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Inspire Policy Making with Territorial Evidence

TOPIC PAPER

The energy transition and climate change resilience: ESPON evidence

Upgraded 2021 version
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The present ESPON topic paper summarises the evidence gathered from recent ESPON studies. It also discusses the consequences of sustainability and climate change in relation to urbanisation processes and risks of territorial disparities due to climate policy driving the restructuring of European regions and cities. The evidence from both ESPON studies and recent research stress frictions between holistic sustainability concepts, territorial trends, and urban planning. These findings summarise the energy transition and resilience to climate change that scope the regional tier. A transformative approach in multi-scalar territorial governance is needed, particularly in tension-ridden regions affected by the energy transition or climate disasters. The policy questions on territorial disparities that are raised in this paper are intended to inform a debate among researchers, governments and institutions, helping them to set priorities, implement better policies, and ensure the long-term future of Europe.

MAIN POLICY QUESTIONS

- How can European cities and regions empower and implement holistic sustainability concepts, such as the radical energy transition, decarbonisation of national economies, green innovation, green infrastructure, and ecosystem services?
- How should Europe elaborate and implement the EU Green Deal to prevent climate policy packages from increasing territorial disparities? What climate change adaptation measures could be put in place as part of an integrated, place-based regional and urban strategy?
- How should regions and cities cooperate to ensure the efficiency and coordination of adaptation and mitigation measures at wider geographic scales and territorial governance models?
- How should cities and regions mitigate negative implications and uncertainties of the energy transition and contribute to the quality of life of communities that are being phased-out?

MAIN POLICIES AND POLICY DOCUMENTS

- A European Green Deal and related policy documents such as Just Transition Fund regulations
- Territorial Agenda 2030
- European Union Urban Agenda

1. Introduction

Sustainable development and climate change have multiple interlinkages, and this is reflected in two historic transformative agreements adopted at a global scale in 2015: the 2030 Agenda for Sustainable Development and the Paris Climate Change Agreement. The Sustainable Development Goals (SDGs) were developed and introduced to continue the international agreement on sustainable development, titled the 2030 Agenda for Sustainable Development. Compared to the previous global strategy, the approach adopted towards sustainability was strengthened, in that environmental sustainability was also supplemented by social and economic sustainability. Indeed, the tagline “people, planet, prosperity” includes economic growth, environmental sustainability, and social inclusion (United Nations, 2015).

The SDGs are a holistic concept and benchmarking instrument that have spread to many strategic arenas to promote development and growth. They encompass a total of 17 goals “to transform our world”, starting with no poverty and zero hunger, and ending with the world peace and partnership (Figure 1); altogether, they contain 169 targets. Though relationships emerge between North and South, developed and developing countries, the global strategy targets the developing world through global tiers. Therefore, the operationalisation and foci of the SDGs differ in regard to the sector focus and territorial scale, as the European welfare states perform well by a majority of indicators. A set of 100 indicators was developed to monitor the SDGs at national level, specifically in the context of European Union (EU) policies (Eurostat, 2019).

Figure 1

Sustainable development goal (United Nations, 2015)



The urgent need for policies tackling the climate crisis and implementing the Paris Agreement has been closely and inseparably related to the SDGs. Climate change is already disrupting national economies and affecting local well-being. The concept of resilience – not just being able to adapt to changes, but being able to withstand and quickly recover from various unforeseen challenges – has become increasingly common and practical. It is vital to safeguard climate-vulnerable sectors such as water, agriculture, and public health, as well as to articulate specific actions to empower and support more vulnerable areas and groups.

Measures to mitigate, adopt and reduce the impact of climate change should strengthen and promote sustainable development. In Europe, climate action (SDG 13) is a challenge with significant implications for all aspects of our modern life and society. The success of SDG 13 depends on the efforts taken in the implementation of other SDGs. This paper focuses on energy (SDG 7). Climate and energy goals not only contribute to healthy lives and well-being (SDG 3), but also to green economies (SDG 8) with responsible production and consumption (SDG 12). Protecting biodiversity (SDG 15) and water resources (SDG 6, SDG 14) is directly related to climate change.

Creating stronger links with the SDGs, as well as aligning them with development and sectoral plans, is needed for territorial strategy-making at both regional and local scales. The key policy areas and public interventions in Europe include: the restructuring of economies due to the energy transition; ensuring a just transition; adjusting forestry and agriculture to climate realities; and providing

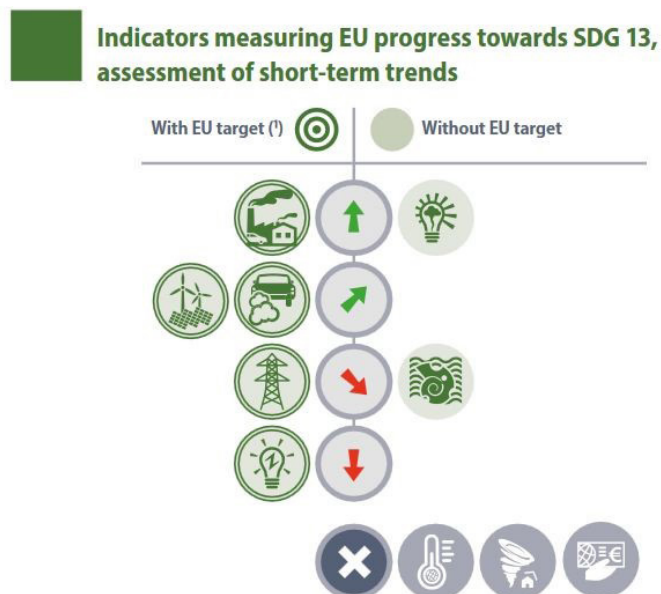
services of general interest, including timely and efficient disaster management. By nature, all of these issues are highly territorial and require place-based plans. However, the key indicators of SDG climate actions are not available at a regional scale, and monitoring is based on proxies or evaluated case-by-case.

A “[Green Deal for Europe](#)” outlines a long-term plan to make Europe the first climate-neutral continent by 2050. The plan is labelled as “the greatest challenge of our time”, but also as a new EU growth strategy. Already in the 2020s, the European Union needs to cut greenhouse gas emissions by at least 40% below 1990 levels by 2030, though much tougher goals have been negotiated. Fast-forwarding the implementation of solutions to climate change requires both strong territorial policy-making and localised adaptation measures.

In order to achieve carbon neutrality in the EU, all sectors of the economy need to be involved. However, this does not mean that each individual sector must achieve net zero emissions on its own – it requires achieving a balance among the sectors as a whole. Balancing the emissions should consider land use, energy generation and consumption patterns at a larger territorial scale. Mitigation efforts reducing CO₂ emissions need to be boosted through increasing the share of renewable energy and reducing the emissions of new cars through energy consumption. Contrary to the mitigation indicators, there are no targets on adaptation (e.g., deviation of temperature, climate-related economic losses, and financial support for adaptation) as shown in Figure 2 (Eurostat, 2019).

Figure 2

Short-term trends of SDG 13 on climate action (Eurostat 2019)

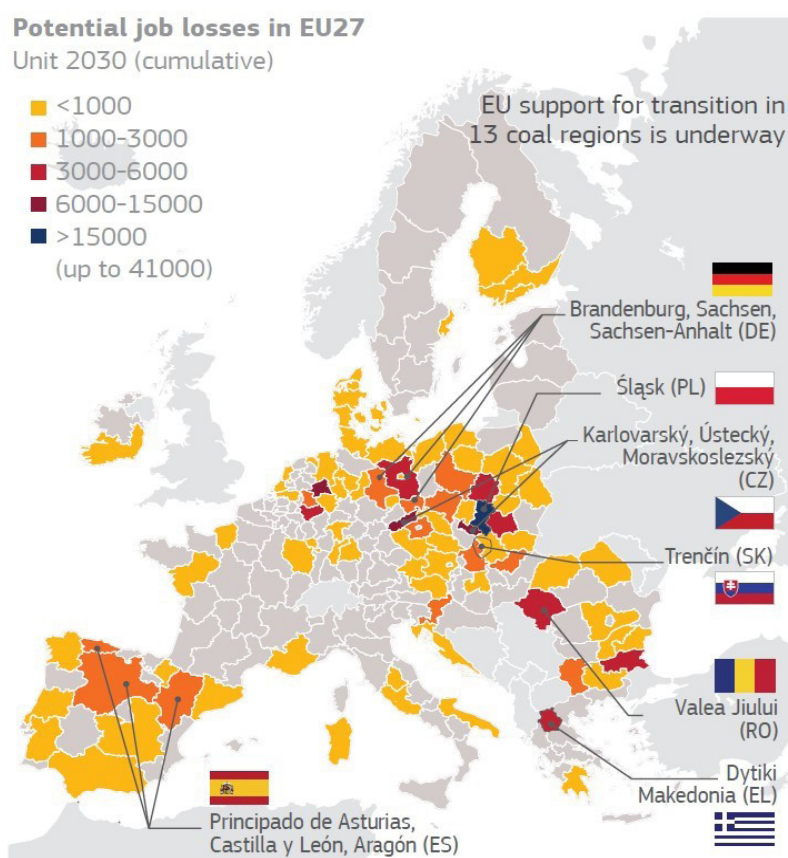


As the Green Deal aims to ensure a just and inclusive transition, both regions dependent upon coal and those with a high energy consumption require special attention. While EU coal regions share many commonalities, their paths towards decarbonisation differ widely. To ensure softer structural change, the European Commission (EC) launched the '[Platform for Coal Regions in Transition](#)' in 2017. It is estimated that by 2030, around 160,000 direct

jobs may be lost in the coal sector alone (Alves et al, 2018) (Figure 3). Development based on a regionally-adjusted restructuring process is supposed to create new employment opportunities, though the effects are limited so far. In addition, the energy sector's induced restructuring creates a multiplying effect, fundamentally impacting both regional and local economies, and further rearranging many European geographies.

Figure 3

Potential cumulative job losses in coal regions (European Commission DG JRC, DG REGIO).



In addition to massive mitigation efforts, climate adaptation will require systemic policies across Europe, so as to ensure resilience to climate change and disaster risk reduction, particularly in the central and southern European metropolitan and urban areas. Risks and uncertainties are related to sustainability considerations, such as mitigation and adaptation trade-offs that need to be properly addressed. The EU's next budget cycle, the Multiannual Financial Framework (MFF 2021-2027), plays a critical role in the fight against climate change (Runkel et al, 2019).

The ESPON approach entails a territorial approach promoting integrated policy-making among all levels of

governments and places, including multi-level and multi-stakeholder approaches that are at the heart of sustainable urban development. The potential benefits and challenges are varied for different types of towns, cities and regions, underlining the potential for territorial inequality through sustainability. The territorial evidence presented and questions raised in this paper are intended to inform a debate among researchers, governments and institutions, helping them to set priorities, implement better policies, and ensure the long-term future of Europe.

In 2021, [a number of events](#) presenting ESPON evidence related to the SDGs, the energy transition, and climate emergency will take place. These events concentrate on

regional restructuring for sustainable development, the Green Deal, energy transition, quality of life, sustainable planning, and environment. The themes have been targeted by a policy needs assessment carried out by the ESPON programme in all 27 member states of the EU, the UK, as well as four partner states: Iceland, Liechtenstein, Norway, and Switzerland. This methodology enables the facilitation of discussions on cutting-edge territorial processes with regional stakeholders and the promotion of emergent policies in each country. During the assessment procedure, information about the present and planned policy processes was collected.

This resulted in an extensive amount of data consisting of ongoing and planned policy documents and programmes (development strategies, spatial plans, visions, etc.). The collected data was analysed with a content analysis

method (frequency analysis) and resulted in the identification of several thematic clusters across Europe where ESPON evidence support is most needed. The results of the needs assessment show that climate, environment, and energy are leading themes which require adjustments in policy processes at regional and local levels. This is the starting point for ESPON outreach activities on the topic of SDGs, for which this present topic paper sets the ground. Considering that within the cluster of climate and energy a large number of ongoing policy processes were compounded, the regional policy should scope/cope with highly dynamic climate policy arenas and emerging measures to be implemented according to the ambitious national framework and regional specificities. This topic paper for 2021 includes the state-of-the-art ESPON and academic evidence on these issues.

2. ESPON evidence

2.1. Regional implications of the energy transition

ESPON resources

- [Policy brief of coal phase-out regions](#)
- [LOCATE – Territories and low-carbon economy](#)
- [ESPON QoL – Quality of Life Measurements and Methodology](#)
- [Territorial futures – Possible European Territorial Futures](#)
- [ESPON SDG Benchmarking Tool](#)

This section explores the spatial implications of the energy transition in the context of the regional discourse. Exploring energy alternatives for evidence-based regional decision-making cannot be fully operationalised due to the complexity, openness, and nonlinear behaviour of wider economic, technological, as well social processes (Rotmans and Loorbach, 2009). The major socio-technological changes in the European common market (considering external and internal factors of the European energy system) differ from strategic spatial planning (Kunzmann, 2013).

The energy transition in European regions has been emerging as a policy priority in promoting sustainability, fighting climate change, and delivering the Green Deal. At the European and national territorial governance tiers, it is a highly political-, fairly legal- and strongly sector-based policy arena. In terms of European integration and multi-level policy-making, the regulatory authority has shifted to the supranational level, although public debates on how to implement climate and energy policy through measures, taxation, and other 'end-user' policy instruments remain at the domestic level of Member States. The policy process is described as a disjunction between politics and policy. Also, various policy-making and epistemic communities continue to decode the climate policy narratives based on ideology, freedom, economic opportunity, political challenge for political leadership, and an ecological threat to nature as categorised by Wendler (2021). At the Member State level, the dominant form of framing climate action is economic, which leads to social implications of structural change in regional policy-

making, predominantly in the coal and other energy-intensive regions. Thus, the region as a sub-national level is increasingly becoming a critical action arena to implement low-carbon energy systems.

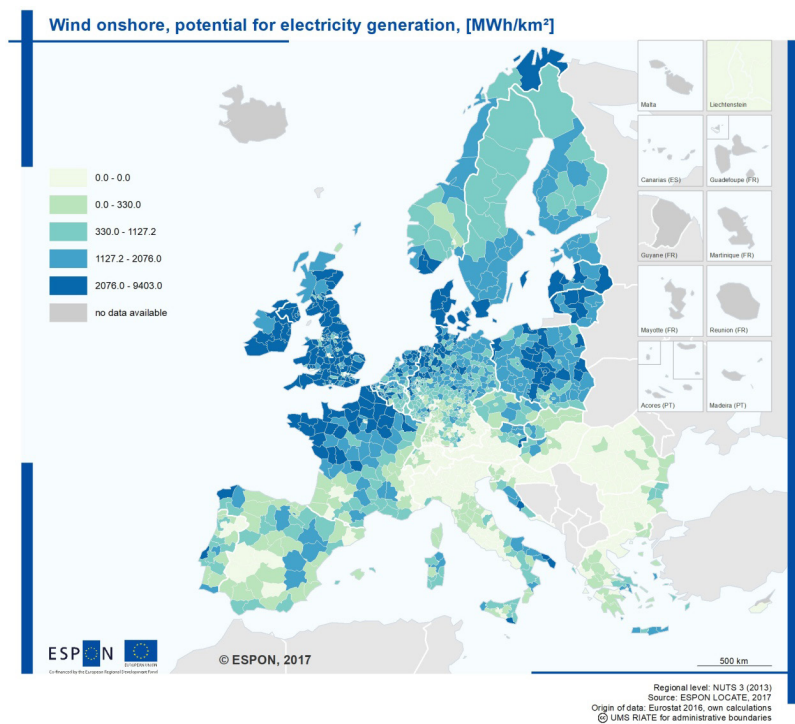
In the 2010s, regional development strategies focused on the economic development opportunities of renewable energy technologies (Gibbs, 2018). The achievement of climate policy targets will depend significantly upon the rapid implementation of projects in regions and cities, decisions on investments, the siting of renewable sites, and supporting renewable power in practical project-level terms. Regions and local municipalities formulate and run progressive climate programmes, and have been taking various roles, from initiator to facilitator and investor, depending on the degree of authority (Hoppe, 2020). Kempenaar et. al (2020) explore systemic energy transition in the form of regional design ateliers in the Netherlands, proposing them in the upcoming stages of 'planning' for the energy transition. Territorial and scalar dynamics related to energy transitions are often expressed through the centre-periphery patterns. The territorial scales and implications are discussed in forecasting, posing the question, "What if we had 100% renewable energy?". ESPON LOCATE investigated the territorial dimension of the transition to a low-carbon economy (2018c). It summarises: "Energy consumption and renewable energy potentials are as diverse as the regional conditions encountered in the transition to a Low Carbon Economy: Climate conditions, topography, built environment and economic profiles as well as legal frameworks, governance structures and stakeholders

show great variety.” Regional patterns of renewable energy potential highlight considerable variances, mainly due to geographic and climatic differences within Europe. Wind energy can be harvested in Northern Europe, particularly onshore in coastal and open landscapes, and offshore in the coastal sea (Figure 4). In contrast, solar energy dominates in Southern Europe. Photovoltaic (PV) generation shows considerable dynamic development in

high potential, but also in less privileged, solar regions across Europe, especially in Germany, Belgium and Switzerland (ESPON LOCATE, 2018c). The report concludes that it is not just the natural endowment of a region which is important for the renewable deployment. The investment also depends on the socio-economic and governance conditions of that region that are critical in making an impact.

Figure 4

Potential for electricity generation of wind onshore (MWh/km²) (ESPON LOCATE, 2018c)



Regarding policy initiatives in countries with strong multi-level governance structures, the principal of subsidiarity enables regions to transition to renewables. In countries with weaker multi-level governance structures, there is evidence of the strong impact of international bottom-up peer-to-peer initiatives, such as the Covenant of Mayors and C40. In any case, the national government supports regional and local initiatives in the low carbon economy (to some extent).

In regard to the implementation of the energy transition, the regional level plays an important role on the ground. LOCATE summarises that active and well-resourced regions make a difference in terms of scope and speed of such a transition using a holistic, cross-sectional, and integrated perspective (ESPON, 2018c). Transitional and dynamic regions cooperate with the municipal level by pooling resources, finding synergies, and providing important linkages between all territorial governance tiers from the central government to local actors. Evidence of

strengthening and supporting the regional level as an active transition promoter is found in the policy analysis.

The territorial approach should consist of an adequate balance of support actions, respecting the maturity of entrepreneurial and knowledge stock. In a more diversified and advanced transition, the magnitude of research and development (R&D) capital investments and inbound open innovation should be promoted. In weaker regions and countries, the priority should be placed on reducing entrepreneurial risk vs. measures reducing entrepreneurial uncertainty.

The regional drivers in accelerating and supporting the energy transition can be regional planning and policy, citizen, and stakeholder involvement in decision-making processes, which enables the regional actor network, and actor heterogeneity, although economic factors, including coordinating public and private funding and general status and quality of regional governance, also play a certain role. For example, the planning and roll out of

inter-municipal heating grids requires coordinated actions but many aspects of the joint infrastructure planning can be or are poorly regulated, thus leading to high degrees of uncertainty and delayed implementation or, in the worst case, dropping the project.

The territoriality of the transition depends on the governance structure and legal framework of land use planning, which varies from central to polycentric. Collaboration with higher tiers of government usually strengthens municipal renewable projects. There is a possibility that the initial optimism and commitment among regional actors can fade into scepticism due to few concrete renewable actions taken because of poor compliance of agreements, land use restrictions, or the NIMBY (Not In My Back Yard) phenomenon (Hoppe et al., 2020).

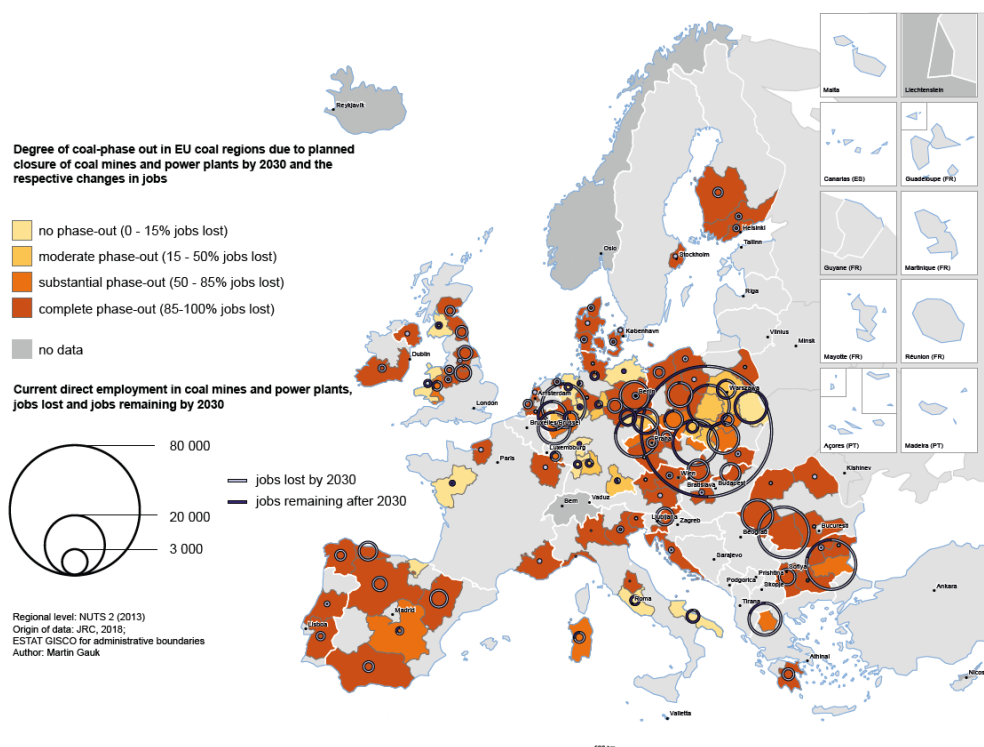
Despite the overwhelming consensus on fighting the climate emergency and achieving ambitious win-win policy proposals, there are not only winners in the

systemic energy transition. In many cases, the transition inevitably perpetuates pre-existing sets of winners and losers. The winners benefit from cleaner sources of energy, reduced emissions, related increased employment, and regional innovation opportunities. The losers bear the burdens and allocation gaps which cause widening regional disparities.

The socio-economic outcomes of climate policy affect 108 European regions with dominant coal industries and nearly 237,000 related jobs, as identified by Just Transition Fund (JTF) regulation. Many strongly-affected regions are located in central-eastern Europe: Poland, Germany, the Czech Republic, Bulgaria, and Estonia (Figure 5). Coal regions are highly vulnerable as their regional economic ecosystems are locked in coal and oil shale sectors. Their regional potentials to induce and cope with structural change are predominantly weak (Neffke et al., 2018).

Figure 5

Potential cumulative job losses in coal regions (European Commission DG JRC, DG REGIO).



Multiple local factors play a crucial role in regional decisions that seek to compromise ‘coal’ and ‘climate’ interests and setting the phase-out path and speed. The ESPON policy brief on coal phase-out regions (ESPON,

2020a) stresses that the JTF in the coal phase-out regions should focus on major capital investments and business incubation for entrepreneurship, as well as on R&D investments. The key is economic diversification.

Entrepreneurial activity should be promoted via JTF governance and implementation mechanisms in coal phase-out regions using the regional smart specialisation concept and choosing the most favourable corridor out of an economic path dependency.

Large capital investments are predominantly foreign in nature. SMEs play a supportive, secondary role in phasing-out structural change. Nevertheless, the importance of multiple entrepreneurship stimuli can play a role in the transition to increase entrepreneurial and knowledge stock maturity. A balance of structural actions should be set in two areas. The first, in how R&D capital investments and inbound open innovation relate to regional innovation, and the second in how entrepreneurial risks are managed and mitigated, which can be reduced by accessing support from the guarantee fund and government insurance (ESPON, 2020a).

As the major objective is economic revitalisation, with multiple investment priorities from SMEs to digitalisation, renewables and circular economy, it is debated whether the JTF should be allocated in the social sphere and to regenerations. The fund supports the reskilling of workers and labour market incentives. In addition, land restoration of former processing and mining sites is supported. ESPON evidence on SMEs, the Knowledge Economy, Foreign Direct Investment, and technological transformation of regional economies demonstrates how territorial evidence can inform decisions on the intensity and mix of the capital and R&D investments, reskilling, and regeneration.

Some regions in 'old' Europe, which have begun the transition two decades ago, managed to choose a neo-

industrialisation path. This case is exemplified by Nordrhein-Westfalen, where innovative new energy technologies are developed and manufactured (Harrahill and Douglas, 2019). Collateral damage sectors, other energy-intensive manufacturing, engineering, and support maintenance services are affected by the counter-multiplying effect. The emerging renewable energy could offset some job losses, though these could be more capital intensive than job intensive.

Considering territorial realities of shrinkage, brownfields can be turned to greenfields, giving land back by de-urbanising settlement patterns using novel climate-proof and decarbonised criteria. New infrastructure in renewal districts should avoid path dependencies, e.g., car-oriented commuting. The scaling policies enable the stability of funding and mitigating vulnerability to both political and economic cycles.

The transition policies have already been implemented using the European Structural and Investment Funds (ESIF). The researchers recommend mainstreaming the notion of Just Transition, promoting it under all Green Deal actions (Colli, 2020). Financial diversification of JTF actions may compound and also coordinate other funding schemes, including the European Regional Development Fund (ERDF), the European Social Fund, the European Agricultural Fund for Rural Development (EAFRD), LIFE and the Horizon programme. It is expected that the JTF can serve as a strong instrument to design and implement strategic regional and territorial plans, which can improve funding integrity but also programme actions in terms of territorial cohesion.

2.2. Climate adaptation and resilience

ESPON resources

- [TITAN](#) – Territorial Impacts of Natural Disasters
- [GRETA](#) – GReen infrastructure: Enhancing biodiversity and ecosysTem services for territorial development
- [SDG Benchmarking Tool and TIA tool](#)
- [Alps2050](#) – ALPS 2050 Common Spatial Perspectives for the Alpine Area. Towards a Common Vision
- [BT2050](#) – Territorial Scenarios for the Baltic Sea Region

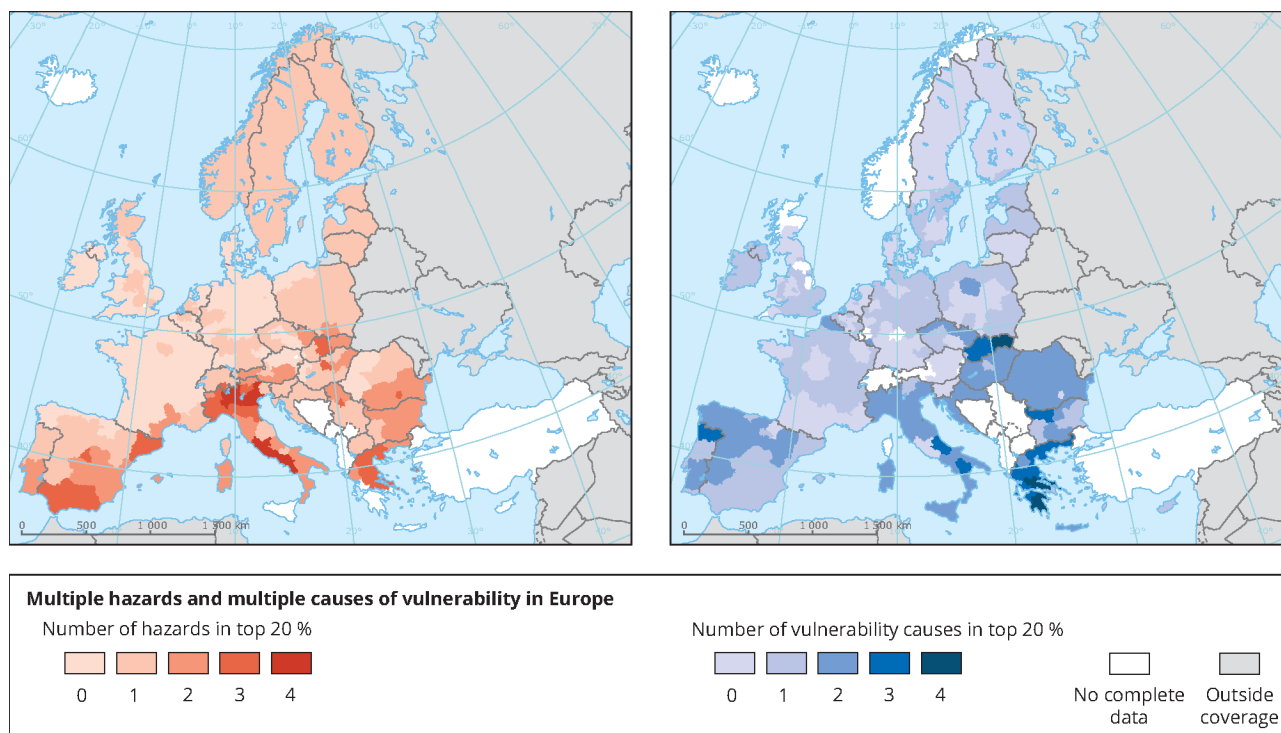
The European climate-energy policy context has changed over recent years, with climate change adaptation getting a higher priority next to climate change mitigation in climate policy (EEA, 2020). The impact of climate change increases territorial gaps. No European region is protected from the consequences of climate change, though the impacts of climate change vary considerably across Europe in terms of geographical regions, with different types of impacts and different degrees of vulnerability depending on the socio-economic conditions, services, governance, and awareness. ESPON-TITAN elaborates a novel approach and methodology to provide evidence of the economic and societal impacts of natural hazards in the contexts of disaster risk management and climate change. The increased risk of sea-level rise, drought, desertification, floods, and other natural hazards calls for place-specific responses (ESPON, 2021). In the future, climate impacts will be even stronger and unequally

distributed across Europe (Forzieri et al, 2018). While regional variations have a wide territorial context, Southern Europe and the Mediterranean Basin, mountainous areas, coastal zones, and floodplains are particularly vulnerable to climate change. The vulnerability to climate risks will be higher in the Mediterranean area, which is predicted to suffer more from the effects of heat-related human mortality, fundamental water deficiency, significant habitat loss, and a much higher energy demand due to cooling and enlarged areas of forest fires (EC, 2018b) (Figure 6).

Climate change hits mountain regions, such as the Alpine region, more severely. These regions must then fulfil the role of forerunners with regard to climate change adaptation: disaster risk management, touristic adaptation strategies, and feasibility of new energy technologies (ESPON, 2018).

Figure 6

The number of hazards and number of vulnerability causes in the top 20% of exposure in Europe (EEA, 2018)



Northern Europe will also become more vulnerable. During the summer of 2018, northern Scandinavia experienced record-breaking daily temperatures. In Sweden, the Public Health Agency estimated an excess mortality of 750 deaths between July and August 2018, with more than 600 of these attributed to higher temperatures, when compared with the same weeks in 2017 (Aström et al., 2019). Record-breaking temperatures in 2019 caused heat-wave events (with the temperatures in several European countries exceeding 40°C for 3–4 days during June and July), which may have led to 1,500 deaths in France and 400 deaths in the Netherlands.

Climate risks are directly related to social vulnerability. The underlying objective of climate adaptation is to avoid

the decline of citizens' well-being and quality of life due to climate change and disasters, including related but unintended consequences. Maladaptation and insufficient, partially-delayed solutions cause widening social and economic disparities in Europe.

Special attention should be paid to the poorer regions, as poverty risk increases vulnerability to climate risks (Figure 7). Heatwaves, which expose socially-vulnerable groups sensitive to climate change to higher risks, are expected to occur more frequently in Southern Europe. As such, regions with a higher risk of poverty, such as southern Italy, southern Spain, Greece, Bulgaria, and Romania, are critically exposed to these heatwaves (Figure 8).

Figure 7

At Risk of Poverty rate in 2015, an indicator of social vulnerability (Nordregion, 2016)

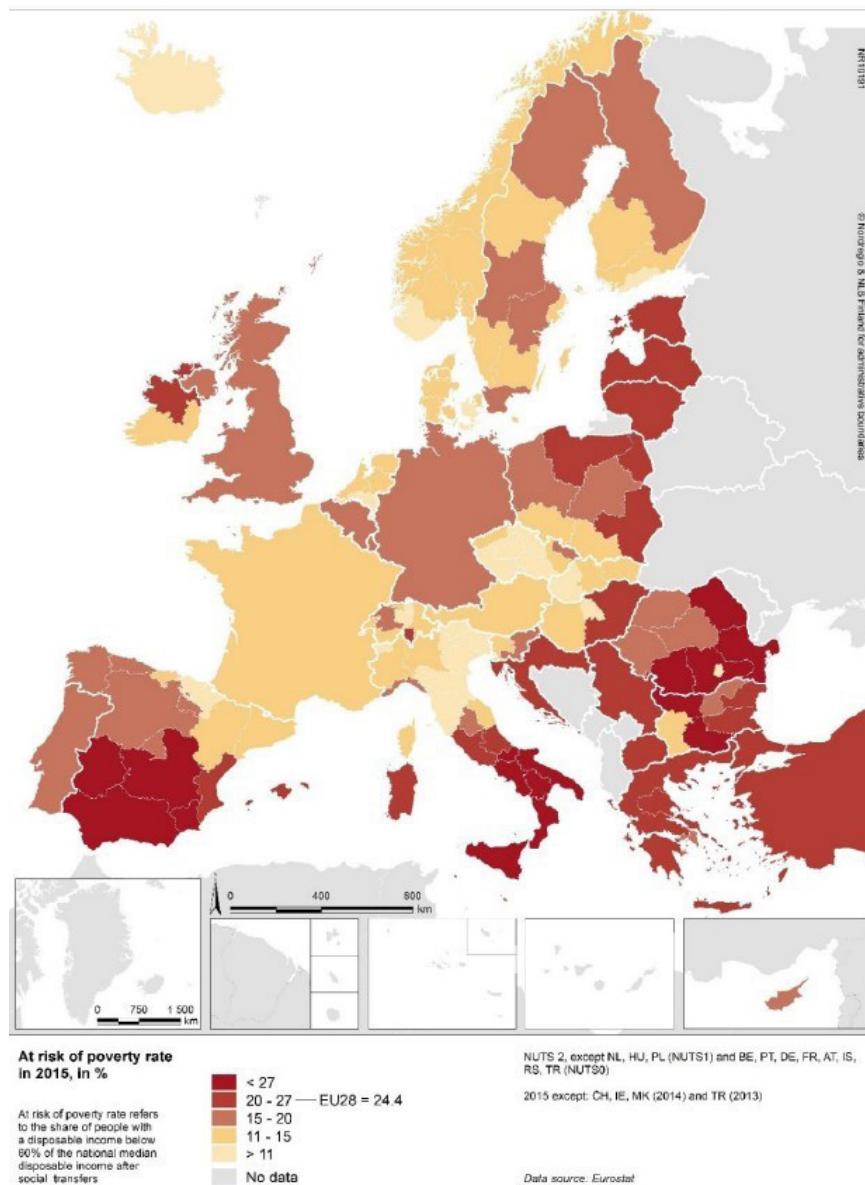
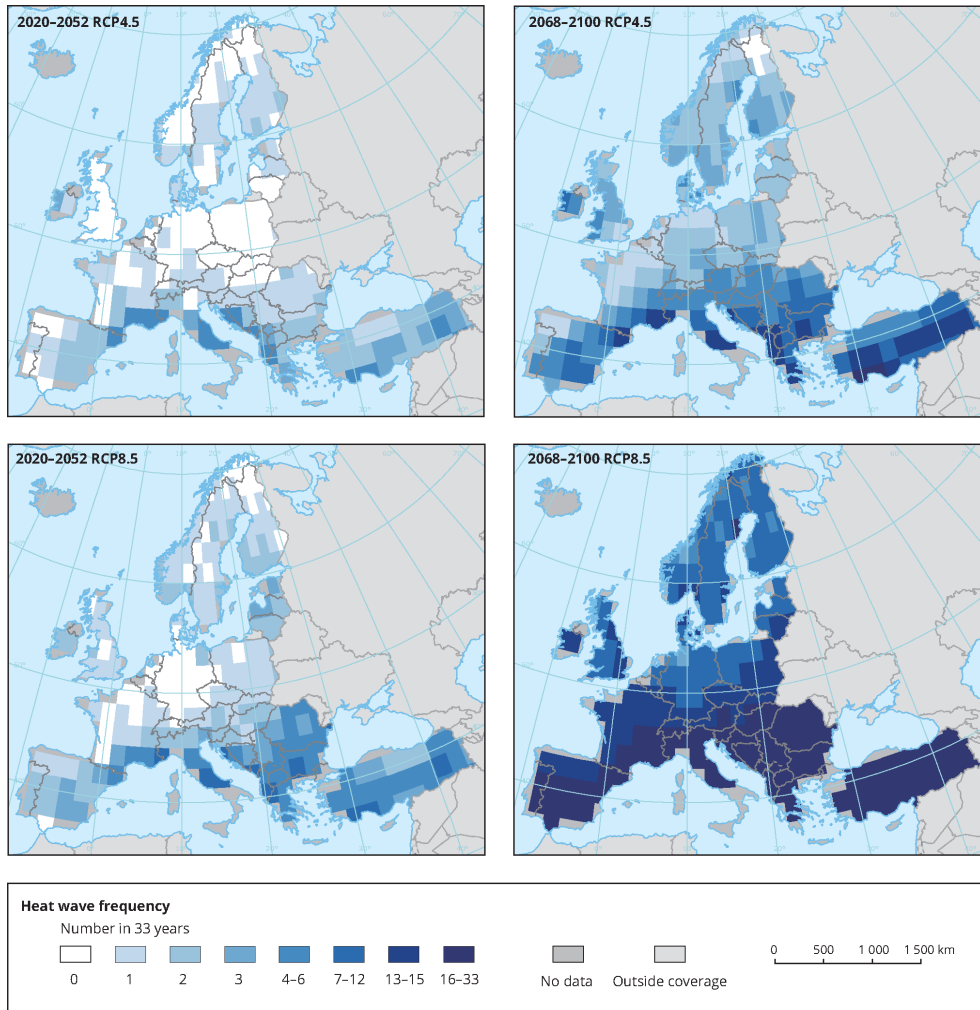


Figure 8

The number of heat waves in the period 2020–2052 and 2068–2100 under the RCP4.5 (moderate) and RCP8.5 (extreme) scenario (EEA, 2019b)

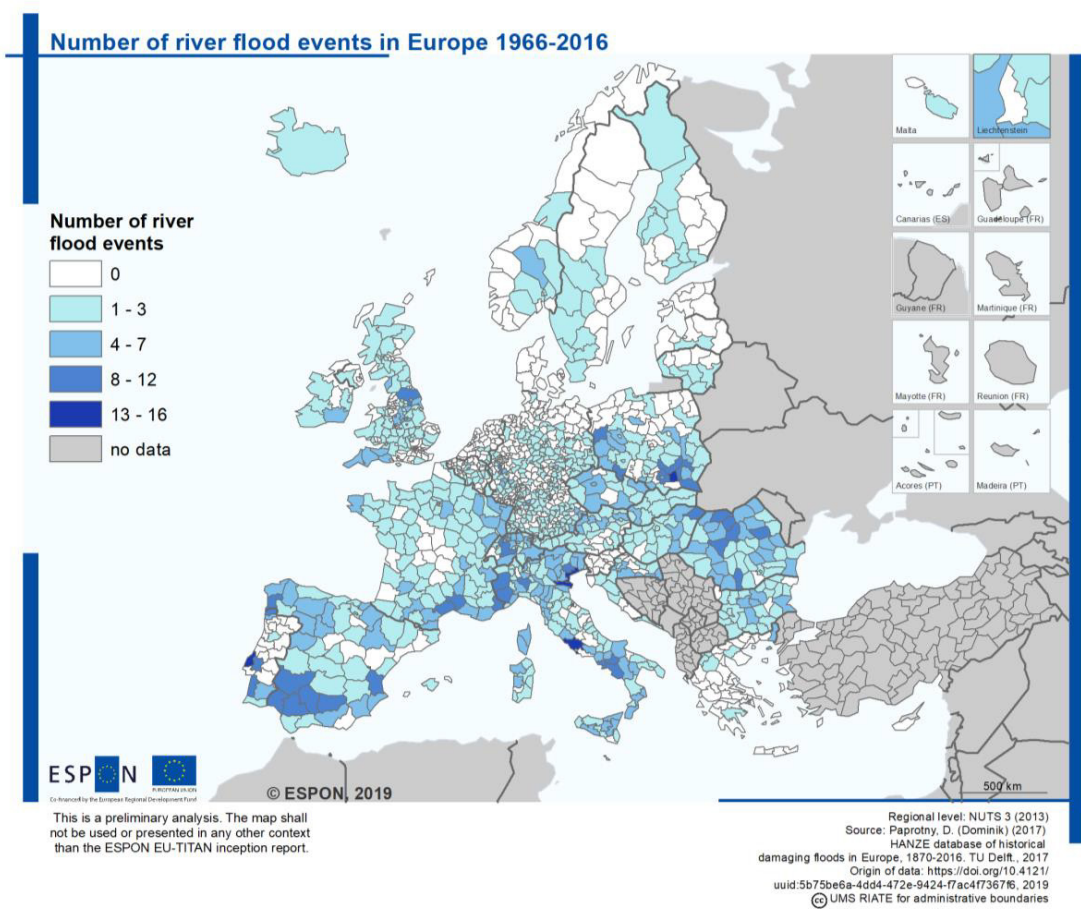


Flooding can damage both urban infrastructure and property, while heavy water run-off affects every aspect of urban life – from transport and logistics to public health and the residential sector. The territorial impact of policies to decrease the risk of urban floods can be assessed using the ESPON TIA tool (ESPON, 2020c). The flood hazard map based on the HANZE database shows the number of events per NUTS3 area for a given time frame

between 1966 and 2016 (Figure 9). The uncertainty of the HANZE database survey concerns the reliability and inter-comparability of the reported historical data. Change in relative sea level causes damages and disasters in European coastal zones, and has an extended impact via functional tiers on coastal regions, logistics and tourism-driven economies.

Figure 9

Number of river flood events in Europe, 1966-2016 (ESPON TITAN, 2019).



Climate hazards can directly damage buildings and capital stock, impacting the value of the property. Direct damage to energy, transport, telecoms, waste, and ICT infrastructure can happen as a result of these hazards. Long-term damage and disruptions may affect the region's services and daily operations. Social impact may cause loss of life, evacuations and societal disruptions. Using damage functions, TITAN distributes the total costs of a climate hazard event across six main capital stock types, namely: human capital, machinery, infrastructure, buildings, arable land, and others (ESPON, 2021). Climate disasters lead to the loss of various types of regional and sectoral capital stocks that result in lower outputs, lower regional incomes and lower regional demand. After capital stocks have been damaged by a climate hazard, they need to be reconstructed. The territorial vulnerability of European regions is mapped based on impact pathways, weighted vulnerability scores, and potential economic losses. Regions with greener infrastructure per capita may be less exposed to environmental impacts, e.g., heat islands and floods. (TIA tool, 2018). By nature, small cities are more resilient.

Mobilisation on programmed climate actions is based on regional evidence. The overall assessment of SDG 13 (climate action) is neutral, as both progress and negative developments have occurred. As energy efficiency targets are compromised, and the increase in the share of renewable energies has slowed down, adaptation is booming, particularly in municipal territorial governance. The EC has introduced adaptation in the Covenant of Mayors and has been mobilising cities in adopting local adaptation strategies. By 2020, more than 1,800 Covenant signatories from European countries, covering nearly 100 million inhabitants, had committed to conducting vulnerability and risk assessments, and to implementing adaptation plans (Bertoldi et al., 2020). The main barrier of adaptation identified by the mayor's platform is limited financial sources, followed by immature or high-cost technologies.

The TITAN project proposes instruments and policies for disaster risk management and adaptation. It also identifies governance structures that have succeeded in integrating disaster risk management into spatial planning and

cooperation mechanisms of stakeholders at various territorial governance tiers (ESPON TITAN, 2021).

With the ESPON TIA tool, territorial sensitivity describes the baseline situation of a region, in terms of its ability to cope with external effects (ESPON, 2020c). It is a characteristic of a region that can be described by different indicators independently of the topic analysed. The exposure layer describes the intensity of the potential effect on a specific indicator of the EU's implementation of the 2030 Agenda. Although cross-cutting in nature, there is a need for dedicated adaptation planning. Priorities, synergies and conflicts, and mainstreaming of adaptation all happen in a specific regional context.

A revision of the EU adaptation strategy is expected to directly and more explicitly address the multiple levels of governance, namely European, national, regional, and local, while considering pan-European aspects of adaptation as well global developments. The European Commission continues to mainstream climate resilience considerations in all relevant policy fields. In the new adaptation plan, mainstreaming will extend beyond the sectors targeted in the 2013 EU Adaptation Strategy. It will support the further development and implementation of adaptation strategies and plans at all levels of governance which are related to intervened territorial approaches. In this systemic approach, there are three cross-cutting

priorities: integrating adaptation into macro-fiscal policy, nature-based solutions for adaptation, and local adaptation action.

European vulnerability to transnational effects is expected to increase in the coming decades, but quantitative projections are not available (EEA, 2019a). Nearly half of the European countries revised their adaptation plans, including climate risk assessment (EEA, 2020). In Finland, the 2018 assessment covered hydro-meteorological and climatic risks specifically for different sectors, which also strengthened the regional approach (Mäkinen et al., 2020). The priority sectors and infrastructure, as well as nature-based sectors, should receive more place-based attention, including targeted analysis for climate-proof territorial policies (BT, 2050).

Only a few countries gained deeper insights through evaluation of the still-emerging policy field of adaptation. The target of the evaluation is very important. The Finnish evaluation focused on the implementation of a plan which will lead to policy updates and identification of new approaches. So far, the standardised reporting is based on a scoreboard, although common, better-quantified adaptation indicators need further research and policy support (EC, 2018). The current wide diversity of regional plans undermines the benchmarking and progress monitoring.

3. Discussion

3.1. Sustainability evidence and indicators beyond climate rhetoric

The sustainability goals and indicators – more narrowly those focusing on the energy transition and climate adaptation indicators – lead to the question of European diversity. New emerging discourses, such as climate resilience, seek contextualisation from established sustainability action plans (i.e., Agenda 21). Quality of life is perceived by citizens emotionally, not just physically, according to the positivist paradigm. Territorial capacities for transition and adaptation are discussed in the context of fixed territorial structures, fluid functional tiers, long-term change, and disasters. Sector-based and cross-cutting territorial approaches are contested.

Is land use regional and local? It relates to the adjusted national commitments of EU member states based on carbon accounting, which is focused strongly on the supply side, with few amendments from the demand/end-user/consumer side, undermining the carbon leakage both continentally and globally. As for what can be done locally in urban areas with high land intake, the sustainable land-management framework requires sectoral coordination and investments in integrated land-use planning, including urban land with a built environment. Evidence-based accounting for carbon debits and credits are essential, not just on forest and agricultural land uses, but also for transfers and land intake, which are not recognised by current international and European carbon accounting and national reporting (UN, 2019).

Measurable indicators play a crucial role in delivering sustainability and adaptation. Downscaling and refining the SDGs and selecting the relevant indicators could be challenging. The optimal spatial scope of city-region relations depends on the policy intervention capacity to make the most of the regional endogenous potential. Understandably, this spatial scope depends on the city's functional regional influence. Highly adaptable, sustainable urban development policies fuel the inter-urban competition for investment, shared discourses of growth and development, jobs, as well as the realities of increasing pressures to decarbonise urban economies and mitigate climate risks in international economic integration (Peck, Theodore, and Brenner, 2013).

The Nordic municipalities struggled with breaking down global goals and priorities to the local level and noted the lack of support from higher tiers of government (Nordregio, 2016). To avoid inefficient use of resources, it is necessary to define priorities at the beginning of process, keeping in

mind the holistic nature of the sustainability concept and the 2030 Agenda. Local and regional authorities should define how to start and what actions are needed first. Potential conflicts between SDGs must also be addressed internally, from the outset of the process.

Sustainability seeks to tackle concerns of climate change, land use, economic development, and environmental protection through a multi-stakeholder approach (Adscheid and Schmitt, 2019). Tackling territorial complexities includes challenging both inertia and lock-ins in the built environment and weak systems thinking for sustainable urbanisation. Insight into changing urban dynamics and its impacts and relevance to urban forms results in different consequences for infrastructure and urban environments. There is still widespread disagreement on the relative importance of drivers (Colsaet et al., 2018); that is, to what extent are observed urbanisation dynamics caused by demand (e.g., demography, economic development), supply (e.g., the development of land by market actors), territory (e.g., existing infrastructure), and/or institutional practices. Similarly, the vulnerability and predisposition of people to be negatively affected by climate change is quite complex and are linked to personal vulnerability, economic status, social support, and awareness of risk.

In relation to the quality of life, ESPON QoL (2020b) argues the factualness of indicators, as discrepancies between facts and people's awareness occur. The ESPON researchers call for the citizen-centric approaches to quality of life benchmarking, which relies heavily on mainstream economy or environment-dominated Eurostat standards.

3.2. Unexpected consequences and feedback loops in holistic approaches

Focusing on the SDG indicators as a single policy outcome to achieve climate and energy goals may have unexpected consequences (Camagni & Capello, 2013). An improvement in the quality of people's lives is simply ensured through access to public services and reduced inequalities, regardless of the energy transition or climate disasters. Progression towards one goal of the SDGs may result in a cancellation effect, whereby progression towards another goal is then limited (Scherer et al., 2018). The territorial synthesis is not a simple mathematical exercise in addition.

Heat waves, air pollution, and extreme weather increasingly damage human health (Watts et al., 2021).

The affected health and resulting implications should carefully take the potential side-effects into consideration. A fossil fuels-based energy sector has a major impact not just on climate change, but also on air quality and public health. These three areas have been inextricably linked. Adding welfare and socio-economic well-being makes the interlinkages even more complex. Economic considerations that prioritise outdated forms of energy and transport that are fossil fuel intensive have unintended side-effects, unnecessarily adding more health damage from air pollution. Instead, investments in health imperatives, such as renewable energy and clean air, active travel infrastructure, and physical activity will ultimately be more effective than a conservative economic path on slow phasing-out. Many of the steps taken to prepare for unexpected shocks are similar to those required to adapt to the extremes of weather and cumulative long-term climate threats. The policies include the need to identify vulnerable populations, assess the capacity of a controlled transition and the cost of transition in both economy and health, and emphasise community resilience and equity.

Climate change indicators, as the part of ecological domain of quality of life elaborated by the ESPON QoL project (2020b), track the greenhouse gases emissions; decarbonisation of the economy; vulnerability presence; persistence of risks; adaptation; access to Disaster Risk Reduction (DRR) policies and means; awareness; and climate-friendly behaviour. However, climate-friendly awareness bringing more sustainable consumption habits and lifestyles is not statistically well covered. In general, the quality of life index shows low correlation to the environmental resilience of European regions. This demonstrates that the overall exposure of climate change is more geographically driven on a north-south axis than it is by affluence or quality of life. Still, the relationship of consumption-based welfare and ecological and climate change related quality of life remain loose and not well-grounded. The results from the quality of life index led to the call for strengthening the measurement of ecological factors by shifting from end-of-pipe production-based to consumption-based indicators of CO₂ reduction and footprints.

Mitigation actions, such as decreasing the carbon intensity of the energy system and phasing out coal, create major health co-benefits. There is mounting evidence that employees in some fossil fuel extractive industries, particularly those in coal mining, as well as populations living in close proximity to these industries, have a high incidence of certain illnesses, such as chronic respiratory diseases, cancers, and congenital anomalies (Cortes-Ramirez et al., 2018). Phasing out coal is essential, not only for the mitigation of climate change, but also for the reduction of premature mortality due to air pollution. Consequently, premature mortality from ambient air

pollution will decline and benefits from mitigation will mirror both the health and economic costs of climate change. Employment in low-carbon sectors will replace the jobs in the phased-out high-carbon sectors.

The feedback loops between the goals lead to synergies, where development in one goal is beneficial to another, but can also lead to trade-offs (where development in one goal negatively impacts another). The goals with the highest number of trade-offs are economic growth and the environment (SDGs 8, 9, 12, 15). These interactions occur due to the current reliance on economic growth and increasing levels of consumption to the detriment of the environment. The negative implications in relation to sustainable goals as well regions and territories must also be taken into consideration when creating policies to achieve the SDGs. The actions described in mitigation policies may require further efforts in adaptation.

The challenge is taking a holistic regional approach instead of split sectoral policies. To avoid this, an integrated approach is required to ensure that the actions that have synergies with other targets are implemented (Allen et al., 2018). Both a lack of technical capacity in terms of the skillsets of the policymakers, and a difference in countries and regions, impacts the degree to which synergies occur, as well as affects the impact that different actions have.

Miola and Schiltz (2019) argue that country context-dependent indicators should be used as they provide a more consistent data source to evaluate the performance of a country. Assumingly, the variations at a NUTS3 region could be even higher. Also, the rankings can be sensitive to the imposed assumptions and chosen aggregation method, even when the same indicators are used. Depending on the political climate in some countries, the process of implementing the SDGs framework could be more important than the final result in terms of performance.

Equality and solidarity dilemmas of the energy transition

Technological maturity and economic feasibility are keys to the energy transition, though these factors can also be supported by several policy measures. Next to technological change, the energy transition involves major social, behavioural, organisational, and institutional change. If new technologies and new grid systems are available, producers and consumers, as well prosumers, should get used to new roles and new business models, and novel governance arrangements should be facilitated by new policy settings. Colli (2020) stresses three challenges of the JTF. As the second and third pillars of the Just Transition Mechanism are market-based, it approximates forecasted amounts rather than specific country allocations, which adds uncertainties to regional long-term programming of the Just Transition.

Civic empowerment and social goals of the general well-being of communities are critical in the energy transition (Hoppe & de Vries, 2019). They broaden the understanding of complex technological systems and support strategising structural changes in energy systems. This discourse of the energy transition appreciates the multi-actor nature of social innovation and explores the socio-material intertwinement by experimental intervention logic (Wittmayer et al., 2020). The energy transition changes social relations, in addition to the direct effect on the declining well-being of coal communities that cannot be compensated by the early retirement and other public measures and social services. The social impact of rising unemployment from the current average of 15% will be substantial. Healthy life expectancy is lower for those living in the coal areas, and there are no clear signs of this gap reducing (Eurostat).

In terms of spatial relations, the energy transition means decentralisation, which can lead to (re)centralisation of energy facilities. In the energy transition, the concept of social innovation is contextualised in the domain of energy systems transitioning into more sustainable ones that also allow for more distributed energy generation. New

business models and institutional arrangements equally support top-down and bottom-up citizen-led action and projects in the energy transition. New participative approaches like co-creation and co-production of energy transition policies have been tested in urban living labs and energy cooperatives (Wittmayer et al., 2020).

The knowledge gap of governing the energy transition at the regional level unveils inter-regional and inter-municipal issues of the energy transition, addressing its meaning, theoretical concepts, and practical territorial implications. Although adaptation policies at all levels refer to a variety of frameworks, goals and tools, these rarely address questions about increased resilience or adaptive capacity. As stated in a report by the European Environment Agency (2020), increased awareness of adaptation is often seen as a proxy for increased adaptive capacity, and is one of the elements of measuring the success of the adaptation policies. ESPON territorial governance tools for long-term changes, such as the SDG Benchmarking Tool and TIA tool, have been scoping to signal the unsustainable short-termism of politics and business.

4. Policy recommendations

MAIN POLICY QUESTIONS

- How can European cities and regions empower and implement holistic sustainability concepts, such as the radical energy transition, decarbonisation of national economies, green innovation, green infrastructure, and ecosystem services?
- How should Europe elaborate and implement the EU Green Deal to prevent climate policy packages from increasing territorial disparities? What climate change adaptation measures could be put in place as part of an integrated, place-based regional and urban strategy?
- How should regions and cities cooperate to ensure the efficiency and coordination of adaptation and mitigation measures at wider geographic scales and territorial governance models?
- How should cities and regions mitigate negative implications and uncertainties of the energy transition and contribute to the quality of life of communities that are being phased-out?

The climate policy and energy transition discussed in this paper provide a background and framework to support ESPON discussions on European territorial cohesion. The ESPON programme aimed to analyse the specific framework and key conditions for successful strategy implementation in regions and cities. Such knowledge would form a relevant basis for improving regional low-carbon transition strategies and governance structures, as well adjusting legal framework conditions that often remain cross-national and are regionally blind. The following thematic clusters need further discussions for contributing evidence-based knowledge to the territorial policies in the sustainability pathways:

1. Addressing the risk of widening territorial gaps, with the targeted approach in coal regions
2. Elaborating and integrating climate-proofing in regional policy-making
3. Establishing multi-level holistic policy-making for climate change

Single territories contribute to the transition towards climate-proof and decarbonised regions and cities in different ways, according to their structural features, various limitations and lock-ins. The environmental dimensions of territorial cohesion should be more strongly integrated in key European policies to reach a territorial cohesion according to the SDGs.

1. Addressing the risk of widening territorial gaps

The SDGs are a blueprint to achieving a better and more sustainable future, in this context with the purpose of stimulating a more balanced EU territory, mainly because of the growing horizontal interventions of the Green Deal, climate policies, and a transition that occurs in changing territorial and urban patterns. The draft of the Territorial

Agenda 2030 states that global challenges in the field of sustainable development are highly relevant for local and regional development in Europe, while transformation and transition are gaining momentum. The energy transition and climate change adaptation must continue to help European countries and regions grow upwards and towards one another, while avoiding wider regional injustices and inequalities in the EU, both within and between regions. EU cohesion policies should articulate measures to prevent climate policy packages from increasing territorial disparities. In particular, this concerns coal regions. Rauhut and Medeiros (2018) proposed the Territorial Cohesion Index, which indicates and integrates rationales for development challenges, particularly for regions and cities that are lagging behind. Also, various composite sustainability indices are applied in macro regions and countries.

Widening territorial gaps. Regions with coal power plants and coal mines are the regions with lower economic power than those without any of these facilities (Alves Dias et al., 2018). There are risks associated with enlarging territorial gaps due to implementing the climate policy in the form of the Green Deal. Therefore, much more focused analysis is needed to explore the energy transition, structural change and its impact chains in the coal and carbon-intensive regions. The Just Transition needs proofing, as the majority of already phased-out coal regions remain depreciated. The Cohesion Policy remains a major EU investment tool to support the implementation of sustainable development that is in line with the Urban Agenda for the EU, such as investing in more sustainable infrastructure and balancing territories.

Coordinated policy-making in cross-border areas and territories with specificities. Transboundary risks need to be assessed and considered in a coordinated manner. There is a direct need to strengthen adaptive capacity across borders and have similar territorial specificities in EU macro regions that share common climate risks and territorial conditions (e.g., pan-European river basins such as the Danube, Rhine and Elbe, mountainous areas such as the Alps, and islands).

2. Climate-proofing of green regional growth strategies

There is no doubt that climate policy will be an engine of the green economy and infrastructure in the coming decades. The know-how in making urban development and urban living greener and more resilient is a new societal task in rethinking spatial planning, design, infrastructure, services, and mobility. The importance of enhanced urban resilience and adaptation action is acknowledged by many European mayors, as the declaration and methodology of the Covenant of Mayors has integrated adaptation to municipal climate policies (EC, 2018b). Still, special attention is needed for sustainable urban and peri-urban development, despite increasingly strict controls on greenfield urban growth and land use in general.

The LOCATE project prioritises the development of tailored implementation strategies for different economic sectors, energy sources, and spheres of daily life (ESPO, 2018c). Also, the integration of regional and local plans and competences may increase the scale and efficiency of the energy transition. The regional approach can condition and broaden the avenues for funding, financial investment aids and research funds. It is essential to present regional experience and examples with sufficient context information, providing key data on relevant framework conditions for project development and implementation (legal framework, functioning of economic

aid schemes, tariffs, taxation, etc.). Dissemination actions are similarly important.

At the lower governance tiers, the Joint Research Centre (JRC) report by Bertoldi et al. (2020) highlights the interconnected nature of climate mitigation, energy efficiency actions, and renewable energy sources adopted at the local level. The combination of effective urban energy policies and the coordination between national and local governments opens up the potential to mitigate climate change. Sustainable energy and climate action planning by the Covenant of Mayors initiative and methodology sets the ambitious policy measures from baseline emissions and establishes an effective, transparent system.

Ensuring more resilient infrastructure could be achieved by climate-proofing sectoral and infrastructure investments. The current framework of the Strategic Environmental Assessment needs more advances in the direction of climate risks. Adaptation means anticipating the adverse effects of climate change and taking timely precautionary measures to prevent or minimise the damage they can cause, though taking advantage of opportunities that may arise from climate change is often overshadowed or totally forgotten. Here, the picture is more nuanced for winners and losers in the land use, energy, and transport sectors.

Climate-proofing through systematic scrutiny in this way would allow policymakers to recognise trade-offs that might exist between urban development and climate risks. One way, for example, is by developing a localising suite of screening tools for sustainable development goals that are used in territorial governance, to consider the trade-offs and synergies between the policies in question and other sustainable development outcomes.

Making greater use of integrated urban development policy approaches increases resilience to unexpected disastrous events, thus keeping public services, efficient transport, reliable energy networks, and broadband internet stable throughout the territory. The focus should be on integrating mitigation and adaptation efforts to avoid trade-offs and counteracting. New business models that are fit to the economic and energy transition, and that are also resilient to climate change, should take advantage of new technologies enabled by finance, pricing and taxation, and social responsibility.

The quantification of the benefits of green infrastructure should be operationalised to create economic motivations for implementing it. This involves applying economic valuation methods to the specificities of green infrastructure. The strong benefits and allocation of hot spots should inform decision makers where to invest in green infrastructure. Policy integration with relevant domains, such as finance, energy, health and social

services, is vital; it should become prominent by the integration of ecosystem and green infrastructure principles in strategic spatial planning (ESPON GRETA, 2018b). Climate-proof is future-proof.

Assessment of the climate goals. Assessing climate goals requires critical upgrading in terms of scientific excellence and integrity. This is not provided by the current framework and methodology of statistical and environmental reporting, which belongs to the ready-made cohesion paradigm and policy relevance from the 2010s. If there is methodological progress at the national scale, regional coverage remains fragmented, with low quality and certainty. This undermines the overall multidisciplinary, targeted, and balanced approach to reflecting the universal, indivisible, and integrated nature of sustainability. Several global, developing country-adjusted approaches, methods, and priorities do not fit European countries and regions. There is the need to refine the climate goals to the local and regional level in order to exploit the transformative potential of the 2030 Agenda, and to empower policy support and awareness in addressing the SDGs at regional levels of governance. For this purpose, the ESPON SDG benchmarking tool provides a simple and user-friendly application that informs stakeholders of regional trends and progress, as well as disparities and inequalities (ESPON, 2020d). The holistic approach taken on multiple territorial scales, with a variety of sources and dispersed information, needs to be assessed by scientists representing a variety of backgrounds, scientific disciplines and pan-European geographies. The ESPON research on Baltic Sea forecasting 2050 underlines trans-border policy implementation in the water and green trans-border clusters (ESPON, 2019).

As mitigation policies are well covered by quantitative indicators, adaptation policies remain relatively vague in terms of indicators and societal implications. The common metrics used for the impacts and vulnerabilities of climate change, its uncertainties and long-term prospects should integrate non-climatic factors, cross-sectoral interactions, and cross-border impacts.

3. Setting the multi-level policy support for climate policy

The policy and research headlines sound ideal to turn political commitments into sustainable climate-neutral cities and regions. Beyond the objective to provide clean, secure and affordable energy for all, the energy transition is an opportunity to make Europe more democratic, more competitive, and more just. Easier said than done. Making tough choices should be grounded on territorial and regional evidence.

To rearrange and reset unfit policy frameworks, one can create the high-level science policy forum to provide a

strong, evidence-based instrument to support European policymakers in various territorial governance tiers, promoting carbon neutrality and sustainable development. Applying the political mainstream discourses, the Urban Agenda for the EU does not focus on the smaller cities that are important for territorial cohesion, but on metropolitan and bigger functional urban areas (Medeiros and Rauhut, 2018). Fuenfschilling et al. (2019) discuss urban experimentalism and governance experimentation in a multi-level governance context, calling for caution against too 'heroic' assumptions and naïve expectations of cities and their mayors, as urban sustainability transitions are not driven in and by cities themselves.

The sustainable paradigm is a shift towards governance systems, where decisions are built upon co-operation and collective global values, and where strategies and actions of major actors are aligned, applying long-term, adaptive, and participatory governance models that can also apply to urban governance (Jokinen et al., 2018). The approach should strengthen regional climate strategies, cases, and practices for a policy-driven cataclysmic transition, specifically in regions with special situations. It supports designing integrated pathways to sustainable development and climate change that correspond to specific needs and priorities. As sustainability results in a certain rhetorical makeover in urbanised Europe – a certain green window dressing in both the public and private sector – climate policy is already a kingmaker in Europe's territorial governance.

A systemic energy transition poses a great challenge for societies. A better understanding of the dynamics of complex, adaptive systems provides insight into the opportunities, limitations, and conditions under which it is possible to influence such systems. The transition living labs in several European carbon-intensive and coal regions both test and promote good practices. Transition management is based on key notions of complex systems theory, such as variation and selection, emergence, coevolution, and self-organisation. It involves a cyclical process of phases at various scale levels: stimulating niche development at the micro level, finding new attractors at the macro level by developing a sustainability vision, creating diversity by setting out experiments, and selecting successful experiments that can be scaled up (Rotmans and Loorbach, 2019).

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