metals. We have investigated in particular the steel industry, which is a main employer in the region with several subsidiaries of the Austrian multinational steel producer voestalpine situated here. The economic base has been diversified and other important companies such as microelectronics, paper and pulp are present. The region shows good transformative capacities for the energy transition, and some measures have been taken towards decarbonising the industry, advancing renewable energies (e.g. via the Renewable Energy). But the Ukraine crisis has confirmed that advancement on the CET is far too slow. Our analysis with the help of a variety of research methods has helped to reveal key trends, as well as challenges and (possible) coping strategies.

The following key challenges related to the Clean Energy transition are looming in the region:

- The **decarbonisation of the steel industry**, and the speeding up the energy transition at the provincial and case study region levels need to be tackled with more effort.
- **Soil sealing and related abandonment of housing** in city centres in the region's municipalities need to be stopped and reversed.
- **Social questions around gender pay gap, care system, and image of the region** have to be addressed.
- The above mentioned challenges need to be dealt with to ensure that people stay in the region and **ageing and outmigration trends** be countered.
- **Weaknesses in coordination and cooperation across governance levels** have to be tackled: they concern coordination and cooperation between the Austrian provinces, between provincial and national levels, as well as between public initiatives for climate and energy.
- **Better inclusion of citizens and civil society stakeholders**, awareness raising measures, and support for marginalised and low income groups (e.g. for renovation) will be required to facilitate the Clean Energy Transition.

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APPENDIX

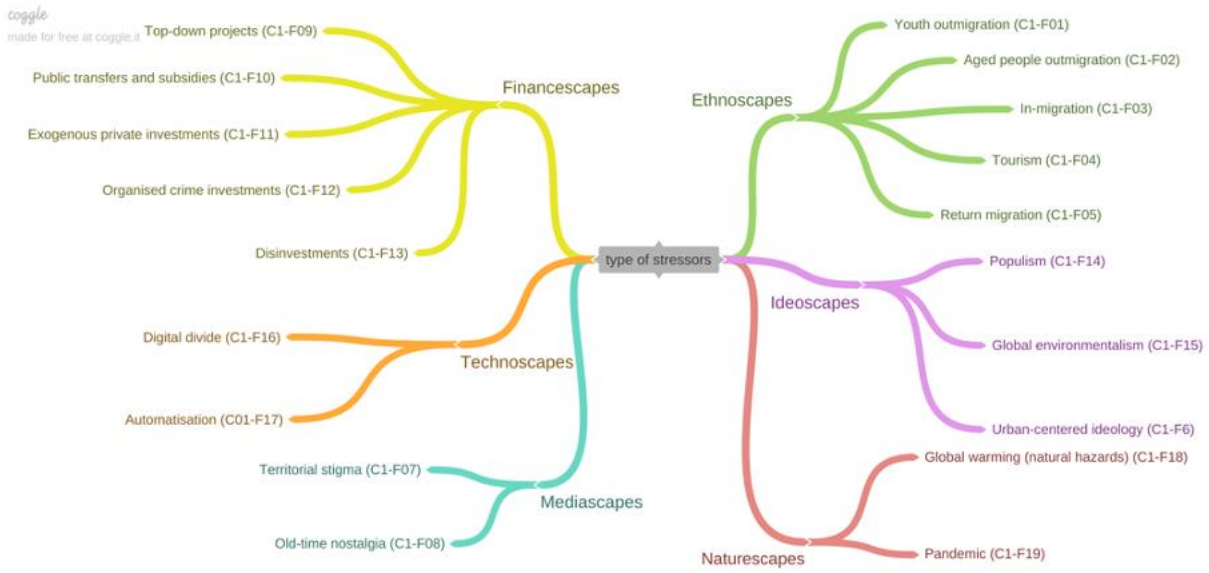
9 Appendix

Table 11 – NACE Rev. 2 classification

NACE Rev. 2	Description
A	Agriculture, forestry and fishing
B	Mining and quarrying
C	Manufacturing
D	Electricity, gas, steam and air-conditioning supply
E	Water supply, sewerage, waste management and remediation
F	Construction
G	Wholesale and retail trade
H	Transportation and storage
I	Accommodation and food service activities
J	Information and communication
K	Financial and insurance activities
L	Real estate activities
M	Professional, scientific and technical activities
N	Administrative and support service activities
O	Public administration and defence; compulsory social security
P	Education
Q	Human health and social work activities
R	Arts, entertainment and recreation
S	Other service activities
T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use
U	Activities of extraterritorial organisations and bodies

Source: Eurostat, 2008, p.47.

Figure 15 – Socio-cultural component: type of stressors



ENTRANCES

ENergy TRANsitions from Coal and carbon: Effects on Societies

UNIVERSIDADE DA CORUÑA

ENEA

K&I Knowledge and Innovation

IWH Halle Institute for Economic Research Member of the Leibniz Association

Leibniz Institute of Ecological Urban and Regional Development

ZSI

NTNU

eurada

Mineral and Energy Economy Research Institute Polish Academy of Sciences

spi Sociedade Portuguesa de Inovação

wecf France

CARDIFF UNIVERSITY PRIFYSGOL CAERDYDD