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Rethinking regional economic resilience: Preconditions and processes shaping transformative resilience

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Rethinking regional economic resilience: Preconditions and processes shaping transformative resilience

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Abstract

The unpredictable impacts of slow-burn processes such as climate change and sudden shocks such as the current COVID-19 crisis have led to a renewed interest into regional economic resilience. Much of the literature focuses attention on how regional economies and industries could *bounce back*, that is, how they could return to their pre-shock conditions. Other scholars have proposed to construe resilience as *bouncing forward* to capture the mechanisms and processes that underpin positive adaptation and structural change in response to a crisis. In this article, we argue that both conceptualisations fail to consider shocks and crises as a window of opportunity for regional economies to transform to a radically different and more desirable trajectory. This paper brings a new perspective into play, that is, transformative resilience which places shifts towards more sustainable pathways centre stage. This understanding of regional economic resilience acknowledges that a crisis may bring about permanent structural change *and* it considers to what extent these transformations are to the benefit of society and the environment. This article seeks to identify in a conceptual way what factors and dynamics are vital for enhancing the transformative resilience of regions. To this end, we link recent insights from the debate on regional economic resilience to challenge-oriented regional innovation systems and elaborate on the role of pre-shock conditions and various core processes in building up regional transformative resilience.

Keywords
transformative regional resilience, environmental and societal challenges, challenge-oriented regional innovation systems; green path development

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1 Introduction

Financial and economic crises at the end of the 2000s and the current COVID-19 pandemic have sparked an enormous interest in the resilience of regional economies in Economic Geography and related disciplines (Bailey et al., 2020; Bristow and Healy 2020; Evenhuis, 2017; Martin and Sunley, 2020; Sutton and Arku, 2022).

The notion of regional economic resilience has been criticised for being a buzzword and fuzzy concept (Christopherson et al., 2010; Davoudi, 2012; Martin and Sunley, 2015; Pendall et al., 2010). Many scholars invoke the notion to assess how regional economies respond to and recover from major shocks, disruptions, disturbances and crises (Martin, 2012). There is however no universally agreed definition of regional resilience (Bristow and Healy, 2020; Martin and Sunely, 2015). Much of the literature focuses attention on how – and how fast – regional economies and industries could *bounce back*, that is, how they could return to their pre-shock conditions. Other scholars have proposed to construe resilience as *bouncing forward* to capture the mechanisms and processes that underpin positive adaptation, reorientation and structural change in response to a crisis (for a detailed discussion, see Martin et al., 2016). Recently, yet another understanding of regional resilience has been introduced in the Economic Geography literature, that is, resilience as system transformation (referred to as transformative resilience) in response to shocks (Martin and Sunley, 2020). Transformative resilience points to the capacity of regions to 'transit to a new sustainable path characterized by a more productive and equitable use of its physical, human and environmental resources' (Martin and Sunley, 2020: 15).

In this article, we take a critical view on prevailing bounce back and bounce forward conceptualisations of regional resilience. Taking up recent ideas about transformative resilience we bring a new perspective into play, one that places shifts towards more sustainable pathways centre stage. This understanding of regional economic resilience acknowledges that a crisis may bring about permanent structural change *and* it considers to what extent these transformations are to the benefit of society and the environment. Such a view is also gaining currency in the policy world (see, for instance, Giovannini et al., 2020; McCann and Soete, 2020; Pontikakis et al., 2022).

The aim of this article is to examine in a conceptual way what factors and dynamics are vital for building up and strengthening regional transformative resilience. To this end, we link recent insights from the debate on regional economic resilience to challenge-oriented regional innovation systems. This provides an inroad for understanding how regional pre-conditions and various core processes shape the transformative resilience of regions.

The remainder of the article is structured as follows. Section 2 provides an overview and critical discussion of established views of regional resilience in Economic Geography and cognate disciplines. Section 3 introduces the notion of transformative regional economic resilience. Section 4 examines in a conceptual way how transformative resilience – interpreted as the capacity of regions to enhance the challenge-orientation of their innovation systems – unfolds

in regional contexts. In section 5, the article explores the articulated ideas with two examples from Norway and Austria. Section 6 concludes and sketches out future research avenues and some first policy recommendations.

2 Regional economic resilience: prevailing views

Over the past few years, the idea of resilience has received growing attention in economic geography and regional studies (Bailey et al., 2020; Boschma, 2015; Bristow, 2010; Martin, 2012; Martin and Sunley, 2015, 2020). The notion echoes an old question in economic geography, namely why some regions succeed in coping with shocks and crises while others fail (Christopherson et al., 2010; Hassink, 2010; Simmie and Martin; 2010).

Regional economic resilience has become a popular concept in economic geography analyses but there are still many unresolved issues around its definition, precise meaning, conceptualisation, and measurement (Martin, 2018; Sweeney et al., 2020). For instance, there is little consensus about whether regional resilience should only deal with shock situations or also with slow burning crises and long-term structural change (Martin, 2018; Martin and Sunley, 2020). Furthermore, there are discussions about whether it is mainly internal or external factors (multiscalarity) that affect regional resilience (Bristow and Healy, 2020).

The resilience concept has roots in physical sciences, engineering and ecology and is now also widely used in other disciplines such as psychological studies, economics, geography and planning (Davoudi et al., 2013). Within economic geography, an evolutionary approach to resilience has gained prominence. As further elaborated below, this approach rejects equilibrist thinking that is prevalent in both engineering and ecological versions of resilience[1], points to the inevitability of structural change and argues for understanding resilience as reorganization of existing industries or shifts to new economic activities (Evenhuis, 2017; Martin, 2018).

Martin and Sunley (2020, p. 10) understand regional economic resilience broadly as the capacity of actors within a region to cope with and recover from unfavourable shocks to its economy. They underline that the resilience of a region's economy develops over time as 'an historical evolutionary process' (op. cit.: 31). The state of a regional economy and its resilience are hence seen as the result of historical and region-specific processes. A region's capacity to tackle shocks, its strategies and activities towards a shock are influenced by former experiences which are embedded in firms' and organisations' routines, in actors' networks, in the structure of the regional innovation system, and so on. Additionally, experiences with tackling a shock

[1] The engineering conception implies that regional economies and industries return to some state of equilibrium that existed before a shock. The ecological conception assumes that a shock can push regions and industries into a different equilibrium state without changing their identity, basic operation and functionalities. Referring to Manca et al., 2017; Pendall et al., 2010; Scott, 2013), Evenhuis (2017: 5) notes that 'Evolutionary notions of … resilience start from the assumption that regional economies are never in any type of equilibrium, but instead, this conception presupposes a dynamic process of constant renewal (though renewal may at times be more intense, prompted by pressures from without). This conception essentially equates adaptation and resilience to the process of, respectively capacity for, transformation'.

give lessons for firms and other stakeholders for future possible shocks. Then, studies of the long-term development of regional economies are important in order to understand their current degree of resilience.

Prevailing 'faces' of regional economic resilience and their shortcomings

Economic geography work on regional economic resilience has settled on a distinction between two main forms, that is, bouncing back and bouncing forward (Boschma, 2015; Martin and Sunley 2020). In this subsection, we take a critical stance on both established views of resilience.

Conceptualising resilience as *bouncing back* emphasises the capacity of regions to expect and absorb shocks to its social, economic and technical systems, to the extent that it could maintain its preceding functions, industrial and institutional structures and identity (Christopherson et al., 2010). Hence, at its core is how regional economies could return to their pre-shock position and sustain their industrial paths. Such a 'backward into the future' approach might be problematic for a variety of reasons. A region's pre-shock structures may not be favourable ones (in the sense of providing full employment, decent incomes, or ecological and social sustainability, Martin and Sunley, 2015). Embarking on a 'bounce back route' might thus be a questionable endeavour. What is more, conceptualising resilience as bouncing back neglects that recovery from shocks could also be understood as and constituted by new path development, which would reflect a rather different form of resilience, that is, bouncing forward.

Conceptualising resilience as *bouncing forward* refers to a region's ability to respond to shocks and crises by adapting its structures, reorienting existing industries and nurturing new (industrial) paths (Martin and Sunley, 2015). The notion thus highlights that shocks and crises could bring about innovation and structural transformation. This idea of resilience (often referred to as 'evolutionary resilience') thus acknowledges that new industrial paths may emerge from crises and the destruction of old ones (Boschma, 2015; Hu and Hassink, 2017; Simmie and Martin, 2010), thus moving structural change centre stage. However, it provides a 'neutral' view on crisis-induced transformation processes, remaining agnostic as to what kind of reorientation of existing industrial paths and what types of new economic activities emerging in regions would be favourable. In other words, little is said about the nature and direction of change.

Both bouncing back and bouncing forward fail to consider shocks and crises as a 'window of opportunity' for transforming to a radically different and more sustainable trajectory (Davoudi et al., 2013).

3 Reconceptualising regional economic resilience

In this section, we elaborate on a third type of regional economic resilience, namely, transformative resilience. This understanding privileges the idea that a crisis may not only lead to structural transformation but may also change the direction of transformation processes (Folke et al., 2010; Manca et al., 2017; Martin and Sunley, 2020). The notion of transformative resilience highlights that crises could be an opportunity to move towards a strategic orientation on ecological and social sustainability and inclusive innovation and transitions. Transformative resilience thus implicates an alternative agenda for regional economic development, one that is less oriented towards short term growth and more focused on environmental sustainability and inclusive development (Evenhuis, 2017; see also Cretney, 2014; Davoudi et al., 2013; Hudson, 2010; Jeannerat and Crevoisiser, 2022; MacKinnon et al., 2022).

Transformative resilience – understood as the capacity of regions to respond to shocks and crises by moving towards more sustainable development paths – may take many different forms. It may entail the regionalisation of global supply chains, shifts towards more environmentally-friendly forms of tourism, sustainability transitions of socio-technical systems such as energy, mobility, food or housing, post-growth initiatives, new institutional and behavioural practices, and so on. The notion thus needs further specification.

In this article, we interpret transformative resilience as the capacity of regions to enhance the challenge-orientation of their innovation systems to tackle pressing problems and needs faced by the region as a result of sudden shocks like the Covid-19 pandemic and/or slow burn processes such as climate change or ecosystem degradation. A special focus will be on challenge-oriented initiatives that aim at facilitating green path development. The notion of green path development covers the rise of new green economic activities (through path creation, diversification or importation), the green renewal of mature industries and the decline of old brown sectors (see, for instance, Grillitsch and Hansen, 2019; Trippl et al., 2020).

The concept of challenge-oriented innovation systems (CORIS) has recently been introduced to critically rethink the role of innovation systems in an era of grand societal challenges (Isaksen et al., 2022; Tödtling et al., 2021). Inspired by emerging debates on a new understanding of innovation (see, for instance, Coenen and Morgan, 2020; Schot and Steinmüller, 2018) and the 'goal-orientation' of innovation systems (Hekkert et al., 2020; Schlaile et al., 2017), the CORIS approach extends the conventional RIS concept in various ways. It propagates a broader view on the purpose of innovation and complements the traditional orientation on economic growth and international competitiveness by a focus on place-based problems and regional challenges. Tackling these problems/challenges requires attention on a greater diversity of innovation activities and innovative agents. Tödtling et al., (2021) advocate an extension of the traditional focus of RIS studies on technological innovation to other types of innovation (including, for example, social, user and institutional innovations) that are produced by actors operating in various domains. Next to established innovation actors (the so-called 'triple helix', which includes firms, research organisations and governmental bodies), new (hitherto neglected) innovation actors (such as civil society organisations, actors from the public sector, users and

citizens) are said to play a significant role in the development, application and upscaling of innovative solutions to pressing (regional) problems and challenges (Trippl, 2022).

CORIS are defined as innovation systems that show the capacity to address various – and partly – interrelated regional problems by developing challenge-oriented initiatives (Tödtling et al., 2021). This capacity is not only conditioned by regional dynamics but also by non-local processes and the region's embeddedness in national and supranational regulatory and policy structures, multi-scalar innovation and production systems, trans-local learning networks, etc. (Binz and Truffer, 2017; Loorbach et al., 2020; Tödtling et al., 2020).

A central presumption of scholarly work on CORIS is that historically grown real-world regional innovation systems are often unfit for tackling ecological and social challenges. The place-based structures, actor constellations, network practices, institutional configurations and dominant innovation and entrepreneurial activities inherited from the past are said to deliver barriers to green and inclusive innovation and to reinforce unsustainable pathways (Schot and Steinmüller, 2018; Trippl, 2022).

This has sparked an interest into the reconfiguration processes that RIS need to undergo to enhance their capacity to address the economic, ecological and social challenges the region is confronted with. Recent work suggests that shifts from conventional RIS towards CORIS – and the asset modification and reconfiguration processes of actor constellations, networks, institutions and practices that underpin them – may unfold in different ways. Isaksen et al. (2022) and Trippl (2022) identify two routes of CORIS development, that is, a reorientation route and a transformation route.

The reorientation route is characterised by the mobilisation of the assets, actors, networks and institutional structures of existing RIS to address regional challenges and to seize appropriate opportunities for green path development. In other words, this route is about enhancing the challenge-orientation of existing RIS by redirecting established elements and functions to new goals and reusing (recombining) historically grown assets. Building on inherited industry specialisations, knowledge bases and other assets could be a sound sustainability strategy that helps to create economic value and jobs (Bugge et al., 2021). Innovation and transition activities that address place-specific challenges while increasing economic uncertainty could lead to fierce resistance from incumbents and suffer from a lack of political and societal legitimacy. Mobilising established RIS actors and assets and tackling regional challenges with innovative solutions that also provide economic opportunities might thus be a proper strategy in some places.

The transformation route is said to be more about the creation of new challenge-oriented structures and the dismantling of old, unsustainable ones. It involves the inclusion of new, hitherto neglected innovative actors, the break-up of old networks and the formation of new ones, and institutional change processes. The creation (and importation) of new assets (and to a lesser extent the repurposing of existing ones) plays a significant role. As indicated above, taking the transformation route could also involve the deliberative destabilisation of old RIS

structures and practices and the strategic removal of assets inherited from the past [2]. Arguably, such endeavours are often hampered by powerful economic and political interests (Turnheim and Geels, 2013). Overcoming vested interests, breaking up resistance to change, cutting support for business-as-usual (Kivimaa and Kern, 2016) can thus be key features of the transformation route. The need for such activities is particularly urgent in places with a strong specialisation in polluting industries and unsustainable RIS.

The distinction between the two routes – reorientation and transformation – is an ideal-type one. Trippl (2022) notes that in real-world settings, CORIS development may show features of both routes. The two routes can be seen as the two ends of a continuum, along which various combinations of reorientation and transformation activities are likely to be observed.

4 Building up regional transformative resilience

As outlined in the previous section, regional transformative resilience – interpreted as the capacity of places to address pressing economic, ecological and social problems the region is facing – demands a reorientation or transformation of historically grown RIS to enhance their challenge-orientation.

In this section, we seek to unravel how such changes unfold in regional contexts. To this end, we propose a simple model (Figure 1) that accords attention to (1) the pre-shock conditions in a region, (2) various core processes, and, (3) outcomes of the process.

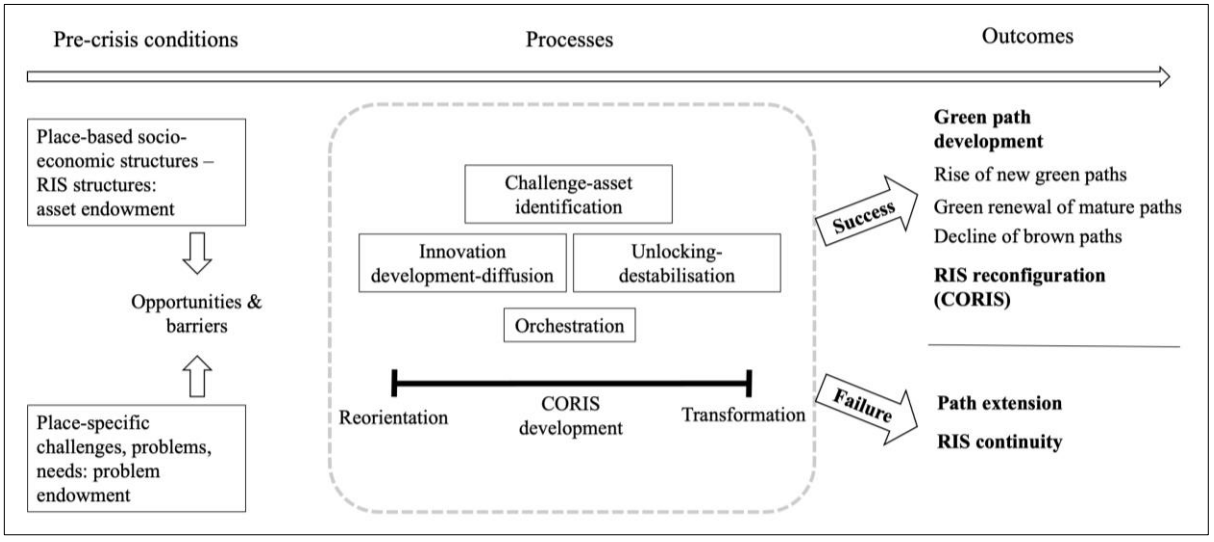

Figure 1: Transformative resilience: Building up CORIS for green path development in response to shocks and crises

[2] Deliberate destabilisation of old paths and the strategic 'destruction' of old assets might be vital, because such processes are unlikely to take place automatically but require deliberate efforts and policy intervention (Johnstone and Newell, 2018; Normann, 2019; van Oers et al., 2021)

4.1 Pre-shock conditions

The first key dimension relates to the conditions found in the region prior to the shock. The focus is on historically grown place-based innovation system structures, that is, the region's mix of industries and firms and their relationships, knowledge infrastructure, innovation support structures, and institutional configurations. Further, the region's insertion into global production and innovation networks, international regulatory arrangements, and multi-level governance settings are important to consider.

Importantly, next to the production, institutional and support structures economic, environmental and social challenges faced by the region should be factored into analyses of initial (pre-shock) conditions. Put differently, it is not only conventional asset endowments but also problem endowments that matter. It is crucial to recognise that different regions have different exposures to environmental and societal problems (McCann and Soete, 2020). Arguably, regions may face various and – partly interconnected – challenges in the economic, ecological and social spheres. Regional challenges require attention, not least because they could constitute a source of innovation and sustainable path development. Uyarra et al. (2020) argue in favour of including problems and challenges that present actual or latent demands with the potential to create or shape markets. This could help to expand - not just discover - entrepreneurial opportunities (Flanagan et al., 2022).

A core question is how a major shock or crisis like Covid-19 affects the production, institutional and support structures of RIS. Such events may well play different roles in different regional settings. Some regions may experience a massive decrease in their asset base. Firms and other stakeholders may have fewer resources during a crisis. Innovation networks might be disrupted. What is more, a sudden shock or crisis like COVID-19 could further aggravate place-specific problems and create new economic, social and political challenges (Bailey et al., 2020). However, a shock or crises could also break up long-established development trajectories, unsustainable patterns in RIS and industries, opening up opportunities for green path development. These can indeed be major and difficult shifts, but the extremity of a shock can break down many past barriers. A major shock may 'remove' unproductive and unsustainable firms, economic activities and practices and release (human, capital, industrial, etc.) assets that could be re-employed and reoriented to renew existing paths or nurture new ones. It may put the strategies of firms and other organisations under pressure and question established priorities. RIS actors may begin to take advantage of changed circumstances, promoting new arrangements and priorities in economic structures, mindsets, institutions, infrastructure and regulatory architectures.

In summary, a nuanced view on the regional structural conditions that existed before a major shock or crisis took place deems important. They have an impact on how hard and in which ways a region is hit by a crisis (Martin and Sunley, 2020). Further, the place-specific asset and problem endowments after a shock can create very specific preconditions for building up transformative resilience.

4.2 Processes

We contend that challenge-oriented initiatives that are built up in response to major shocks and crises are based on and can be analysed through four core processes (Hölscher et al., 2019; Trippl, 2022).

'Challenge-asset identification': The first core process covers the identification and framing of regional challenges, vulnerabilities and opportunities. As noted by Flanagan et al. (2022) this involves complex questions such as what is perceived as a problem or challenge, which challenges receive attention (and by whom), and what are the perceptions about their urgency, roots and effects? Different stakeholders may have very different views on these issues. Consequently, much depends on who is involved in this process and who has the power to shape the discourse on regional challenges and assets.

Innovation development-diffusion: the identification and framing of regional challenges and the available asset base will have a strong influence on the second core process, that is, the search for solutions. This process encompasses innovation and diffusion processes, that is, the development, testing, and the upscaling of novel solutions in the region (and beyond). This might include the development (or importation) of technologies or non-technological solutions (or a combination of both, since many sustainability challenges require an integration of a range of technological and non-technological innovations).

Unlocking-destabilisation: As noted above, innovation and diffusion processes might not suffice. Depending on the case under consideration, a third core process, namely unlocking and deliberate destabilisation of old paths and unsustainable RIS structures could be vital. It involves the revelation and unlocking of unsustainable path dependencies in the RIS, the destabilisation and phasing out of unsustainable activities, practices, products, technologies, networks, institutional structures, and might come with undermining vested interests and 'picking the losers' (Braams et al., 2021; Hölscher et al., 2019; Kivimma and Kern, 2016). Some scholars argue that sudden shocks and deep crises – like the current pandemic – provide a window of opportunity for deliberate destabilization (Heyen et al., 2017; Rosenbloom and Markard, 2020).

Orchestration: 'Challenge-asset identification', 'innovation development-diffusion' and 'unlocking-destabilisation' processes are linked to a fourth core process, that is, orchestration. This includes the coordination of multiple actors who might have very different interests and motivations, which calls for mediation, formulation of shared visions and setting collective priorities as well as the minimisation of trade-offs and conflicts. Furthermore, navigating complex multi-level governance systems, coordinating with and mobilising support from national and EU policies is crucial to meet place-specific needs and address broader societal challenges in the region.

The four core processes play out differently, depending on whether a reorientation or transformation route (see section 3) is taken (or to what extent and in which ways elements of

both routes are combined). When reorientation is the main strategy for transformative resilience, established RIS actors will play a powerful role in identifying and framing regional challenges and influencing the search for solutions. In such situations, technological innovation, a dominant focus on economic value creation or issues that do not otherwise threaten their position and destabilise RIS structures are likely to be observed. With transformation as main strategy and new actors been given more prominence, regional challenges and solutions will be identified as more pervasive, requiring destabilisation of unsustainable RIS structure and development of entirely new regional assets. This makes the orchestration of the change process far more demanding in the transformation than in the reorientation route.

4.3 Outcomes

As discussed above, reorienting or transforming RIS and developing a set of challenge-oriented initiatives to address economic, environmental and social problems that result from sudden shocks and longer-term dynamics such as climate change, are demanding and complex processes, which eventually lead to a stronger challenge-orientation of RIS and green path development activities. Arguably, there could be many hurdles along the way which may inhibit the initiation or consolidation of such processes, resulting in RIS continuity and the extension of old, unsustainable paths.

5 Empirical illustrations

This section provides two illustrative regional examples, both of which face not only the challenges of the Covid 19 crisis, but also the long-lasting challenges of decarbonising their key industries. Both regions, Stavanger in Norway and Lower Austria in Austria, are examples of the challenges related to the development of CORIS and building regional transformative resilience to support the development of green regional industrial pathways. Based on ongoing work in both case study regions (expert interviews, document analysis, business survey), this chapter provides preliminary findings that help explain some important elements of our model (pre-crisis conditions and processes). It is certainly too early to fully assess the outcomes of the process, as the Covid 19 crisis is not yet over and addressing broader socio-environmental challenges has only just begun.

5.1 Stavanger: the legacy of the petroleum sector - opportunities and barriers to green industrial diversification

With about 350,000 inhabitants in 2022, the Stavanger region is the third largest city region in Norway. The region is the main agglomeration of the petroleum industry in Norway. Since the late 1960s, a specialisation in offshore petroleum activity has developed through supportive national and regional policy and an interplay between oil firms, suppliers, R&D institutes and universities (Deegan et al., 2022). The specialisation has been identified as a regional challenge by policy-makers and other established RIS actors as the petroleum sector is expected to shrink

in the years ahead. At the same time, it is perceived as an opportunity, because it could provide a platform for branching into new green industrial activities.

Diversifying the industrial base and moving into more ecologically sustainable industries are two core pillars of the region's industrial strategy (Industrial strategy 2021-2030, Stavanger municipality[3]). The diversification efforts are facilitated by the development of a CORIS, relying heavily on reorientation activities. The past few years have witnessed various challenge-oriented initiatives, with innovation and path development activities orchestrated through nationally supported industrial clusters that aim to develop (i) renewable and low emission energy solutions (with leading actors in the petroleum sector as cluster participants), (ii) smart care solutions for the health sector, (iii) smart-city solutions, (iv) secure, smart and sustainable transport infrastructure, and, (v) new technology for the aquaculture industry[4].

The specialisation in the petroleum sector is seen as an opportunity for diversification that could build on the skills and technologies accumulated over 50 years of petroleum activity. A complete destabilisation and phasing out of the petroleum sector is not seen as a viable solution by the majority of stakeholders, as the skill base and other assets should not be destructed but rather reused for new industrial activity. Nevertheless, key formal and informal institutions need to be altered. A dominant narrative among industrial actors in Stavanger is that the petroleum sector will continue to dominate for a long time ahead, albeit with updated technology that results in a greener industry (Deegan et al., 2022). The narrative plays a part in hindering new industry development, in addition to financial organisations prioritising safe investment in the dominant industry where they '… possess "insider" knowledge about the industry and its managers, network connections, and social ties to many of its actors' (Gjelsvik and Trippl, 2018, p. 120).

Diversification activities are also hampered by the fact that the petroleum sector pays higher wages than other industries due to resource rents (Fitjar and Timmermans, 2019). In particular in times when the petroleum sector is booming due to rising oil prices, it attracts highly qualified workers from other skill-related industries and hampers their development through competitive inter-path relations.

The Covid 19 pandemic actually heightened 'the high salary barrier' (Eriksen and Tønnesen forthcoming). The national government launched comprehensive measures in May 2020 to uphold the activity in the petroleum sector and its supply industry[5]. Those measures were also rationalised by the need to keep important competence residing within the petroleum sector that is deemed important for a green industrial transformation. Even though the Corona support for the petroleum industry was given a 'green stamp', the national government together with

[3] https://www.stavanger.kommune.no/naring-og-arbeidsliv/naringsstrategi-2020-2030/#15445
[4] https://www.innovasjonnorge.no/nic
[5]Retrieved from the Norwegian Government's homepage:
https://www.regjeringen.no/no/dokumentarkiv/regjeringen-solberg/aktuelt-regjeringen-solberg/smk/pressemeldinger/2020/tiltak-for-olje--og-gassnaringen-og-leverandorindustrien/id2700656/

regional lobbyists have rather protected the 'status quo' through 'bouncing back measures, presumably slowing down the ongoing industrial diversification in the Stavanger region.

5.2 Lower Austria: drivers and pitfalls of green path development in the plastics and building materials industry

Lower Austria is the largest of Austria's nine federal states in terms of surface area, and with 1,65 million inhabitants, the second largest in terms of population. Over the past 20 years, the region has developed into an important economic location, benefiting from its proximity to the city state of Vienna, connections to metropolitan areas such as Munich, Bratislava, Budapest and Prague and, more generally, the markets in Central and Eastern Europe. Apart from the growing tourism and visitor industry, the regional economy shows a strong export orientation with a focus on specialised materials and technologies. With companies of global significance in the region, two industries are particularly important: the building materials sector and the plastics industry. While these industries are continuing to grow, they face the challenges of decarbonisation and reducing the overall environmental impact of their production.

The plastics industry is confronted with concerns about the impact of plastics for the environment and human health (e.g., Lim, 2021). The building materials sector also faces increasing pressures for transformation. Cement, brick and roof tile manufacturing accounts for more than 8% of the global carbon dioxide emissions (Monteiro et al., 2017), which is what the aviation and shipping sectors are accounting for combined. The European Commission is driving solutions through funding schemes and legislation to reduce plastic waste and introduce low-carbon building materials and circular economies for both industries through the Green Deal. Therefore, producers are increasingly forced to find solutions by developing new products and/or efficient circular arrangements.

The innovation activities in the context of green plastics and low-carbon building materials are widely seen an opportunity and necessity for future-proofing the region's economy. Both industries have started challenge-oriented initiatives to reduce their environmental impact by developing and introducing new alternative products and circular solutions (e.g., bioplastics, green cement and bricks, wood as a building material), but so far these represent only small niches in their product portfolios or have not yet achieved market entry. Both plastics and building material industry build on well-established regional skills and other assets formed over many decades. Therefore, a transformation of the RIS is not the desired strategy in this case as the established asset base is seen to provide valuable entry points for challenge-oriented industrial initiatives.

The willingness and regional support for green path development has been clearly articulated by regional policy actors. The Lower Austrian regional economic strategy identifies cleaner production, building up circular economies, as well as sustainable energy systems as important drivers for future innovation activities (Ecoplus, 2021). The regional economic development agency 'Ecoplus' seeks to orchestrate reorientation activities to enhance the challenge orientation of Lower Austria's RIS. Ecoplus is an established semi-public organisational

platform for knowledge generation and sharing by connecting regional companies, investors, policy making and research.

Many of those activities take place in eight thematic clusters and platforms (food, plastics, green building, mechatronics, e-mobility, aerospace, green transformation & bioeconomy and health)[6]. The green building, e-mobility and green transformation & bioeconomy clusters show a high degree of challenge-orientation. They recognise the urgency of climate change, and biodiversity crises as important drivers for change. Founded in 2004, the green building cluster consists of more than 200 partner firms and organisations focusing on resource-efficient construction and building materials, climate-adaptive technologies and digitalisation. Often the larger incumbent companies are taking on ideas for driving greener industrial pathways by drawing on their own or regional and national R&D to test and develop alternative products. At the same time, incumbents must be seen as a retarding force. Even though the building and construction sector has been identified as a key contributing sector to climate change (e.g., UNEP 2020) and the plastics industry is responsible for mass pollution, both industries have been characterised as slow innovators due to often place-specific industrial and political path dependencies (e.g., Fastenrath and Braun, 2018 for building and construction). Powerful lobby work can result in 'regime resistance' (Geels 2014). Similarly, this can also be observed for Lower Austria's producers of building materials and the plastics industry.

The impact of the Covid-19 crisis on CORIS development is not entirely clear yet. However, results of a regional business survey indicate that Covid-19 was not a catalyst to accelerate the ambitions of reorienting the RIS and fostering greener activities (Lemke and Fastenrath, 2022). Increasing prices and interrupted supply chains might even lead into a negative impact on challenge-oriented initiatives. Therefore, this case is likely to be an example for 'bouncing back' rather than for building up transformative resilience.

6 Conclusions

Disruptions have increasingly become prevalent in many parts of the world. The unpredictable impacts of slow-burn processes such the climate change, globalisation or technological change and sudden shocks such as the COVID-19 crisis have led to a renewed interest in regional economic resilience. Despite the appeal of the resilience concept and 'build back better' approaches in economic geography and neighbouring disciplines, we argue in this article that a new understanding of regional economic resilience is needed that takes into account the context of persistent ecological and societal challenges. We take a critical view on the prevailing analytical dichotomy of *bouncing back* and *bouncing forward*, by introducing a third type, transformative resilience. This reconceptualization of regional resilience is linked to the current debates about transformative systemic change which is gaining momentum in the urban and regional policy world. This new perspective puts sustainable pathways centre stage and goes beyond a purely economic logic. Instead of returning to economic 'normality', regions may

[6] https://www.ecoplus.at/interested-in/clusters-technopols/clusters-platforms-in-lower-austria/

also use times of crisis for driving lasting structural change in order to tackle wider urgent societal and environment challenges. Theoretically we argue that transformative resilience means that established RIS structures can be reoriented or transformed towards new structures that are more challenge-oriented (CORIS) and might lead into more sustainable regional path development. Concrete challenge-oriented initiatives rest on four core processes: challenge-asset identification, innovation development-diffusion, unlocking-destabilisation, and orchestration. We argue that these processes are playing out differently depending which route is taken or in which way elements of both routes are combined.

The two illustrative examples of Stavanger and Lower Austria demonstrate that historically grown assets such as competence and technology in key regional industries can influence challenge-oriented initiatives. In both cases existing assets can be reused for sustainable transformation, which implies a reorientation of the RIS. However, the examples also unveil resistance to change and narratives that hamper transformative resilience which emphasises the importance of destabilising parts of the institutional infrastructure and building new institutional and other assets.

This article provides initial contours for a theoretical understanding of transformative regional resilience. Future research should take a closer theoretical and empirical look at how crises affect regional innovation systems and how crises might catalyse the reorientation or transformation of established RIS into more challenge-oriented innovation systems (CORIS). We propose three research directions building on this. First, a better understanding is needed regarding the agency in building CORIS in the context of a regional shock or chronic stresses. Here, future work could tie in with recent debates in regional studies on change, replicative and maintenance agency (Isaksen et al., 2018; Grillitsch and Sotarauta, 2020; Henderson, 2020; Baekkelund, 2021; Sotarauta et al., 2021; Gong et al., 2022) to unravel the complex agency dynamics that underpin green path development and transitions towards CORIS. Secondly, empirical analyses of regions that have experienced a more radical transformation of their RIS are needed so that we can learn from the rarer cases. Advancing our understanding of strategic destabilisation and exnovation processes deems particularly important in this regard. These processes have long been overlooked in scholarly debates on RIS development. While this theme is now becoming a more central focus in discussions, scholarly work should delve deeper into how such processes unfold. And third, a closer look at regional initiatives and anchor organisation that provide directionality for transformative change is needed. The research directions outlined and other 'fresh' questions could help to substantively advance our understanding of the uneven geography of transformative resilience, that is, why regions differ in their capacity enhance the challenge-orientation of their innovations systems and what factors condition 'regional choices' of reorientation versus transformation routes (or where to position along the reorientation-transformation continuum).

Our proposed reconceptualisation of regional economic resilience has implications for policy making. If we assume that crises can bring about important structural changes in regional innovation systems towards better societal and environmental outcomes, policy makers should include this knowledge in recovery policies and initiatives, but more importantly, proactively

look for opportunities to reorient or transform RIS before the next crisis hits. Crises often bring new and innovative ideas and constellations to the surface – driven by new agents of change, new coalitions of actors, and initiatives. Policies should foster these dynamics by supporting platforms and organisational structures that help facilitate challenge-oriented innovation.

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