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Possible European Territorial Futures

Applied Research

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Possible European Territorial Futures

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Abbreviations

EEA	European Environment Agency
ESDP	European Spatial Development Perspective
ESPAS	European Strategy and Policy Analysis System
ESPON	European Territorial Observatory Network
EU	European Union
GDP	Gross domestic product
ICT	Information and Communication Technology
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
NEET	Not in Employment, Education or Training
NUTS	Nomenclature of Territorial Units for Statistics
OECD	Organisation for Economic Co-operation and Development
PPCS	Purchasing Power Standard based on final consumption
PPS	Purchasing Power Standard
R&D	Research and development
UN	United Nations
WEF	World Economic Forum

Executive Summary

The ESPON project on possible territorial futures started in June 2016 and runs until November 2017. The work is structured in three distinct aspects, following the Terms of Reference provided by the ESPON EGTC. (a) To start with, there is an analysis of territorial development in Europe today and likely developments towards 2030, so-called diagnosis and prognosis. (b) An discussion of territorial implications of three specific 'what if questions' concerning 2030, so-called foresight, including an assessment of this against the results of the diagnosis and prognosis. (c) Developing a handbook or guidelines on territorial foresight, based on the methodologies applied in this project and the lessons learned from this project.

This Volume B of the Draft Final Report focuses on the analysis of the current territorial development in Europe and provides a basis for the work on the developments towards 2030.

To understand Europe's territorial situation today and changes expected towards 2030, the report focuses on four domains: demography, socio-economics, environment & climate change, and research & technology. Based on this analysis, the report draws first conclusions whether Europe moves towards territorial cohesion or not.

Europe's demographic structure and their territorial expression, i.e. settlement patterns, change only slowly. Key factors concerning the current situation are increasing concentration tendencies and ageing. Migration at global, European, national and also regional level play an important role and further accelerates territorial imbalances.

The implications of demographic developments in Europe can only be fully understood from a global perspective. In short, Europe is an ageing part of the world. In the decades to come it will most probably face demographic decline. At the same time, global population is growing and Europe is surrounded by areas with partly very young populations. Over the next decades migration will play in increasing important role for Europe. This concerns both immigrants arriving from other parts of the world, but also an increasing number of young and talented Europeans migrating to young and vibrant metropolitan areas outside Europe. Overall the developments are expected to lead to increasing rural-urban disparities in Europe with increases in working-age population in metropolitan areas. Though in same areas in e.g. in Eastern Europe and Germany also the metropolitan areas might face population decline. At the same time some rural areas e.g. in France, Italy or Scandinavia might see population growth.

Europe's socio-economic development has been asymmetric since the economic and financial crisis. There are increasingly unbalanced distributions of GDP and employment. These imbalances are further accelerated by jobless economic growth. This is also reflected in the disparities of available household incomes. In Europe, the gaps between north and south and also between regions within countries are widening. In particular Greece, but also Cyprus, Spain, Ireland and Italy faced considerable declines in household incomes and increasing social disparities.

Any prognosis on the socio-economic development in Europe and its territorial pattern has to be handled with great care. As shown in the report, developments towards more territorial cohesion are expected to pick up again in the years to come. However, factors such as global economic integration and technological changes can lead to very different developments and critical bifurcation points may emerge before 2030.

Environment & climate change in Europe continues to be under threat. At a local level increasing levels of soil sealing add to already high levels of artificial land use. An intensification of artificial land use is happening in particular in Eastern Europe and some coastal areas round the Mediterranean. Also the impact and adaptive capacity to climate change differs across European regions. While regions with severe environmental challenges are more vulnerable to the impacts of climate change, the adaptive capacity is higher in wealthy Northern Europe. Also the diversity of energy dependency and the consumption and production of renewable energy play a role. The energy intensity of the economies is still considerably higher in Eastern Europe than in Western Europe. At the same time large parts of Eastern Europe are lagging behind in terms of renewable energy production and consumption. Between 2004 and 2014 the shares of renewable energy consumption has increased, especially in Denmark, Iceland and Sweden, followed by Austria, Bulgaria, Estonia, Finland, Greece, Italy and Norway.

To a large extend, current trends in terms of land-use, renewable energy and also the situation concerning climate change are expected to continue along the same lines for the next decade(s). In other words, the overall outlook is rather negative.

New technologies hold the potential to change economies and societies and thus affect on the territories. R&D and innovation capacities concentrate in Europe's capital city regions and regions with high technological activities. Innovation leaders are mostly located in Southern England, southern Germany, Ile de France, Sweden and Denmark. In the strive towards innovation and new technologies, education levels play an important role. There is distinct rural-urban differences in terms of education levels of people aged 30-34. This is most pronounced in Luxembourg, Hungary, Slovakia, Bulgaria and Romania. For the same age group, in some countries, there is still a gender gap in tertiary education level, in 2016.

By 2030, it is estimated that firms and industry will be predominantly digitised, enabling product design, manufacturing and delivery processes to be highly integrated and efficient. The so-called 4th industrial revolution will lead to fusions of technologies and blur the lines between physical, digital and biological systems. At one hand, it is expected that there will be strong territorial, economic and societal concentration processes, as the innovation leaders will have the highest advantages, while adapters will benefit less. On the other hand, it is argued that new technologies allow for declining agglomeration advantages and will bring more decentralisation (e.g. of production process) as well as increasing urban sprawl.

Key messages summarising the analysis in terms of territorial cohesion are:

- Increasing polarisation of settlement patterns;
- Increasing concentration of economic activities;
- Climate change and environment are growing concerns;
- Technology and innovation hold the potential to make new regional stars.
- European disintegration processes are probably reducing the path towards territorial cohesion

1 Introduction

The ESPON project 'Possible European Territorial Futures' stands in the tradition of past ESPON foresight and territorial impact assessment studies. Various future scenarios and their territorial impacts are explored. This provides new insight into possible future developments, which supports policy-makers in assessing the robustness and 'future-proof' capacity of their policies against these developments.

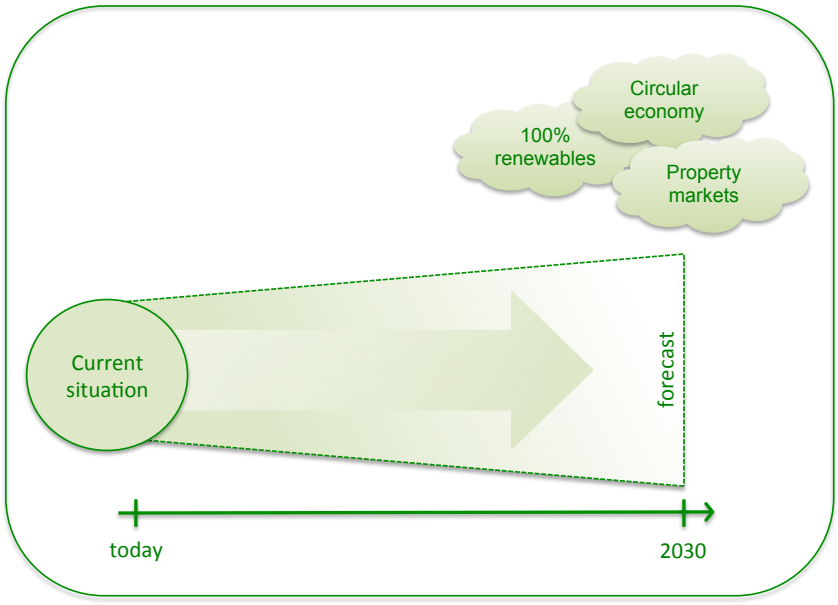
Researching the future implies dealing with uncertainty. One way to work with high levels of uncertainty is to develop participatory approaches, enriching the data analysis, modelling and desktop studies. An additional feature is enabling cross-fertilisation of ideas and common learning, in line with co-creation and design-thinking scenario-building approaches.

The objectives of this project are twofold:

- Enhancing the understanding of possible territorial future developments and consequences, in particular for three foresight topics: a new place-based economic organisation as part of a circular economy, a European energy supply and consumption that is a 100% renewable and a collapse of the European property markets. This requires an update and refinement of existing diagnosis and prognosis concerning the European territory.
- Writing general conclusions and recommendations in the form of a handbook, or guidelines for conducting European territorial foresight studies.

The project started on 11 May 2016 and runs until November 2017. This Volume B of the Draft Final Report focuses on a broad diagnosis of the European territory today and a prognosis of how the territory might look like around 2030. As shown in Figure 1.1, the project started with an analysis of the current situation and from there looks into the future through a corridor of different development paths as we acknowledge the uncertainty about what may happen. This work builds to a large extent on existing research and in particular the work of the ESPON ET2050 project (ESPON, 2014c). The general territorial analysis is meant to form a backbone for a more detailed discussion of the territorial implications for the three foresight topics. The three 'clouds' in Figure 1.1, so the three foresight topics, have been formulated in terms of 'what would Europe look like if in 2030 … '. These questions were researched independently of the general work on the territorial development of Europe. Later the results were compared to discuss what would be different and what policy implications can be drawn from that. In other words, to what degree will the general picture differ if the assumptions of the three foresight topics are considered.

Figure 1.1 The overall approach



Source: ESPON Futures project team

This report addresses the state of the European territory today and expected developments until 2030 under four thematic headings covering a wide range of aspects relevant for territorial development. These are demographic change (Chapter 2), socio-economic developments (Chapter 3), environment & climate change (Chapter 4), and technological change (Chapter 5). The volume closes with a chapter with the main conclusions on the current and expected future territorial situation in Europe (Chapter 6).

The key conclusions discuss today's situation and tomorrow's developments with regard to territorial cohesion objectives and polycentric development at different geographic levels. Based on these conclusions, some pointers for policies are provided, indicating fields for policy consideration to assist territorial cohesion and polycentric development.

This report is based on comprehensive desk research and quantitative analysis of data sets as well as on participatory approaches involving two online surveys and a participatory workshop which took place in November 2016 in Barcelona.

The report is a collaborative effort of all members of the project team including colleagues from Spatial Foresight, Spiekermann & Wegener Urban and Regional Research (S&W), Mcrit, ISINNOVA, as well as from ÖIR.

1.1 Methodological remarks

The project builds on a wide range of research approaches. This report in particular combines results from qualitative and quantitative research as well as different participatory processes.

Foresight approaches support political agenda setting and the identification of future challenges and opportunities. Foresight oriented thinking can help to meet future challenges proactively. It encompasses a range of methods and techniques that combine strategic

analysis, prospective forward thinking and process oriented dialogical work. Foresight studies serve policy development as they can advise policy makers on how to ensure that there current policies are robust in the light of future uncertainties and give them the opportunity to think about risk prevention as well as develop opportunities as part of long-term strategic planning.

Qualitative analysis: A wide range of different studies and reports were analysed to collect information on the territorial dimension of Europe today and in 2030. This included information on general developments, trends, drivers for change and possible bifurcation points. The material covered a wide range of ESPON research and in particular the ET2050 project (ESPON, 2014c), and also other studies on future trends of relevance for European territorial development (Böhme, Holstein, et al., 2015; e.g. Böhme et al., 2016; Lüer et al., 2015; Zillmer et al., 2015). Throughout the report also a range of thematic studies from different sources have been used.

Quantitative analysis: Both describing the status quo of European territory and making initial prognoses for future developments involved quantitative analysis. These required an update of indicators and build to a large extent on earlier ESPON studies, especially INTERCO (ESPON et al., 2012), ETMS (ESPON et al., 2014) and the 6th Cohesion Report (European Commission, 2014a). For selected indicators a first prognosis for 2030 applied the SASI model (ESPON, 2014b). Some of the statistical analysis divides Europe into macro-regions, following the approach taken by ESPON ET2050.[1]

Participatory approaches: The project work also involves a range of different participatory processes, addressing various key players (from academia, policy-analysis and policy-making). In addition to a network of thematic experts and an advisory board, a focus group on possible territorial futures was organised on 23-24 November 2016 in Barcelona with 27 participants. In preparation for this there was an online survey on selected future developments. From 7-22 November answers from 180 respondents were collected. The results of the participatory processes have been important inputs guiding the project team as concerns the topics to be addressed in this report. More importantly the participatory processes ensure a rich discussion and a multi-facetted understanding of the three foresight topics discussed in Volumes D, E and F of this Draft Final Report. A second online survey was analysed and a second focus group was held in Vienna on 20-21 February 2017.

[1] For analytical reasons, the seven macro-regions of ET2050 were aggregated to five macro-regions with country groupings:

- North West Region (BE, FR, IE, LU, NL, UK)
- Baltic and Nordic Region (DK, EE, FI, IS, LT, LV, NO, SE)
- Central and Alpine Region (AT, CH, DE, LI, PL)
- Danube Region (BG, CZ, HU, RO, SK)
- Mediterranean Region (CY, EL, ES, HR, IT, MT, PT, SI)

1.2 The territorial backdrop

Territory matters, as underlined by a wide range of policies and current developments. This includes not least geo-political refocusing in closely delineated territories, as territorial characteristics matter in terms of development opportunities and for the impact of overarching trends and developments.

Since the 1990s, the territorial future of Europe has been discussed repeatedly. This is reflected in the adoption of the 'European Spatial Development Perspective' (ESDP) in 1999 (European Commission, 1999), of the 'Territorial Agenda of the EU in 2007' and of the latter's update, the 'Territorial Agenda 2020', in 2011 (BMUB, 2011). These discussions are also linked to the broadening of EU cohesion objectives with the inclusion of the territorial dimension in the Lisbon Treaty, as well as overarching European policy objectives and strategies, including those expressed in the 'Europe 2020' strategy.

Related European policy objectives include topics such as territorial cohesion, competitiveness, balance and polycentricity, geographic specificities, regional imbalances, discontinuities, governance, territorial cooperation and urban sprawl. All of these have been discussed by a large number of ESPON projects as well as in various discourses outside ESPON.

Some of the key concepts to which the foresight project will relate are below:
Territorial cohesion was integrated in the Treaty of Lisbon as a policy objective alongside the objectives of social and economic cohesion. The policy objective was reiterated in the Territorial Agenda of the European Union 2020 (2011) and further specified in six priorities, establishing a relationship between territorial cohesion and the Europe 2020 Strategy objectives of smart, sustainable and inclusive growth. Despite various discussions and an EU Green Paper on territorial cohesion, there is no clear definition or common understanding of the term. Instead, any understanding of the term varies depending on the source and has changed over time (Böhme and Gløersen, 2011; Faludi, 2010). The most prominent definitions in European policy documents are:

- "(...) particular attention shall be paid to rural areas, areas affected by industrial transition, and regions which suffer from severe and permanent natural or demographic handicaps such as the northernmost regions with very low population density and island, cross-border and mountain regions." (Treaty definition)
- "(…) promote convergence between the economies of better-off territories and those whose development is lagging behind." (TA 2020 definition)
- "(…) transforming diversity into an asset that contributes to sustainable development of the entire EU." (Green Paper definition)
- "(…) territorial cohesion reinforces the importance of access to services, sustainable development, functional geographies and territorial analysis." (5th Cohesion Report definition)

Regardless of an exact definition of territorial cohesion, different arguments have been put forward to include territorial cohesion alongside economic and social cohesion. From an economic perspective, territorial cohesion can add value when it lowers the cost of non-

coordination between different sector policies. Others perceive the added value of territorial cohesion more from the perspective that smart, sustainable and inclusive growth requires acknowledgement of European diversity. Thirdly, from the perspective of the European single market, territorial cohesion can contribute to more balanced development. Lastly, more political arguments are put forward for solidarity. These perceived added values are reflected in the different definitions (Böhme, Zillmer, et al., 2015).

A place-based approach focuses on place-specific long-term strategies elaborated in multi-level governance with a strong involvement of local elites (2009). This has since become a leading idea in the territorial policy and cohesion debate in Europe. In essence, place-based territorial development is assumed to improve development policies by stimulating endogenous development potential and tailoring policy to local circumstances, avoiding, at the same time, the domination of local and regional self-interests that often prevail in highly decentralised policy-making models. A place-based approach properly outlines the role of territorially bound assets such as settlement and accessibility infrastructure. As such, it is the opposite of a sectorial approach that usually neglects synergies between different types of public intervention, and tackles persistent underutilisation of potential and the exclusion of certain places or territories through external intervention and multi-level governance (Zaucha et al., 2013).

Polycentric development and balanced territorial development are closely linked policy objectives. In the same way as territorial cohesion they have many facets. Overall, the policy aims are linked to promoting places of economic dynamism and service provision in all corners of Europe. Polycentric development seeks to avoid polarisation between capitals and small and medium-sized towns and metropolitan and non-metropolitan regions. It also requires strong regional integration of functional urban areas and their surroundings to overcome the urban-rural dichotomy. Polycentricity has traditionally been approached from two perspectives: in demographic terms, with a focus on population and functions in cities and metropolitan regions, and from an economic point of view, seeking to increase economic growth and innovation across Europe (ESPON et al., 2014; ESPON, 2014c, 2014d, 2005).

Geographic specificity is another key concept in territorial policy debates, based on the list of specificities in the Lisbon Treaty. Linking geographical characteristics with specific development challenges or potential, has resulted in special attention for mountain areas, islands, sparsely populated areas, coastal zones, border areas and rural areas and not only in ESPON projects (ESPON, 2011b, 2014a; ESPON et al., 2014).

1.3 As for the future

Supporting policy development, it is important to not only understand the current situation and its origins, but also to provide insights into possible future developments. This implies understanding key trends and drivers for future developments, as well as future uncertainties and possible bifurcation points.

The main starting point is work carried out by the ET2050 project (ESPON, 2014c). Among the main aspects to be considered in this context are developments in governance, energy, resources, technology, infrastructure, work, the economy, welfare, education, research & innovation, consumer behaviour and property markets (see e.g. Rifkin, 2014). A wide range of authors and studies have outlined key developments to be considered. Many of these will be reflected in this report.

In addition to identifying the main trends, it is important to understand uncertainties and risks. This has also been studied by a variety of authors (see e.g. European Commission, 2012; European Strategy and Policy Analysis System, 2015; Randers, 2012; WEF, 2017a) and many aspects of this are reflected in this report. As a general background Figure 1.2 provides a summary of key trends and uncertainties at global and European levels developed by ESPAS (European Strategy and Policy Analysis System). One ambition of the project is to see whether by summer 2017 it is possible to develop a similar table can highlight key trends and uncertainties with a clear European territorial dimension.

Figure 1.2 Global and European trends and uncertainties

	WORLD		EUROPE	
	GLOBAL TRENDS *as projections*	*Uncertainties*	EUROPEAN UNION TRENDS *as projections*	*Uncertainties*
General	Complex, fragile, unstable and insecure world. Age of insecurity.	*Systemic risks linked to emerging countries, stalling global growth.*	Integration of euro area, insecure environment, low growth.	*Capacity to change?* *Accumulation of risks?* *Changing ethics/values?*
Economy	Global ageing.	*Economic downturn of China with systemic consequences?* *Globally changed allocation of investment flows?* *Technological revolution in energy or communications area?*	Unsustainability of current welfare systems. Shrinking labour force. Need structural reforms for investment and saving allocation. Education key in ageing society.	*Massive productivity gains in public sector?* *Massively reshaped economies through technological revolution?*
	Increasing competition for energy, raw materials and other natural resources.	*Impact of shale gas, smart grids, new renewables?* *Impact of climate change?* *Impact of middle class?*	Crisis in the energy mix of many Member States.	*Achievement of a pan-European energy grid?* *Disrupted security of supply?*
	Financial deleveraging and state intervention.	*Currency wars?* *Systemic risks linked to financial systems in emerging countries?*	Slow recycling of toxic assets. Moderate growth without debt. Eurozone integration.	*End of free capital markets?* *Euro without structural reforms?*
	Increased North/South and South/South competition on export markets. Increased role of regional arrangements.	*Geopolitisation of trade?* *Globalisation stalling?*	European Union remains one of the most open economies, vulnerable to downturns in global trade.	*Consequences of Trade and Investment Partnership with the United States?* *FTAs with China/Russia?* *European Union still a standard setter with United States or not?*
Technologies	Converging technologies. Disruption of business models in all services.	*Fully fledged industrial (and then social) revolution?* *Level of disruption and opportunities created?*	Potential for catch-up still here. Clustered markets for innovative mixes (services/products). Education will be key.	*Successful digitalisation and further integration of the Single Market, including services?*
Society	Rising economic middle class. Increased inequalities. Rising discontent. Empowered individuals. Migration patterns regionalised (south-to-south, north-to-north).	*Age of revolutions?* *Individuals challenging collective structures?* *Rise of nationalism and (religious) extremism?*	Reach out to global middle classes, threats on European Union middle class. Rise of inequalities. Creativity-based society. European Union will continue to be a destination country for migrants from the neighbourhood.	*Spill over effects from the instability in emerging countries?* *Resilience/capacity of adaptation of political institutions?*
External relations	More multi-polar but less multilateral. Return to power politics.	*Serious global geopolitical realignment?* *Rise of new multi-institutions driven by BRICS?*	Decline in military spending. Dependency on energy and military supplies. US pivot.	*Future of NATO?* *European Union fragmentation?* *European Union leadership on global stage?*
	New conflicts (esp. natural disasters and its consequences). Global insecurity continues with increased non-state rebel group violence trouble.	*Terrorism, political tensions.* *Instability, low growth?*	Impact on European Union itself (its frontiers, its integration process). European neighbourhood in trouble.	*Domestic and energy insecurity?*

Source: European Strategy and Policy Analysis System, 2015: 16

2 Demographic change

People stand at the very centre of territorial development in general and European cohesion policy in particular. Whether people stay in or move towards an area provides a first impression on the region's attractiveness, economic activity, living conditions and culture. Furthermore it impacts territorial development including infrastructure needs, labour markets, consumption patterns and economic structures. In that sense both, (a) current demographic patterns and (b) differences in demographic change, provide initial insights into understanding territorial development and territorial cohesion in Europe.

Some key figures on the current situation of Europe's demographic development are presented below. This is followed by a section on expected demographic trends and developments for the next decade or two. In this context drivers for demographic change and possible furcation points are also outlined.

2.1 Today's situation

In rough terms, Europe has densely populated and well connected urban areas and less connected rural areas. Larger urban regions (often capital regions) seem to be the favoured hotspots for demographic development (Lüer et al., 2015: 2). Europe's general population structure based on population density, changes only slowly. Europe's population is concentrated in metropolitan areas. Nevertheless, demographic developments affect Europe's regions, creating different opportunities and challenges. This section discusses three demographic developments from the past years, explaining today's situation.

2.1.1 Population developments

Increasing gaps between central and peripheral areas at different geographical levels. Whereas Europe's population structure in terms of density does not change much over time, the population development of individual regions is very heterogeneous across Europe. This is an outcome of the economy, related migration and very different natural population developments. Map 2.1 and Figure 2.1 show recent population changes for 2008-2014. The population of ESPON territory as a whole grew by almost 2%. But, Europe has several overlaying patterns of regional population growth and decline.

At a European scale the North West and Mediterranean macro-regions have been growing as has the Nordic part of the Nordic and Baltic Region. The Central and Alpine Region population decreased slightly due to Germany. More severe are the losses of the Danube Region and the Baltic part of the Nordic and Baltic Region.

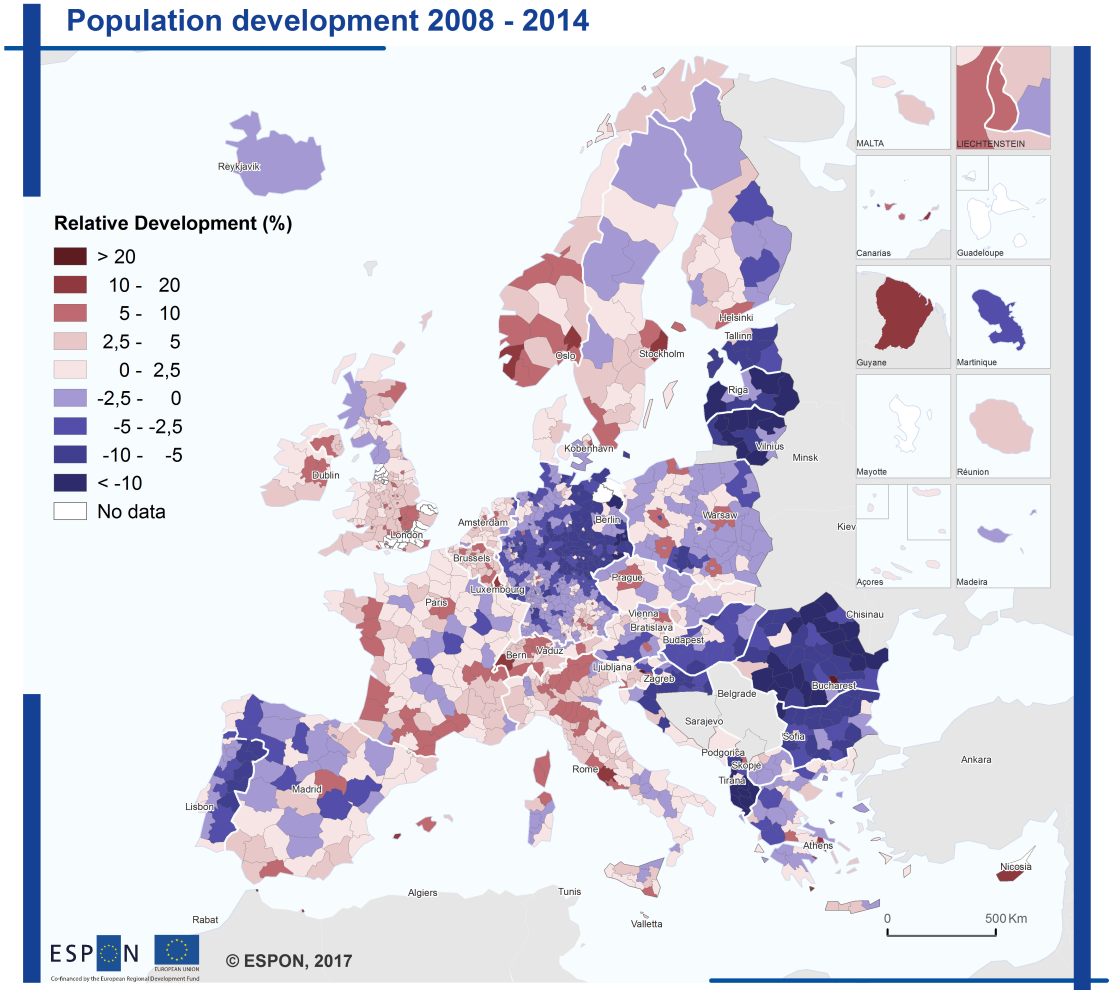
At a more detailed level, population development is dominated by an increasing urban-rural polarisation. In most European countries, population growth has been lower in rural than in urban areas. In all but one of the macro-regions, urban areas experienced population growth, while rural areas experienced population decline. Only in the North West did the population increase in rural areas, albeit at considerably lower levels than urban areas. Most severe is the development in the Danube region. There, population decline in rural areas is so strong

that it counterbalances the positive development in urban regions, mainly the capital regions of each country. The picture is similar in the Central and Alpine region, however, less pronounced. In the Mediterranean region and the Nordic and Baltic region, rural areas are the only ones losing population whereas the other areas are gaining.

Overall, regions expected to face the greatest demographic challenges include peripheral, rural and post-industrial regions, where the population is likely to decline (Eurostat, 2016).

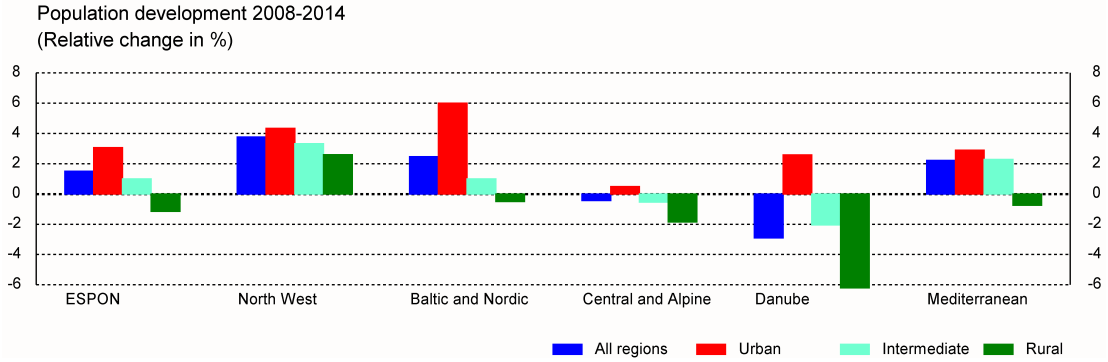
Overall demographic territorial patterns are an outcome of natural population change and migration flows. The following paragraphs will discuss territorial challenges and opportunities deriving from these patterns.

Map 2.1 *Population development 2008 – 2014*



Regional level: NUTS 3 (version 2013)
Source: Spiekermann and Wegener Urban and Regional Research (S&W), Territorial Futures, 2017
Origin of data: ESPON (ESPON_poptot1999-2016_20161019)
Eurostat (online data code: demo_r_gind3), 2008 & 2014
CC - UMS RIATE for administrative boundaries

Figure 2.1 Population development 2008-2014 by macro-region and urban rural typology



Source: ESPON Futures project team

2.1.2 Ageing

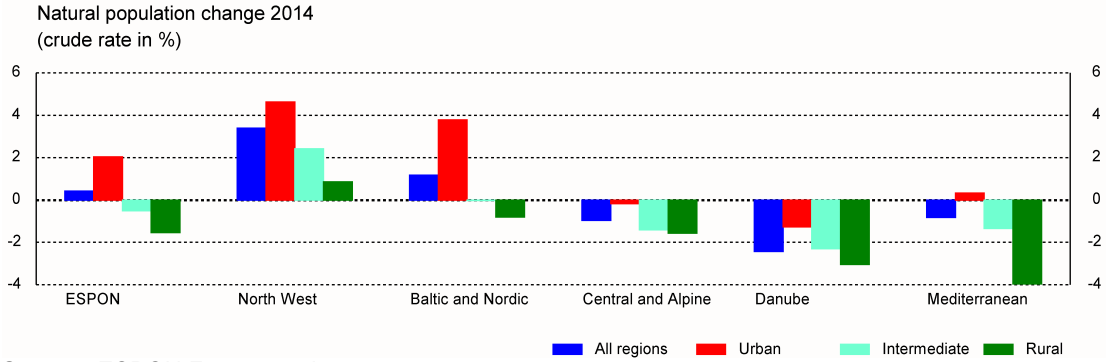
Natural population development is highest in urban regions. This is the opposite of developments in earlier decades. As depicted in Map 2.2 and Figure 2.2 on average urban regions had a clear positive natural population development in 2014. This positive development in cities is mainly due to the large metropolitan areas in the North West Region and in the Nordic part of the Nordic and Baltic region. In other parts of Europe, the urban population is declining, however, not as much as the rural population there. The crude birth rates of these regions are too low to maintain the number of people living there, which also leads to the overall population ageing.

Ageing population posing social challenges. The median age for the ESPON space increased from 40 in 2008 to 42 in 2014 and is expected to increase further as people live longer and natural population development declines. On average, a European born in 2014 could expect to live for 80.9 years (Eurostat, 2016). Life expectancy at birth is highest in southern European regions and lowest in eastern European regions, quality of life, nutrition and health care in these European region. An ageing population poses social challenges for some regions. These derive from simultaneous drops in fertility rates across Europe, longer life expectancy and a shift of baby boomers to the top of the age pyramid (European Commission, DG Research, 2014). The social and economic consequences associated with population ageing are likely to have profound implications across Europe, most notably in eastern Germany, the Baltic States, Bulgaria and rural areas in the UK, Spain, Portugal, Italy, Greece and Romania. Examples of societal challenges are (Eurostat, 2016):

- **Increasing demand for health care systems**. Elderly people demand more health care, although healthy life years increased due to better access to health care, territorial differences persist;
- **Decreasing labour force.** The number of young people entering the labour force can't replace the number of people leaving;
- **Decreasing public income**. Ageing and demographic decline might also impact the capacity of governments to raise tax revenue, balance their finances, or provide adequate pensions and healthcare services. At the same time increasing old-age

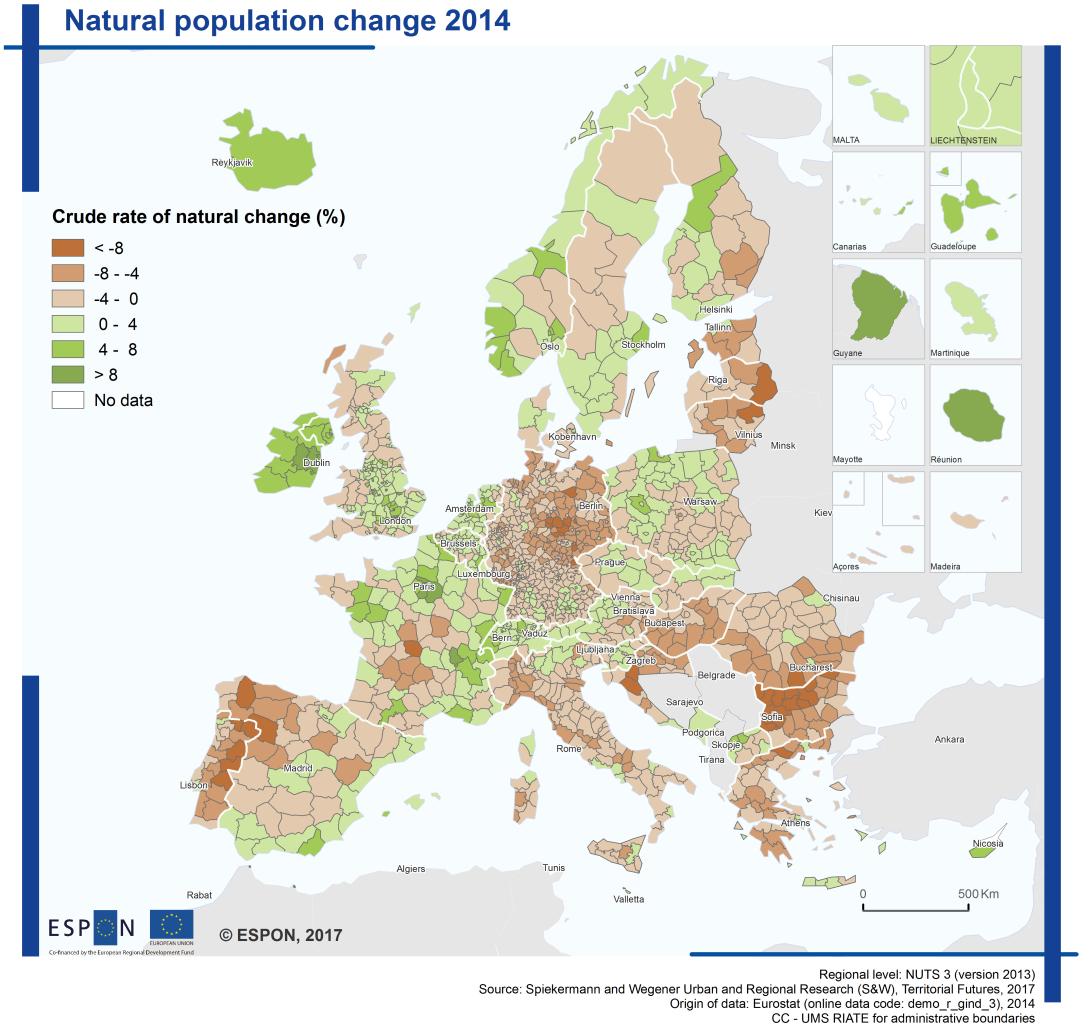
dependency ratios indicate that more people will depend on payments from pension and social welfare systems.

Figure 2.2 Natural population change 2014 by macro-region and urban-rural typology



Source: ESPON Futures project team

Map 2.2 Natural population change 2014



2.1.3 Migration

Different migration patterns enhance regional disparities. Although migration plays an important role in the population dynamics of European cities and regions, it is unlikely that migration alone will reverse the current trend of population ageing and decline in many parts of the EU (Eurostat, 2016).

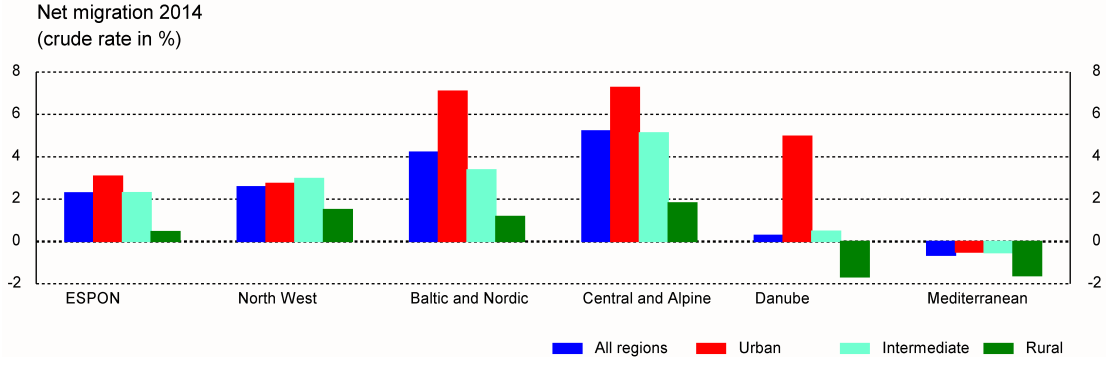
The migration flows in Europe are diverse and change at different geographical levels. Net migration figures cover migration trends at different geographical levels:

- **At the global level** Europe is one of the most attractive regions (ESPON, 2013b), a perspective which has become increasingly visible in recent years with vast migration and refugee flows from Africa and the Middle East to Europe (ESPON, 2015).
- **At European level**, east-west and periphery-core variations are notable. The macro-regions of Europe as defined for this study, are experiencing a clear positive migration balance except for the Mediterranean region (Figure 2.3 and Map 2.3).
- **Within most macro-regions**, urban as well as intermediate regions gain most from internal migration. Severe emigration happens in rural areas of the Danube Region and other eastern European countries as well as across the Mediterranean leading to large lower density areas with population decline.

Migration affects both the receiving as well as the sending regions. Some of the territorial affects noted in recent years are:

- **Brain drain**. In some rural regions younger and more educated people have left for better educational and job opportunities elsewhere, leading to increasing socio-economic problems in the affected regions.
- **Segregation**. In urban areas migrants cluster in certain neighbourhoods leading to a separation of social groups in urban areas.
- **Social tensions**. Especially in areas with limited migration history, social tensions accompany the arrival of new persons, especially with different cultural backgrounds. This has also led to increased discussion on the Schengen agreement and open borders at Europe's outer borders.

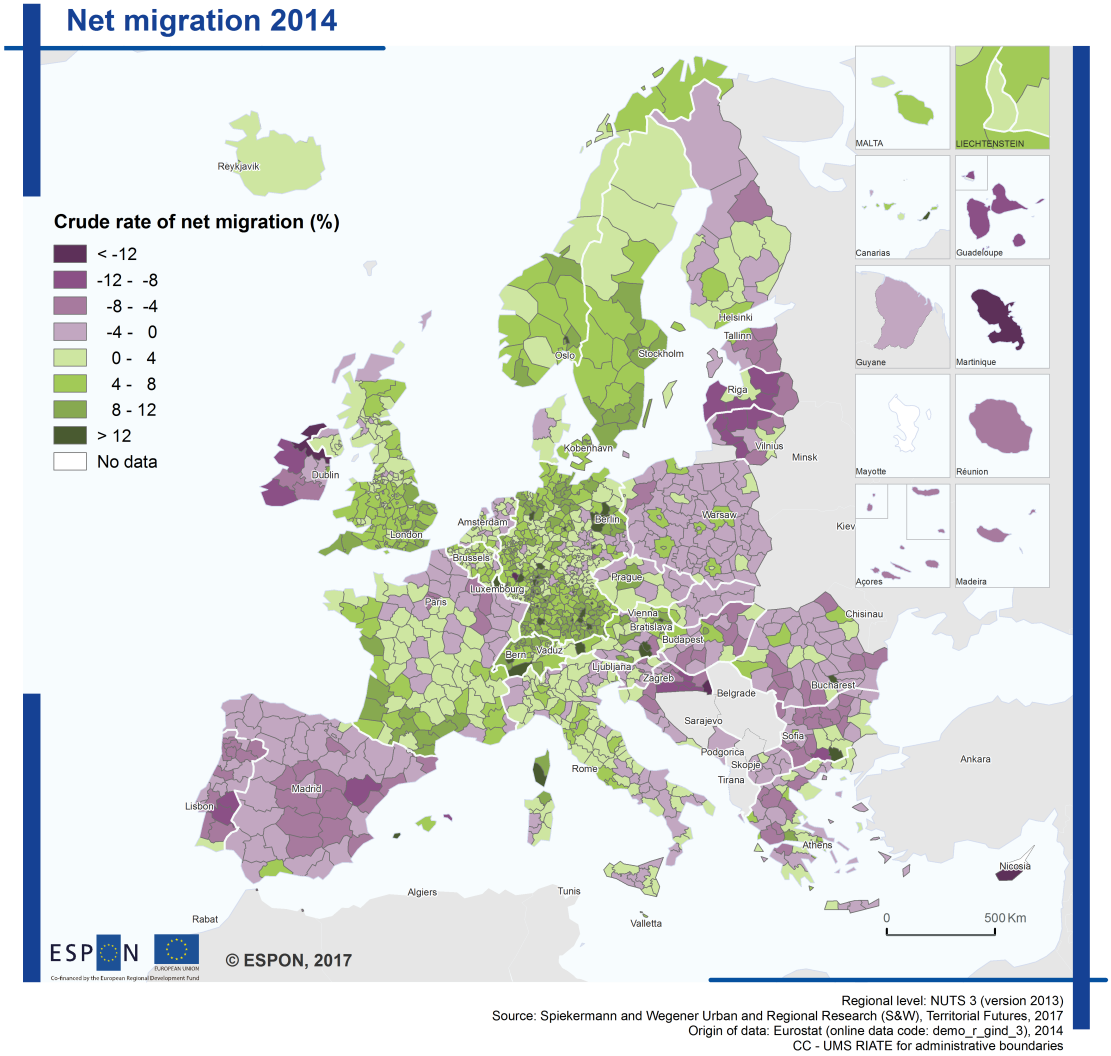
Figure 2.3 Net migration 2014 by macro-region and urban-rural typology



Source: ESPON Futures project team

Overall it appears that migration trends and their effects further accelerate territorial imbalances at a global level as well as within Europe.

Map 2.3 Net migration 2014



2.2 Tomorrow's developments

The implications of demographic developments in Europe can only be fully understood from a global perspective. Global demographic growth and greater wealth will increase the demand for resources and will challenge finite resources on the planet. According to a UN estimate from 2010, the world's population will grow from 7 billion to 8.3 billion over the next 20 years.

2.2.1 Demographic pressures and global flows

Considerable territorial variations across the globe will increase challenges concerning the 'distribution of population and wealth'. Already today there are considerable differences in the age structures of societies around the world and current trends point to two different trends:

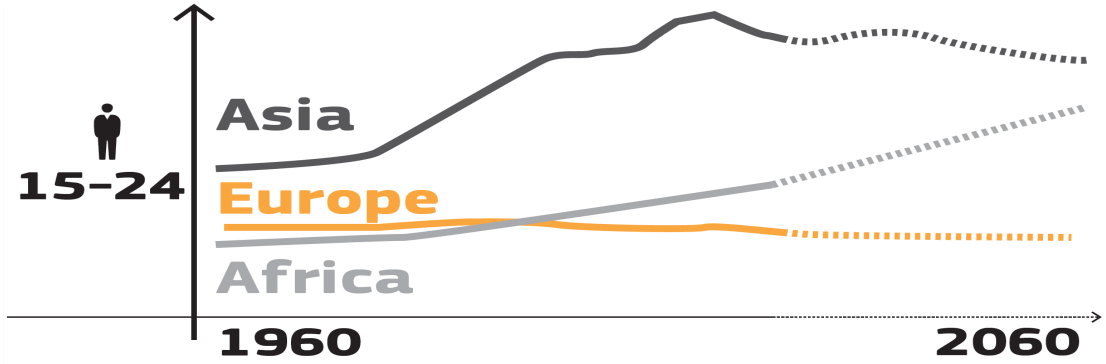
- **Worldwide 760 million people are over 60 years old**. By 2030, that number will probably double (Institute for Futures Studies and Technology Assessment, 2014). Economic growth may decline in ageing societies, while pressure on public pensions,

healthcare systems and support for young people increases (National Intelligence Council, 2012). An ageing society is pronounced in Europe for which there are three traditional options: work harder, work longer, work smarter. Also attracting young people from other parts of the world may reduce some pressures, but will probably not balance ageing in Europe.

- **Young and ambitious societies** with a low median age and very young populations face different challenges. More young people need to find a place in society in competition with both those who are settled in positions of power and with other young people also striving to advance their careers. Better education and limited resources are additional ingredients in this mix, which could easily lead to multiple conflicts. The lowest median age is in Africa, but the Middle East also has a young population compared to Europe. The median age in Germany is 46.5 years, it is 25.3 in Egypt, 19.7 in Iraq and 15.2 in Niger. In short, while the share of young people declines in Europe, it grows Africa and is stable in Asia (see Figure 2.4).
- **The middle class will increase** substantially in some parts of the world. By 2030, the global middle class is expected to grow by 66%, meaning about 3 billion more consumers with increased purchasing power and expectations (Glenn et al., 2015)

These very different developments at a global scale will lead to different demographic pressures and flows, which are most visible in migration. Increased migration could mean up to 400 million people being on the move by 2050, including more climate change refugees (Glenn et al., 2015). More locally, a move towards urban areas and increasing urbanisation is expected. Globally more migration is fuelled by demographic and economic imbalances paired with political, religious and social conflicts. As a result about 60% of the world's population will live in urbanised areas over the next decade (National Intelligence Council, 2012).

Figure 2.4 *Continued population growth, youth bulges and ageing population*



Source: Joint Research Centre, 2016

2.2.2 Continuation of demographic trends

The recent demographic developments observed in Europe (see above) are expected to further accelerate in the decades to come.

Overall population increase. Depending on the model applied, Europe's demographic development differs. However, in most cases the next decades the overall population is still expected to increase, by about 7% between 2010 and 2050.[2] This increase will come with considerable variation between and within countries. Between 2014 and 2030 relatively high population growth is expected in western and northern European countries as well as in the main urban centres in eastern European countries (Map 2.4). The population in most parts of eastern European countries and Germany will continue to decline. In 2030 the populations of Bulgaria and Latvia are expected to be as much as 20 per cent lower than in 2014.

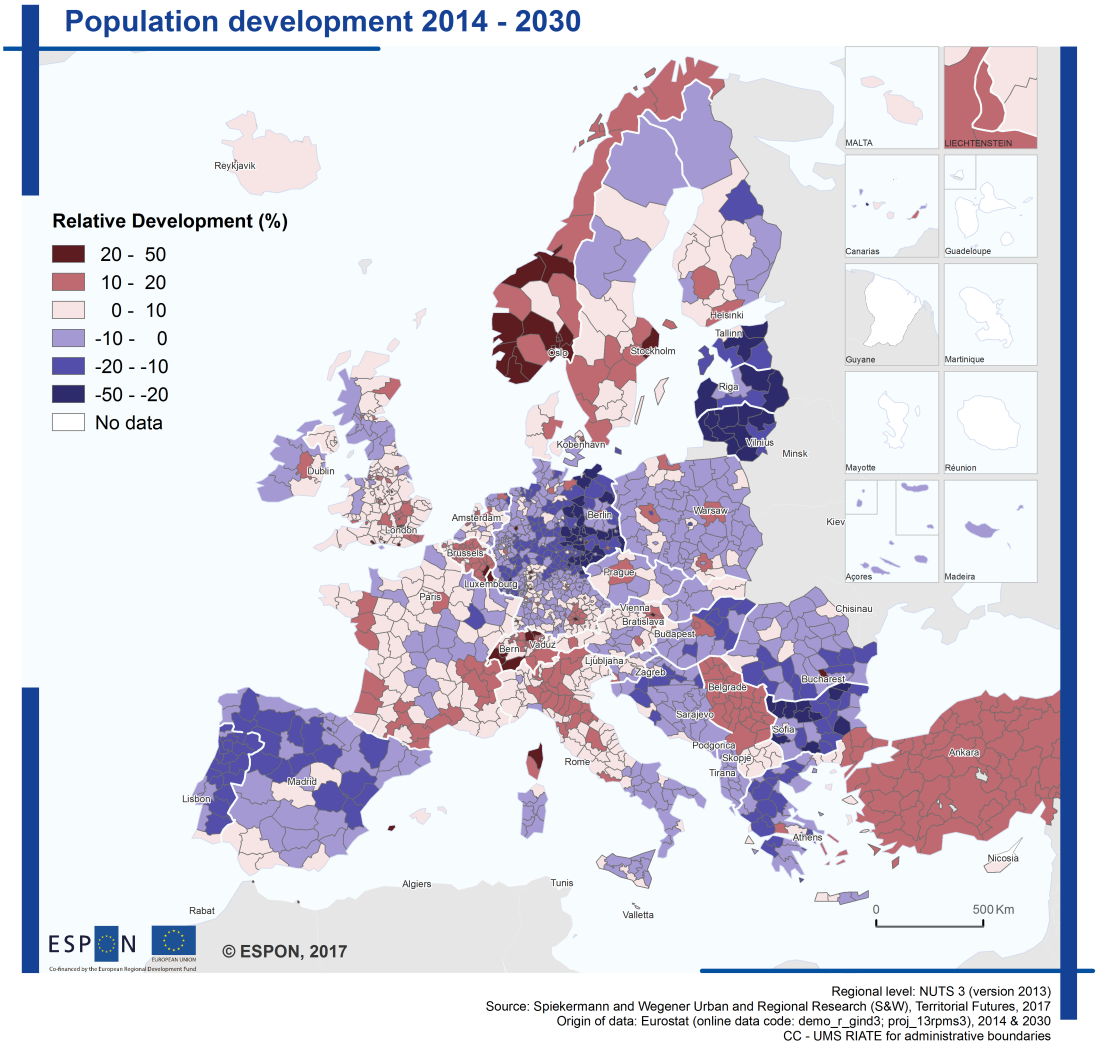
Increasing rural-urban disparities are to be expected. The highest relative population loss for 2014-2030 is expected in rural regions in eastern Germany, the Baltic States, northwest Spain, southern Italy, eastern and southern Hungary, southern Romania and northern Bulgaria. This development is mainly based on fewer young people (0-19) and working-age population (20-64) (Lüer et al., 2015). At the same time the highest population growth and increase in young people and working-age population should be seen in metropolitan areas and their surroundings in Nordic countries (Oslo, Trondheim, Malmo/Copenhagen, Stockholm, Helsinki), Western and Central Europe (Geneva, Hamburg, Luxembourg, Munich, Prague, Vienna, London/Kent), and eastern Europe (Bucharest, Athens and around Poland's major cities). However, significant population increase can also be expected in some rural areas, such as southwest France, some regions in northern Italy, Norway, southern Sweden and Ireland. At the same time, some metropolitan and urban regions will lose people, not only in Germany and the Eastern European countries, but also for example several regions in Portugal.

Europe will age as the total number of citizens in different age groups changes significantly. The number of young people (aged 0-19) will decrease by almost 6% while the decline of the working-age population will be even higher – between 2010 and 2050, the number will decrease by approximately 11%, from 309 million to 274 million people. The number of people over 65, will almost double (+88%) (Lüer et al., 2015) This implies significant changes in the demographic structure of Europe. The share of the elderly will increase from 17.5% in 2010 to 30.5% in 2050, whereas the share of the working-age population will decrease from 61.5% in 2010 to 51% in 2050. The share of young people will also decline, from 21% in 2010 to 18.5% in 2050. Only considering those over 75, their number will be even more than twice as high in 2050 (+136%, from 42 million in 2010 to 98 million in 2050). The over 75 population group will need the most care. Although increasing life expectancy and medical progress will lead to healthier elderly people by 2050, the over 75 population group will still rely on care. The old-age-dependency ratio is the ratio between old people relying on care (65+) and the

[2] Despite this population increase in Europe by 2050, the share of Europe's population in the world has been declining in recent decades and will continue declining to 2050 and beyond. In 2100, Europe (including eastern European non-EU countries) will only account for approximately 5.8% of the global population, compared to 13.6% in 1990, 10% in 2015 and approximately 7.3% in 2050 (United Nations 2015).

working-age population (20-64). The European old-age-dependency ratio will increase from 13.5% to 36% (Lüer et al., 2015). In other words, in 2010 one person aged 75+ relied on seven people of working age, whereas in 2050 one person aged 75+ will rely on less than three people in working age. This will have significant impact on pension schemes, the need for care and on the labour market.

Map 2.4 *Population development 2014 - 2030*



Migration becomes an important development factor. Net migration increased considerably from the mid-1980s onwards, while the number of live births fell. Overall, if the population of the ESPON space declines or not, will depend largely on migration. On one hand, migration can be an important factor to mitigate ageing and future workforce shortage, on the other, it can influence settlement and territorial patterns, increasing the size and importance of ethnic minority communities in urban areas, creating tensions and instability.

Increasing difficulties to stop a brain drain to vibrant global centres. In addition to a further continuation of ageing trends, there may be migration to urban centres within Europe and in other parts of the world. Vibrant economic and social centres outside Europe will grow stronger (see Figure 2.5) and new centres may emerge given the growing number of highly

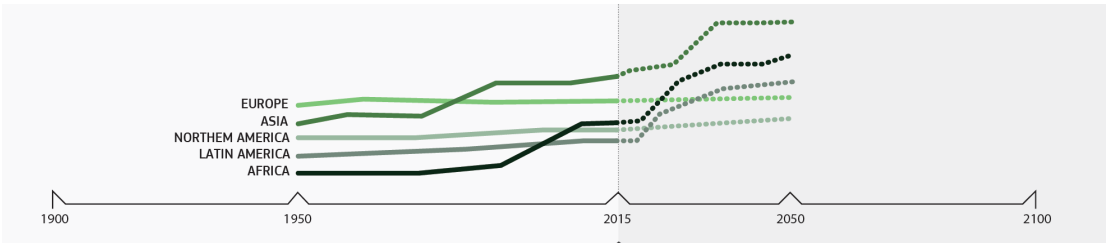
skilled young people outside Europe. In the global competition for experts these centres will increasingly become competitors to economic urban agglomerations in Europe. Attracting highly skilled people from other parts of the world to fill job openings in Europe will probably become more difficult. In the long run Europeans may increasingly consider vibrant urban centres outside Europe as attractive places to work and live. (Böhme et al., 2016; Lüer et al., 2015)

Example – Attractiveness and accessibility becoming more important in global competition.

Attractiveness and accessibility can be supported in many different ways. The online survey in the frame of this study assessed low traffic areas promoting community use of public space. This type of initiative has been ranked as the third most likely development in the online survey[3]. Examples of such public spaces are:

- Milan's Porto Nuova neighbourhood where a 5 hectare empty plot was transformed into an agricultural wheat field by American artist Agnes Denes in 2015.
- "Pla de Buits" in Barcelona, where a municipal programme is revitalising unused city lots through educational, environmental and cultural activities. The pilot superblock initiative also in Barcelona has converted 9 urban intersections into pedestrian squares with a variety of new uses.

Figure 2.5 Urbanisation and mega-cities



Source: Joint Research Centre, 2016

2.2.3 Further outlooks

The overall trend of an ageing population together with migration patterns with concentration towards urban areas, leaves some regions with severe demographic challenges. Characteristics such as the gender and age of migrants prompt different motives to migrate. Additionally, these trends trigger a need for social innovation (solving social problems in innovative ways). Furthermore, gender equality and growing female participation in the labour market and in society more generally, is important to territorial development, in particular to changing migration dynamics.

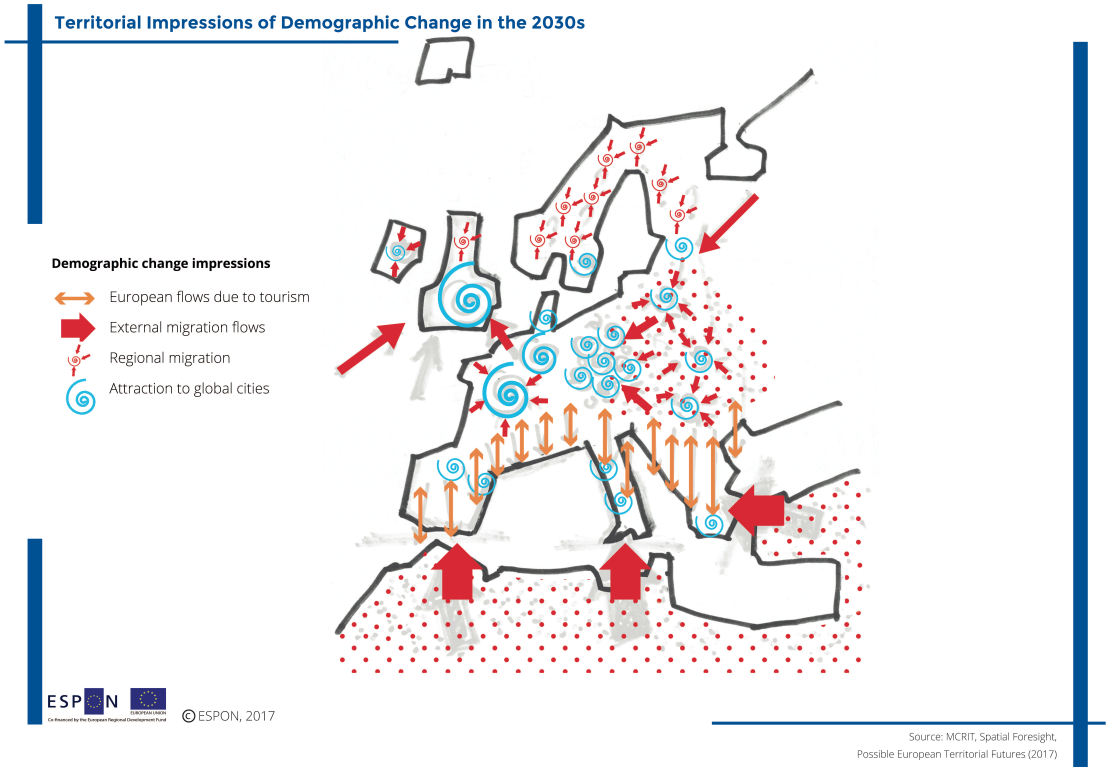
Demographic trends have another large social implication, namely increasing social inequality, both globally and in Europe. Increased social gaps between ultra-secure permanent and vulnerable temporary workers will increase economic imbalances. Common instruments of social policy, such as unemployment insurance, activation and minimum

[3] 22% of survey respondents assessed this development as "totally certain" and 41% assessed this as "very likely". In addition 24% assessed this development as totally effective and 44% as very effective.

wages, need to be adapted to new models of employment, both within Member States and at the level of the EU. A territorial impression of a demographic future for Europe, given all the trends and drivers discussed above is depicted in Figure 2.6. This figure is a rough sketch territorialising the main demographic aspects for 2030 in which migration plays a central role:

- Migration flows from the rest of the world to Europe, particularly from Southern Mediterranean regions, represented (red arrows). Europe is surrounded by areas with very young populations. In the coming decade's migration will be increasingly important for Europe. This concerns both immigrants arriving from other parts of the world, but also an increasing number of young and talented Europeans migrating to young and vibrant metropolitan areas in and outside Europe.
- Internal migration towards global cities competing to attract more creative and talented population is represented in smaller red arrows. In the case of Eastern European and some Baltic cities, people from rural sparsely populated areas continue to move towards large cities and capitals in their countries, as well as towards Western cities (red arrows, blue circles). Greater rural-urban disparities in Europe can be expected. In some areas such as Eastern Europe and Germany the metropolitan areas might also face population decline. At the same time some rural areas, such as in France, Italy or Scandinavia might see population growth.
- More intense north-south flows linked to residential tourism (orange arrows). This movements will increase all over Europe with increasing number of temporary residents, especially in large cities and most touristic areas.

Figure 2.6 Territorial impression of demographic change in the 2030s



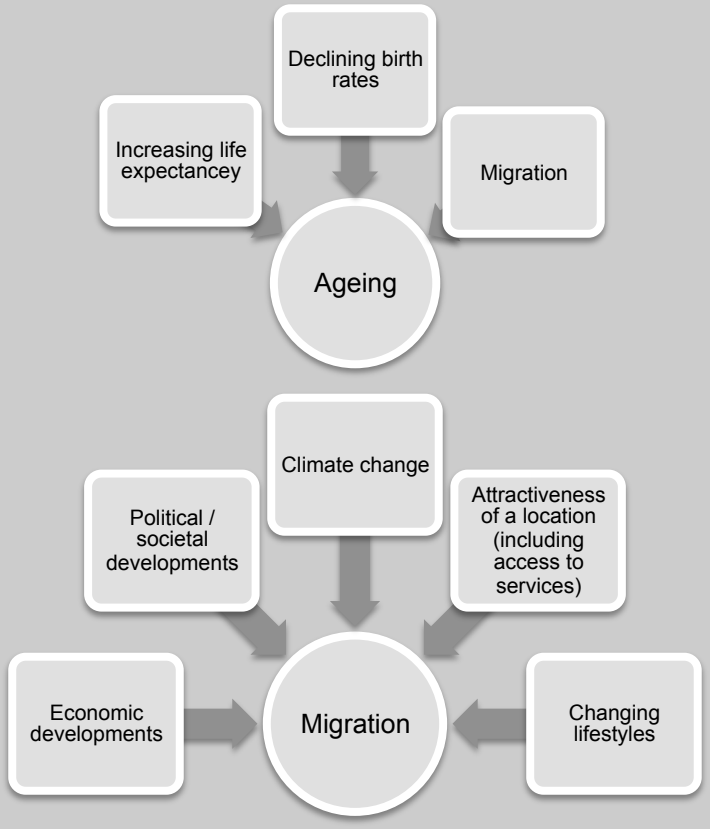
Europe remains attractive for migrants from Europe's neighbourhood, resulting in continuous migrant flows across the Mediterranean. At the same time, some Europeans might seek their fortune in other parts of the world, e.g. in vibrant young metropolitan areas elsewhere in the world.

Within Europe, two main territorial development trends may be expected. First, a flow towards areas with attractive climate and living conditions, e.g. along the Mediterranean coast. Second, a flow towards metropolitan areas – preferably with good economic prospects – which may result in a polycentric pattern of main urban nodes.

At regional levels continuous migrant flows from rural to urban nodes enforces the urbanisation of the continent, as shown by the little red arrows. Therefore cities are growing and becoming more compact and claim more space from their surroundings (sprawl) as depicted by the blue spirals.

Drivers for demographic change

The figures illustrate some drivers for demographic change, which may become relevant in further discussion of European territorial futures.



Although most of Europe's population in 2030 has been born already, demographic development patterns in the next few decades contain a number of uncertainties as outlined in the ESPAS study (European Strategy and Policy Analysis System, 2015). Developments can go in different directions from critical bifurcation points. Further developing the work of

previous ESPON studies (ESPON, 2014c), the text box shows a selection of bifurcation points depending on large scale policy decisions made in Europe or other parts of the world.

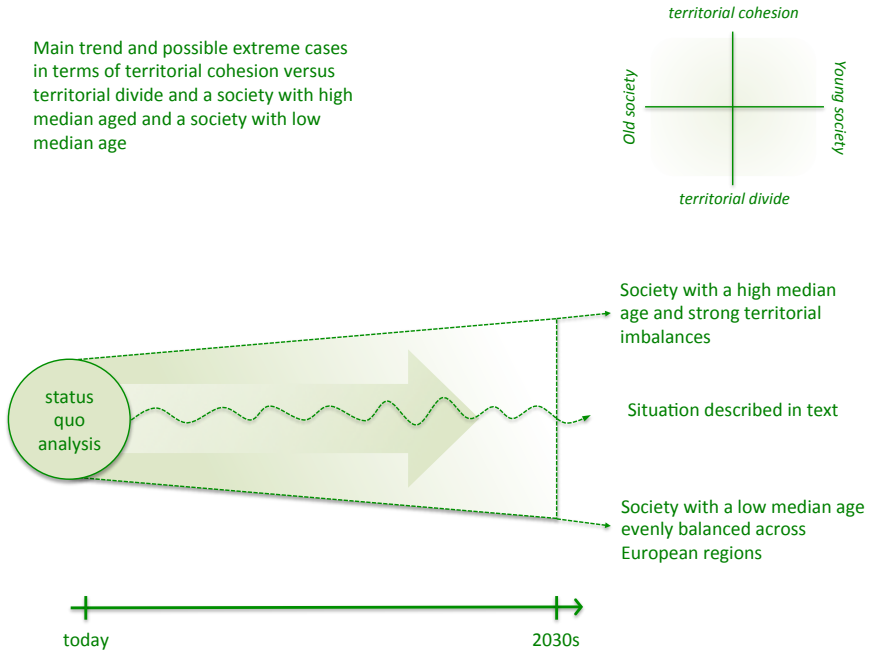
Possible bifurcation points

One of the few certainties about future developments is that they are rarely linear. There are a variety of possible bifurcation points, whether desired or not. Possible bifurcation points related to demographic developments are:

- Changes in migration flows to Europe either through changes in the causes of migration or changes in European migration policies and enforcement.
- Changes in migration flows from Europe to other parts of the world, e.g. caused by accelerated attractiveness of metropolitan areas outside Europe or deteriorating economic conditions in Europe.
- Changing migration flows within Europe, e.g. caused by restrictions on the free movement of labour.
- Changes in life expectancy with either substantially increased life expectancy due to medical breakthroughs, or decreased life expectancy for large parts of the population because of cutbacks in public health care (and or severe pandemics).

The above bifurcation points allow to discuss demographic developments presenting alternatives to the general trends presented in the previous sections (see Figure 2.7). The figure illustrates the main trends as described in the previous sections and extreme cases defining the bandwidth of possible demographic futures, following the bifurcation points as described above.

Figure 2.7 Range of possible territorial demographic futures



Source: ESPON Futures project team

The two extreme cases for demography are based on variations of the median age of society. This factor plays a central role in relation to the other demographic factors. Young persons are more likely to migrate and have a positive effect on the natural population growth.

The first extreme case is characterised by high median age levels. The ageing of society will continue and reach extreme levels in some regions leading to considerable territorial imbalances. These regions are challenges by the provision of services of general interest due to high demands e.g. for health and low levels of public funding due to limited economic activities in the regions. Other regions, however, managed to better profit from increasing median age of society, e.g. specialising in health care provision.

The other extreme case, illustrating the lower bandwidth of possible environmental futures, is characterised by a society with a relative young population. In this case the trend of ageing will be reversed for example due to influx of non-EU migrants. In this extreme case a regional balance in terms of regional age structures will be established.

3 Socio-economic developments

Europe's socio-economic development is a key concern for policy makers. The main focus is often on issues like economic growth (not least GDP) and employment. As the current economic model is facing increasing challenges and jobless growth is posing new questions, overall socio-economic development and in particular its territorial diversification are important factors in discussions about the future.

The following presents some key figures on the current situation of Europe's socio-economic development. This is followed by a section on diverse and even mutually contradicting development trends laying the ground for the next decade or two. In this context drivers for change and possible bifurcation points are also outlined.

3.1 Today's situation

The economic and financial crisis of recent years greatly impacted socio-economic development towards territorial cohesion. Prior to the crisis, regional disparities in terms of GDP, employment and the general wealth of citizens were decreasing. The socio-economic impact of the crisis has been uneven, ranging from regions that hardly experienced any downturn in their socio-economic situation and regions that are still characterised by low levels of GDP and high unemployment rates.

3.1.1 GDP

Europe's economic development has been asymmetric since the economic and financial crisis. Before the crisis disparities between and within regions were declining. However the crisis halted the reduction in regional disparities (Böhme, Holstein, et al., 2015; European Commission, 2014a).

A comparison of GDP per capita to the European average before the economic crisis (2008) and data from 2013 shows which regions improved their relative position and which did not (see Map 3.1). There is a group of countries (Belgium, Germany, Austria, Czech Republic, Hungary, Romania, Poland and the three Baltic States) where most regions improved their relative economic position in Europe. In France, Denmark and Bulgaria there are relative winners and losers. In all other countries, nearly all regions fell behind. This pattern does not coincide with overall economic performance. Low performing regions in eastern Europe gain relative position, while low performing regions in southern Europe lost most.

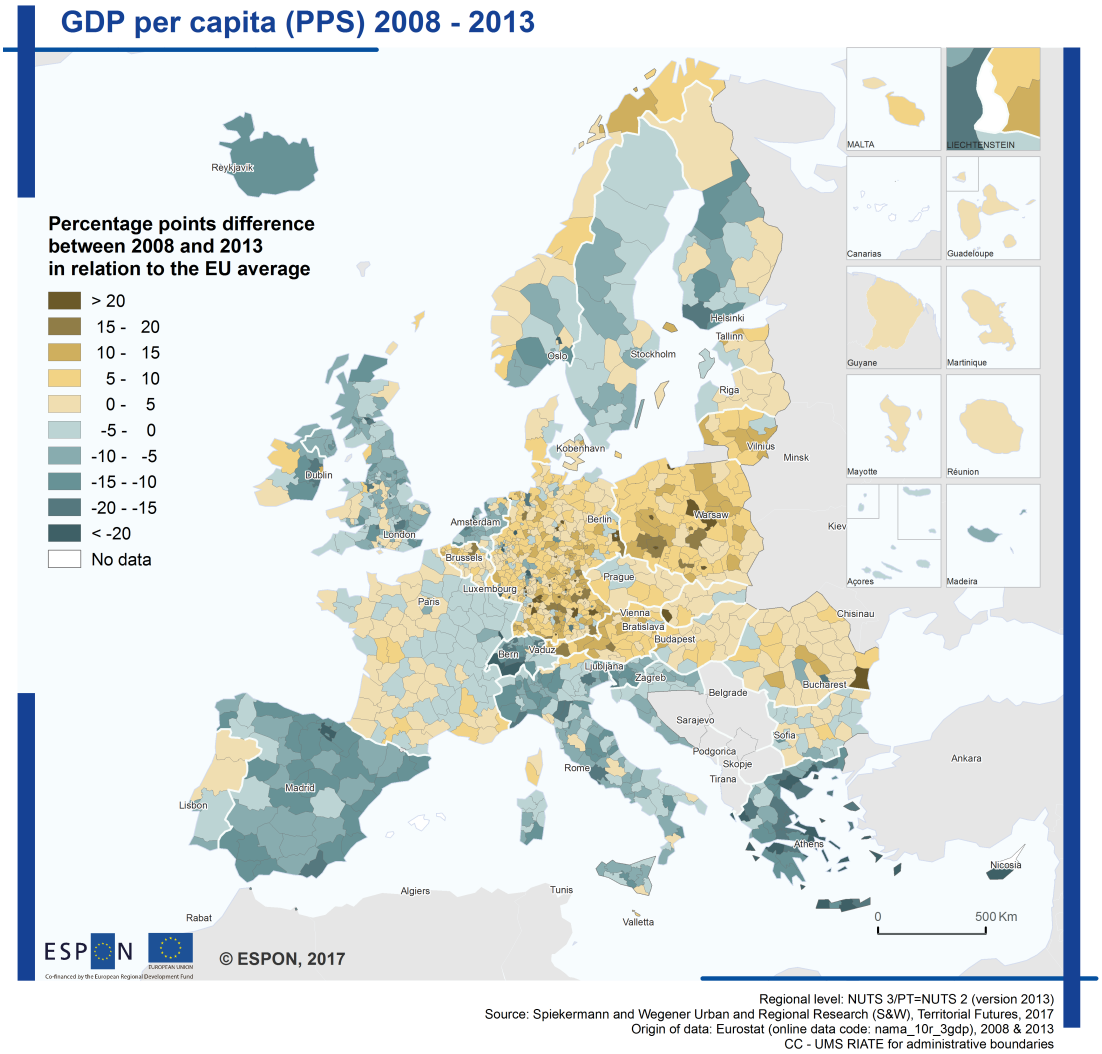
Differences within regions have also increased since the economic and financial crisis. Whereas in the Central and Alpine Region rural areas gained most, in the Danube Region, the relative position of urban areas improved most, as shown in Figure 3.1. On the other hand, the strong losses of the Mediterranean Region mainly happened in and to a lesser degree in intermediate regions, whereas rural areas were somewhat less affected.

Increasing regional differences challenge general cohesion in Europe. GDP reflects not only general economic production in a region, government budgets also depend on the economic

performance of a region. This led to increasing political tensions between and within regions during the crisis. Considering these other aspects, the territorial impact of the crisis to GDP shows a different territorial pattern. The ESPON ECR2 project concludes that urban regions are more resilient to economic shocks than rural regions. Urban and densely populated areas in most European countries have been more resistant or have recovered earlier from the crisis. According to the ECR2 study, rural and declining regions and all regions in Spain, Bulgaria, Greece, Cyprus, Ireland and the Baltic state had not yet recovered by 2012 (ESPON, 2014d).

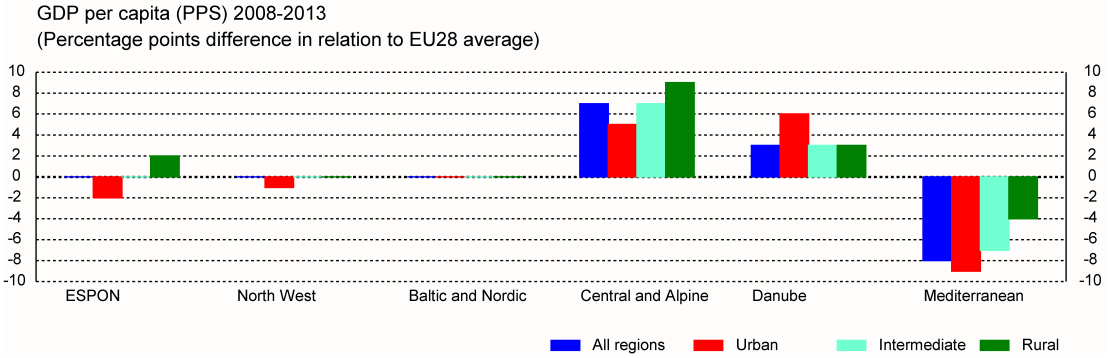
Mapping the GDP per capita over a shorter period (between 2011 and 2013) shows which regions led in recovering from the crisis. Most macro-regions except the Mediterranean are recovering economically. In North West and the Baltic and Nordic Region, cities lead the process, whereas in the Central and Alpine Region and in the Danube Region rural areas gain most in economic performance. The Mediterranean Region is still affected by the lower performance, in particular of urban regions. While in most other parts of Europe urban areas perform better than rural areas, this is not the case in the Mediterranean.

Map 3.1 *GDP per capita (PPS) 2008-2013*



Regional level: NUTS 3/PT=NUTS 2 (version 2013)
Source: Spiekermann and Wegener Urban and Regional Research (S&W), Territorial Futures, 2017
Origin of data: Eurostat (online data code: nama_10r_3gdp), 2008 & 2013
CC - UMS RIATE for administrative boundaries

Figure 3.1 GDP per capita (PPS) 2008-2013 by macro-region and urban rural typology



Source: ESPON Futures project team

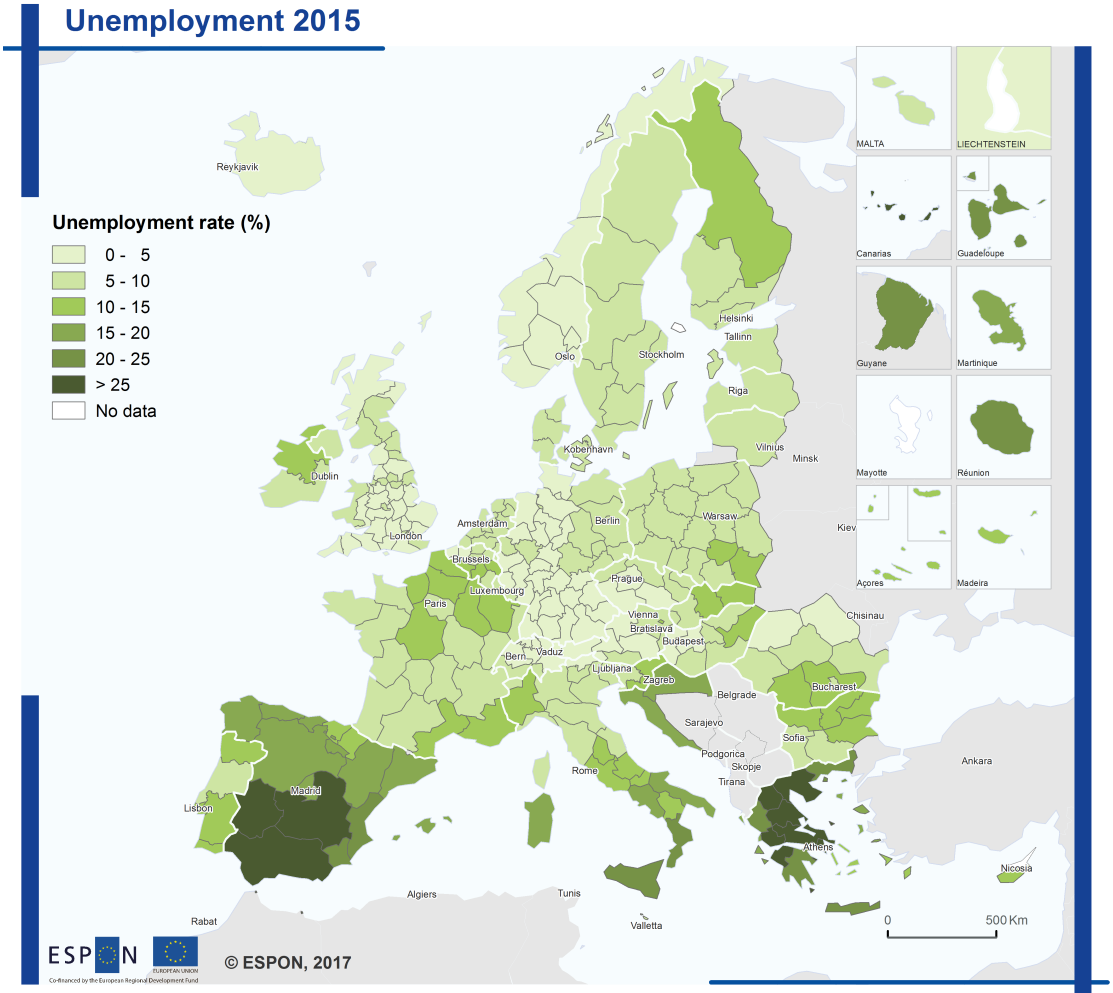
3.1.2 Unemployment

Growing wealth and knowledge skills. The above developments point to a trend that combines increased wealth, measured by world GDP per capita growth (and its expected convergence) and the growth of inequalities, measured by the distance between rich and poor in the vast majority of advanced countries. In particular, children, older people, migrant families and 'young adults' (20-24 years) are the main target of traditional and a new kind of poverty. Unemployment is currently high among the young with different levels of education and training. Indicators for youth labour market performance do not fully capture that an astonishing 15% of European 20-24 year olds that are disengaged from both work and education (NEET youth: Not in Employment, Education or Training) and risk being permanently excluded from the labour market and being dependent on benefits. The emerging social trends in Europe, such as the rising number of elderly people, migrants and single-member households means that poverty risks will persist, unless macroeconomic and educational policies for income redistribution and digital learning are implemented.

Uneven distribution of jobs and unemployment levels. Unemployment has been ranked highest among the challenges for the EU according the Eurobarometer on the future of Europe (European Union, 2016). This was mostly mentioned for southern and central European countries, but also for France, Finland and Ireland. This reflects areas with the highest unemployment rates in Europe.

The economic crisis had remarkable effects on labour markets in some countries (Map 3.2) Unemployment in 2015 was on average around 10% in Europe, but up to 30% in several regions in southern parts of Spain and around 25% in Greek regions. Most regions in Europe have clearly higher unemployment rates today than before the economic crisis. The most severe problems with rising unemployment were in all Mediterranean countries except Malta. However, regions in southern parts of the UK, Germany, western parts of Poland, in Slovakia, Hungary and Romania improved their labour market situation in this period.

Map 3.2 Unemployment 2015



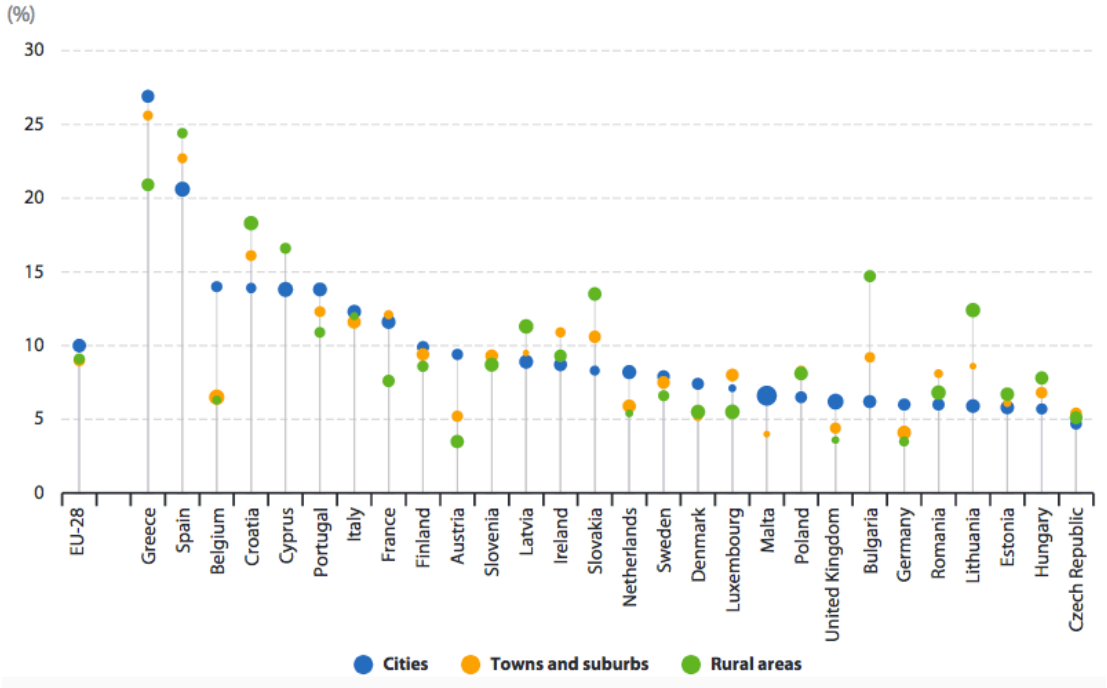
Regional level: NUTS 2 (version 2013)
Source: Spiekermann and Wegener Urban and Regional Research (S&W), Territorial Futures, 2017
Origin of data: Eurostat (online data code: lfst_r_lfu3rt), 2015
CC - UMS RIATE for administrative boundaries

At regional level, urban-rural distinctions can be noted (Figure 3.2). In western European regions unemployment rates are higher in cities, whereas in most eastern European regions rural areas have higher unemployment rates.

3.1.3 Household income

Reversed tendencies regarding social inclusion and quality of life between European regions since the crisis in 2008. Similar to the development of increasing regional disparity for GDP, the quality of life of citizens in those regions, measured by the disposable income, has varied since the economic and financial crisis. The indicator 'disposable income' gives valuable information on wealth in regions and is measured in purchasing power standard based on final consumption (PPCS) per inhabitant. So it is already adjusted to different price levels in Europe.

Figure 3.2 Unemployment rate, persons aged 15-74, by degree of urbanisation, 2015[4]



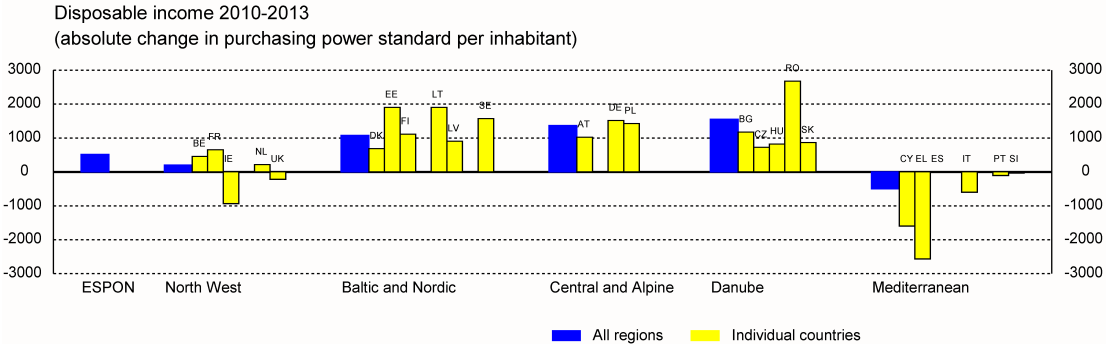
Source: European Commission and UN Habitat, 2016

As shown in Map 3.3 the spread is between more than 20,000 PPCS in the most affluent regions of Austria and Germany and less than 8,000 PPCS in the most disadvantaged regions in Bulgaria and Romania. Most regions of northwest Europe are above the European average of 15,000 PPCS. This is also true for Nordic regions.

Earlier tendencies towards territorial cohesion in terms of reducing disposable income disparities in Europe have halted or even reversed since 2008. The effects of the crisis have been asymmetric in these few years, widening north-south and between regions within countries. Greece was the most severely hit and lost around 2,500 PPCS per inhabitant in this short period (Figure 3.3). But the population in Cyprus, Spain and Italy also had to face a clear reduction in disposable income. In the North West Region, in particular Ireland, but also the inhabitants of many UK regions were confronted with diminishing income levels. Other regions in the North West as well as all regions of the Central and Alpine Region, the Nordic and Baltic Region and the Danube Region saw growing disposable income levels for their inhabitants with increases of about 1,000 PPCS per person.

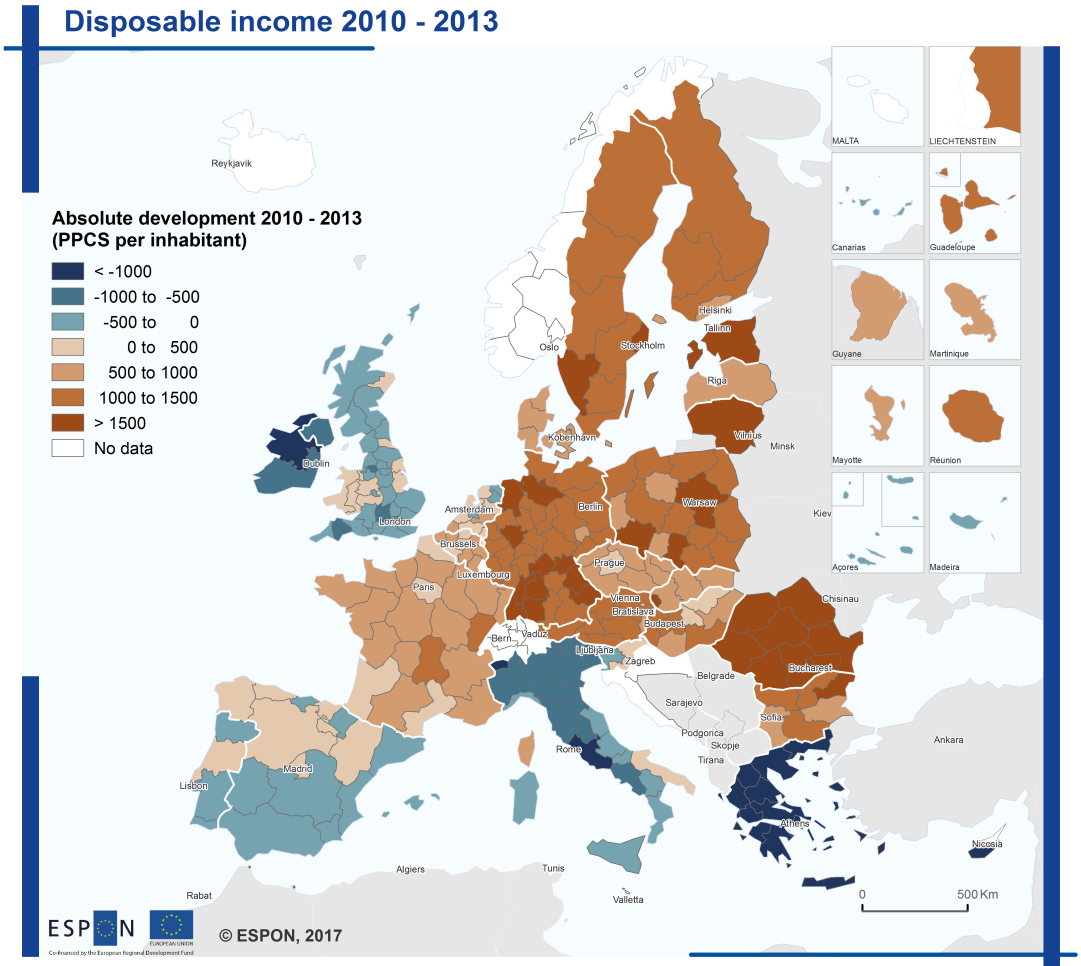
[4] The size of each circle reflects the share of that type in the national population. Population data used to calculate the size of the circles is from 2014.

Figure 3.3 Disposable income 2010-2013 by macro-region and country



Source: ESPON Futures project team

Map 3.3 Disposable income 2010-2013



3.2 Tomorrow's development

As for the next one or two decades, socio-economic developments in Europe will be largely determined by two factors, technological change (4th industrial revolution) and economic integration (geopolitics). More concretely, major trends concern (a) changing economic systems, (b) future fields of economic growth, (c) natural resources, (d) technological changes, and (e) governance (Böhme et al., 2016).

When the 2008 economic crisis kicked-in, developments towards more territorial cohesion in Europe in terms of economic development where put on hold. As shown above, there are increasing economic disparities between the Northwest of Europe and the rest, as stabilising and catching-up processes have slowed. In general terms the future might bring much of the same. However, there are also arguments that – although local and regional economies are heavily framed by their national contexts – the future might be more place specific. Areas (not only urban) which are characterised by high levels of entrepreneurship and early applications of innovation, as well as areas with an outward looking, open economy and a highly diverse population might have an advantage. While areas with a strong focus on 'traditional' industries and an inward looking and protectionist focus might be more challenged in the long run.

3.2.1 Changing geo-economic and geo-political landscapes

Geopolitics increasingly influences macro-economics and impacts peoples' wealth and jobs. Increasing signs of national protectionism and an increasing importance of convictions can play an important role in future socio-economic developments, changing patterns of foreign direct investment and labour migration. Open economies might be more exposed to these trends.

Changing geo-economic and geo-political landscape. This megatrend concerns the current shift from a hegemonic to a multipolar world of economic and political power. The shift to a multipolar world implies modifications to the economic and political landscape, with implications for Europe. In economic terms, by 2030, developing countries are expected to contribute to two-thirds of global growth and half of global output, and will be the main destinations for world trade. However, considerable changes will take place in the relative size of the world's major economies. Fast growth in China and India will see their combined GDP surpass that of the Group of Seven (G7) economies and overtake that of the entire current OECD membership by 2060. Growing competition may give rise to fragmentation and protectionism, leading to trade barriers and isolationism, even in Europe (e.g. Brexit). From a political point of view, a multipolar world may increase intra and interstate conflicts.

Key trends which point to changing geo-economic and geo-political landscapes include (Böhme et al., 2016):

- **National protectionism** in politics and policy areas in large parts of Europe, putting national interests before joint solutions to development challenges. In many countries the rising popularity of 'nationalist' parties underlines this trend. Discussions about national

interests versus international compromises also show how the mood is shifting from solidarity to recrimination - not only with British EU membership. Twisting it somewhat differently, The Economist talks about 'drawbridge uppers' and 'drawbridge downers' (The Economist, 2016) and the World Economic Forum (WEF) discusses the factors exacerbating geopolitical risks (WEF, 2017a). On the other hand, there is a need for further strengthening of network-based cooperation.

- **Increasing global tensions** will continue as multilateral institutions struggle to adjust to shifts in economic power. In a more insecure world, the geopolitical role of the EU and its outermost territories abroad will be challenged (European Strategy and Policy Analysis System, 2015; WEF, 2017a).
- **Increasing role of perceptions** and beliefs both for setting value systems and for motivating political actions, also linked to the 'war of ideas'. This can be linked to religious beliefs (Islam and Christianity) as well as to other convictions, where evidence and facts are disregarded (illiberal democracy). Both globally and within the EU, there are indications for a shift towards a declining focus on evidence-based decision making.

3.2.2 Changing economic models

Before addressing technological change and economic integration, some words on the wide range of trends pointing to changes in the prevailing economic model.

In many areas large scale societal changes (so called paradigm shifts) could alter prevailing paradigms for economic growth and wealth. The limits of growth have been discussed since at least the 1972 Club of Rome report (Meadows and Club of Rome, 1972). In recent years, different understandings of economic growth have also been discussed among academics and politicians in the western world, among others at the WEF under the heading 'beyond GDP' (WEF, 2017b). This debate is linked to shortages of natural resources while growing economic wealth is paired with increased material consumption. It is also linked to increased awareness that economic growth does not necessarily deliver employment, and to the prospect of long-term slow economic growth. The social inequalities of the current system are addressed in this context (Piketty, 2014). In extreme cases there is even talk about the end of capitalism (Randers, 2012). At the same time, there are paradigm shifts pointing to technological solutions, not least to a 4th industrial revolution.

Key trends which might point to changes in our economic model, and thus our labour markets include (Böhme et al., 2016):

- **Beyond GDP,** limits to growth and capitalist systems hint at a transition in our economic system. This discussion is mainly about the inability to account for the environment, climate change, social imbalances and well-being in the mainstream understanding of growth (Randers, 2012).
- **Peak of everything** implies a shortage of resources. Several resources are clearly facing depletion, due to population growth, environmental stress, etc. (Institute for Futures Studies and Technology Assessment, 2014). This is also linked to expected

increases in global energy demand of 40% by 2030, raising issues of energy security and resources (European Commission, 2012). Royal Dutch Shell (2013), a global group of energy and petrochemical companies, stresses that renewable energy might not be enough to keep up with increased energy needs, meaning that traditional energy sources will remain important for the global economy.

- **Decoupling growth & jobs** focuses on the phenomenon of jobless economic growth, which may mean high unemployment even with economic growth and/or that labour shortages due to ageing do not threaten economic growth. However, this will raise issues of economic distribution. The decoupling of economic growth and employment is partly linked to the role of the financial industry in generating economic growth, and partly to technological progress changing labour market needs.
- **Slow growth** shows that global growth continues, but at a sluggish pace as capital markets do not match markets for goods and services. While the IMF warns that slow growth leaves the world economy more exposed to risks, others point to resources and climate conditions, which imply that economies can no longer grow at the same speed as they did in recent decades. So, slow growth is here to stay for the foreseeable future.

3.2.3 Emerging new socio-economic models

Evolving social complexity and human consciousness influence socio-economic models. Socio-economic models follow changing lifestyle patterns and take account of society's complexity and human consciousness. Following the tendencies to go beyond GDP, decoupling growth and jobs and more awareness about resources, new socio-economic models may be emerging without society being aware of them. Great economic paradigms shifts in human history not only bring together communication revolutions and energy regimes in powerful new configurations that change the economic life of society, but also transform human consciousness by extending an emphatic drive across wider temporal and spatial domains, bringing human beings together in larger metaphoric families and more interdependent societies (Rifkin, 2014).

Example: Peer-to-peer production: making better use of material resources

An industrial ecosystem is a local collaboration where public and private enterprises buy and sell residual products, resulting in mutual economic and environmental benefits. This emerging development in some industrial areas of Europe has been ranked as an effective development for the future if implemented all over Europe. 12% of respondents assessed this development as totally effective and 65% as very effective. Respondents emphasise that this development is particularly effective as it suggests a circular model in which multiple stakeholders improve their competitiveness. An example of this development can already be found in Denmark.

Kalundborg Symbiosis in Denmark pioneered an industrial ecosystem in which the by-product of one enterprise is used as a resource by another enterprise in a closed cycle. For instance, organic waste from Novozymes is made into agricultural fertilizer; smoke from DONG is made into gypsum at Gyproc. It was estimated in 2010 that the system helped save 3 million m^3 of water through recycling and reuse,

plus biogas was made out of yeast slurry from the production of insulin. According to promoters, the Symbiosis was founded on human relationships and fruitful collaboration between employees.

Bringing together changing lifestyle patterns as well as making better use of material resources and handling growing amounts of waste, developments in the circular economy and in particular the sharing economy point to possible major trends – at least in the western world. Key trends include (Böhme et al., 2016):

- **Circular economy** highlights the valuable materials leaking from economies. In a more circular economy, the value of products, materials and resources is maintained for as long as possible and waste is eliminated. Society moves towards more sustainable development, as well as a low carbon and more resource efficient economy. Transition to a more circular economy requires changes throughout value chains, from product design, through production or remanufacturing, distribution and consumption to collection and recycling. In other words, such a transition requires new business and market models, new ways of turning waste into a resource and new consumer behaviour (European Environment Agency, 2016).
- **Sharing economy** and collaborative communities refer to a hybrid market model focusing on access rather than ownership and referring to peer-to-peer sharing of goods and services. In many regards the sharing economy is considered as one pillar of a circular economy. Prominent examples are car-sharing and Airbnb. The current system of goods and services may shift from being mainly business-to-consumer to being consumer-to-consumer with consumer empowerment and a switch from ownership to leasing or sharing (European Commission, 2014b).
- **Ecological awareness** refers to a shift towards the use of natural resources in a more sustainable manner and a focus on renewable energy (BMU, 2012). This shift is accompanied by increasing focus on blue and green growth (see chapters 4 and 5).

Example – Governance responses to a sharing economy, formalising the market

A sharing economy is already emerging today for a selective but growing number of products and services, such as bike sharing schemes and temporarily subletting rooms and apartments for tourists. These are not mere grass root developments, but governments and other actors are increasingly shaping these developments creating sharing economy markets. This development has been ranked as the most likely future development in an online survey. 17% of respondents assessed this development as totally certain to happen in the future and 55% indicated that this is very likely to happen. An example can be found in some European capitals.

Paris has negotiated with Airbnb the collection of a €0.83 local tourist tax from apartment owners; in Amsterdam, guests booking through Airbnb will pay up to 5% of the listing price; in Lisbon, the tax is €1 per person per night. While Airbnb collects local tourist taxes it provides municipalities with exhaustive listings of tourist flats in the market, allowing for identifying informal and possibly illegal offers.

While public sector and governance processes play important roles in facilitating changes in almost all of the above trends, there are increasingly also limits to what the public sector can achieve. These limits are framed financial capability with increasing public debts as well as the changing role of the public sector in a (digital) society largely driven by corporations.

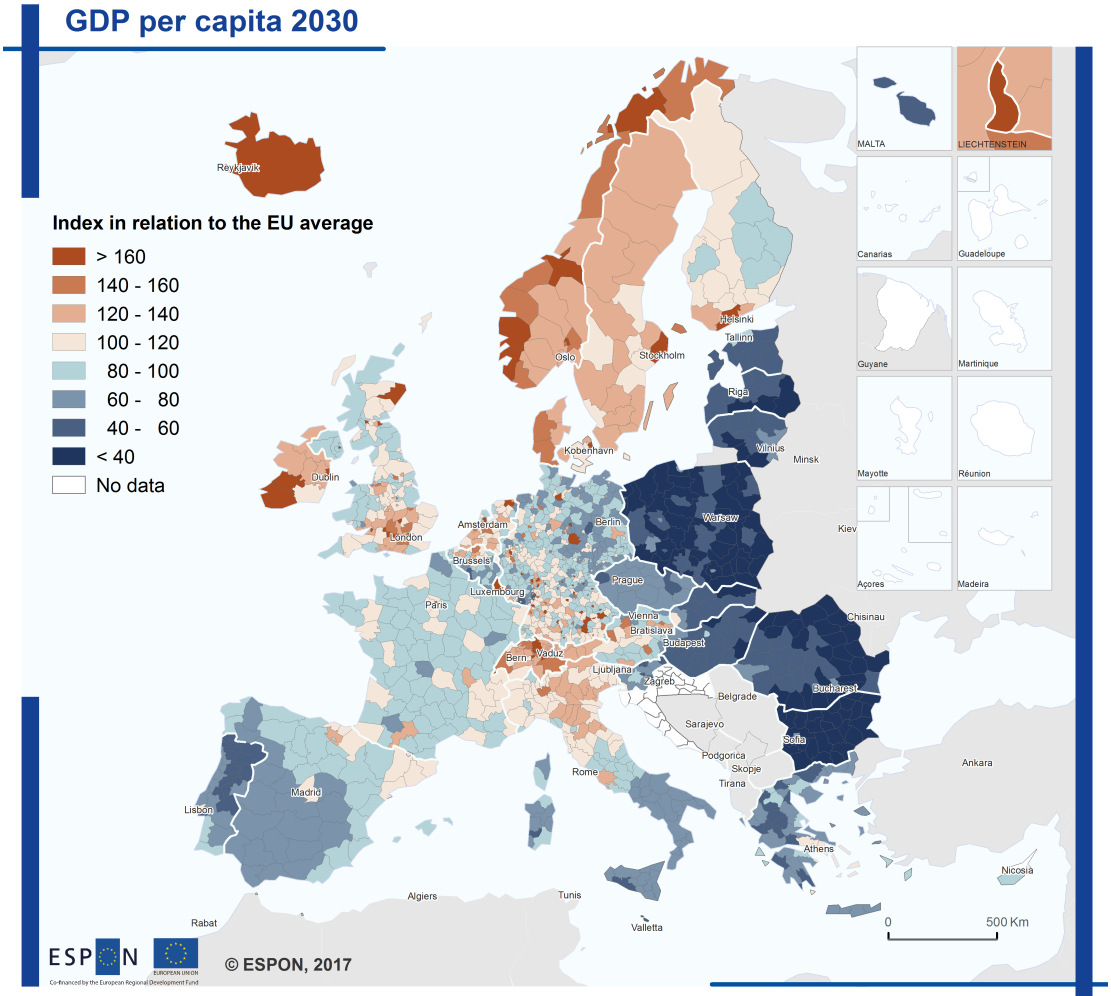
- **Increasing public debts** are a constraint on fiscal and policy options up to 2030. Authorities may not be able to react to trends due to scarce resources. As part of this, Europe will face challenges integrating social objectives (Vision Europe Summit, 2015).
- **Changing roles of corporate and public players** address issues on who owns information, who provides standards, and even on the management of public goods in the long run. This concerns the internet as well as other public domains.

Technology trends impacting socio-economic development are addressed in chapter 5.

3.2.4 Socio-economic developments in Europe

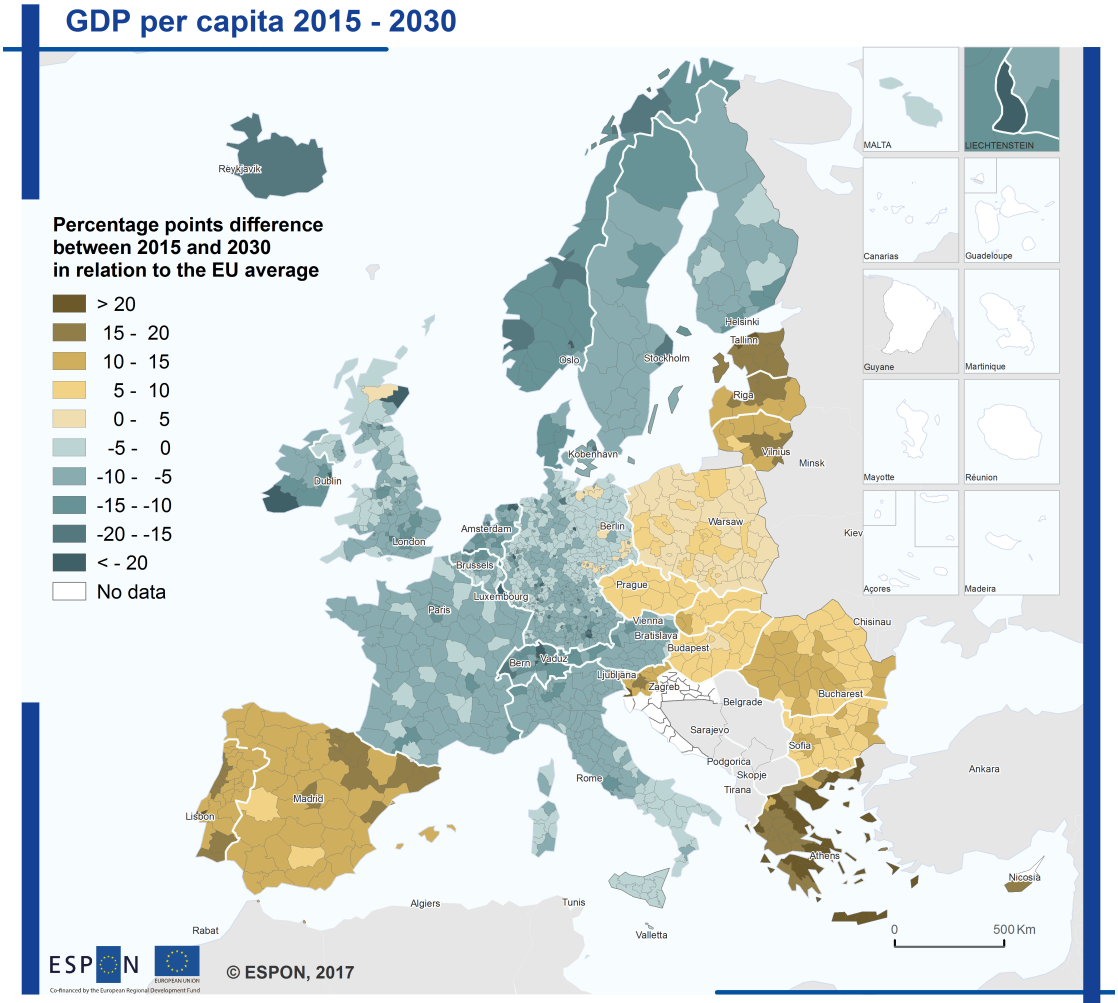
Following the above trends, any prognosis on socio-economic development in Europe has to be handled with great care. Map 3.5 depicts the forecast for GDP development between 2015 and 2030. Comparing forecast GDP development between 2015 and 2030 with the current situation depicted on Map 3.1 shows that regions currently falling behind, such as Greece, Spain and the Baltic States are predicted to gain most relative to EU average GDP between 2015 and 2030. However, high relative levels translate only slowly into the high absolute numbers needed for convergence.

Map 3.4 GDP per capita 2030



Regional level: NUTS 3 (version 2006)
Source: Spiekermann and Wegener Urban and Regional Research (S&W), Territorial Futures, 2017
Origin of data: SASI Model
CC - UMS RIATE for administrative boundaries

Map 3.5 GDP per capita 2015 - 2030



Regional level: NUTS 3 (version 2006)
Source: Spiekermann and Wegener Urban and Regional Research (S&W), Territorial Futures, 2017
Origin of data: ESPON ET2050, 2015
CC - UMS RIATE for administrative boundaries

3.2.5 European integration changes

In addition to the sector changes discussed above, political developments concerning EU integration may change the future and socio-economic development in Europe depicted above. The following briefly hints at possible alternative socio-economic developments in case of increasing European disintegration.

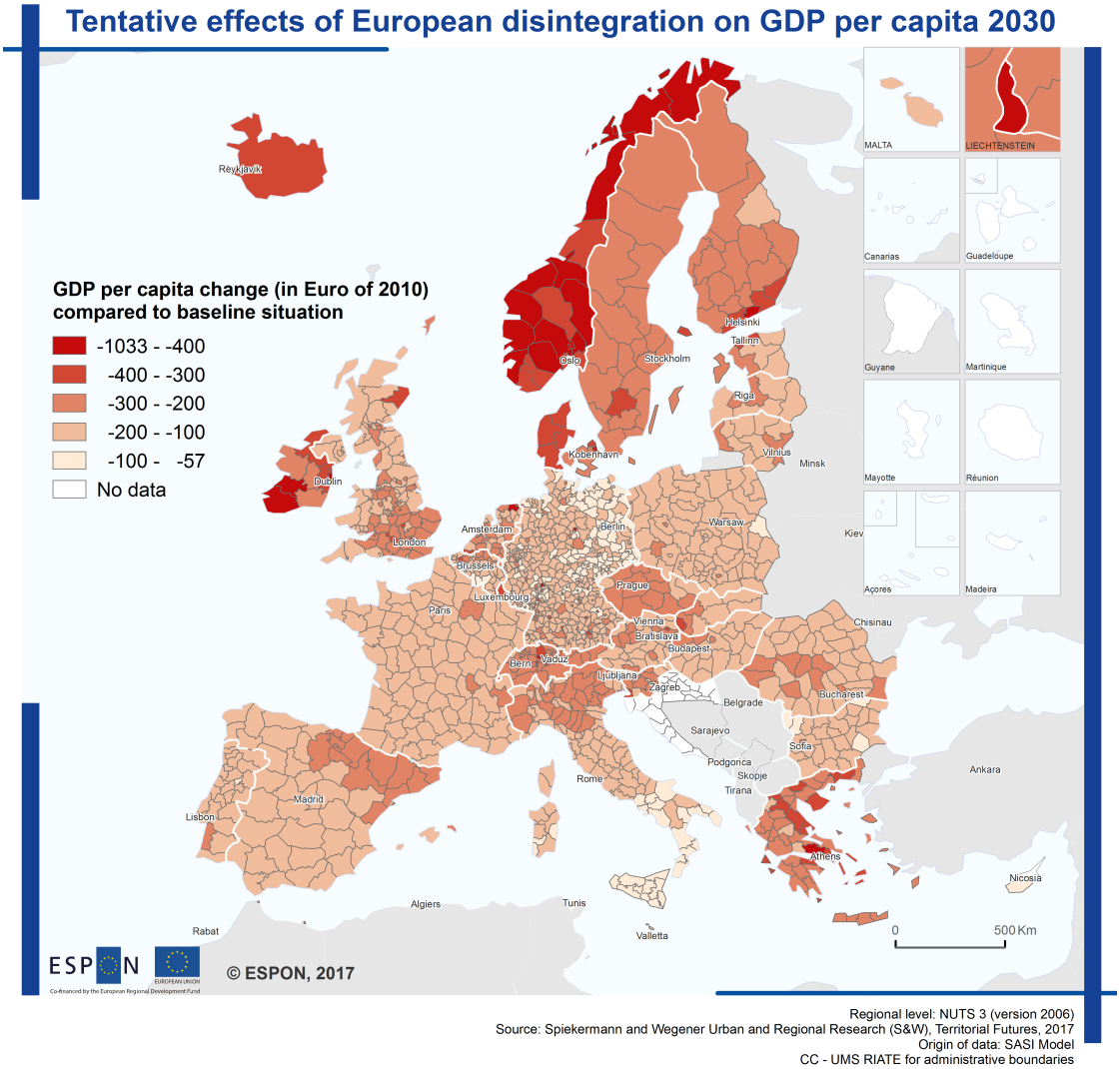
European integration was the main trend of the past decades. The number of EU member states grew considerably to 28 nowadays. The Single European Market was fully implemented, trans-European transport networks were and will be further developed, political, social and cultural barriers were reduced. This integration process is also true for the relationships of the EU with non-EU countries in Europe and neighbouring countries in Africa and the Middle East. However, there are signs that the European integration processes might come to a halt or even might be reversed. The Brexit is the most prominent case example for this. However, the recent and ongoing controversial discussions about financial support mechanism for the losers of the economic crises, about a joint handling of the refugee issue,

about cohesion police, i.e. about solidarity in general in Europe show that further European integration must not necessarily the main trend of the years to come.

To analyse the direction of change a reduced European integration would have, a sensitivity analyses has been made by using the SASI model. Two variants of an exploratory scenario on less integration were implemented in which the only assumptions changed are increasing border waiting times at EU internal and external borders and a different degrees of re-increasing political and cultural borders between countries in Europe.

The effects of disintegration processes in Europe are reductions in economic growth in all regions of Europe, i.e. in such a situation the GDP per capita would be lower everywhere than compared with a continued integration path (Map 3.6). Highest reductions might happen in the Nordic countries, Ireland and Greece. But also several regions in the UK, in northern Spain, in northern Italy, Switzerland, Austria, the Netherlands, Czech Republic, Slovakia and Bulgaria would see economic losses compared to a situation with continued integration. Less negatively affected would be most regions in France, Germany and Poland.

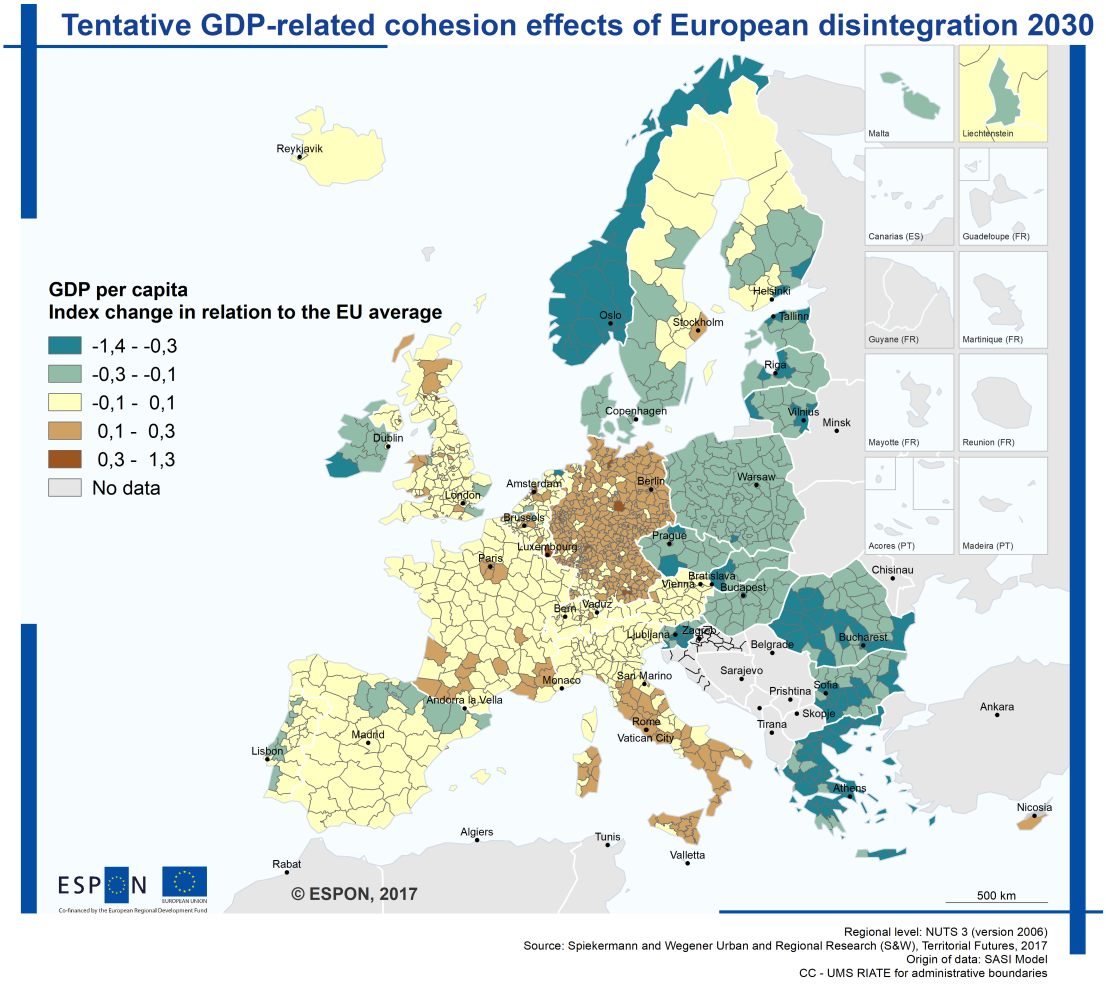
Map 3.6 *Tentative effects of European disintegration on economic performance*



Regional level: NUTS 3 (version 2006)
Source: Spiekermann and Wegener Urban and Regional Research (S&W), Territorial Futures, 2017
Origin of data: SASI Model
CC - UMS RIATE for administrative boundaries

An impression on the territorial distribution of tentative changes in terms of GDP per capita compared to the EU average is shown in Map 3.7. The impacts of disintegration on territorial cohesion are negative as many of the lagging regions will have to face stronger reduction, i.e. fall behind compared to the European average. These are mostly regions in eastern and south-eastern Europe, however, also several regions in northern Europe would lose compared to the European average. Most of the stronger regions will also lose out in absolute terms but gain in relative terms compared to the European average. This would particularly be true for most regions in Germany and middle and southern parts of Italy. Other countries such as Portugal, Spain, France, Switzerland and Austria would not change their position, i.e. the cohesion effect would be neutral here.

Map 3.7 *Tentative GDP-related cohesion effects of European disintegration 2030*



Regional level: NUTS 3 (version 2006)
Source: Spiekermann and Wegener Urban and Regional Research (S&W), Territorial Futures, 2017
Origin of data: SASI Model
CC - UMS RIATE for administrative boundaries

Following ESPAS (2015), until 2030, European economies will start to converge again due to a positive trade balance, rising exports and increased consumption associated with a moderate rise in wages. Although several million new jobs will be created, this will not be sufficient to absorb high unemployment in particular in Southern Europe. Indeed, industrial employment is even expected to fall to 13% of GDP in 2030, if the decline in global competitiveness persists (European Strategy and Policy Analysis System, 2015: 51).

At the same time, Europe is not an isolated place and needs to respond to the fact that the world's economic centre of gravity most likely will shift further to the emerging world. By 2030, Asia is projected to account for 66% of the global middle class and for 59% of middle class consumption (WEF, 2016).

3.2.6 Further outlooks

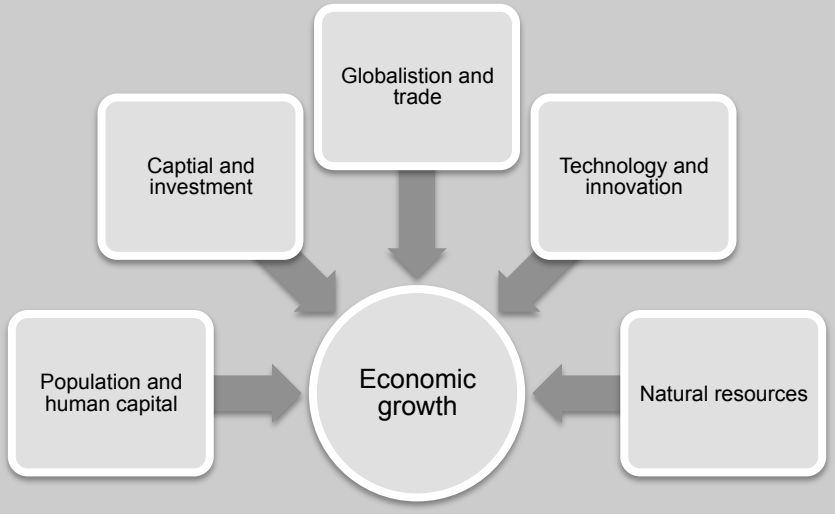
Socio-economic developments are driven by a number of factors. The text box below addresses some of the key drivers for economic growth in general. As changing economic models also play an important role when discussing future developments, the textbox also addresses drivers which will impact on business models.

A sketchy territorial impression of a likely development until the 2030s, following the trends and drivers as discussed above, is shown in Figure 3.4. It shows a Europe in which borders between countries or groups of countries are more pronounced than today. Key messages shown in that figure include:

- Borders between countries or groups of countries are more pronounced than today. The Single Market remains fragmented.
- Socio-economic differences turn Europe more into a sort of archipelago underlining low levels of territorial cohesion and major macroeconomic disparities. Different colours represent different income levels (from red to dark blue)
- To some degree metropolitan areas (blue circles) stick out in economically weaker territories.
- Links to global networks and markets point in divergent directions. While German trade grows in relation to Asia, on the one hand, Iberian countries towards the Caribbean and Latino America, UK towards the Commonwealth and the rest of the wolf (arrows).

Drivers for economic change

The figures illustrate some of the drivers for socio-economic change based on drivers for economic growth (European Strategy and Policy Analysis System, 2015), which may become relevant in the further discussion of possible futures for Europe.



While all five factors are important, demographic development, technological change and international economic integration may be of particular relevance for Europe's socio-economic development in coming decades.

In addition, the WEF (2016) also identifies drivers which are expected to impact industry business models in the coming decade.

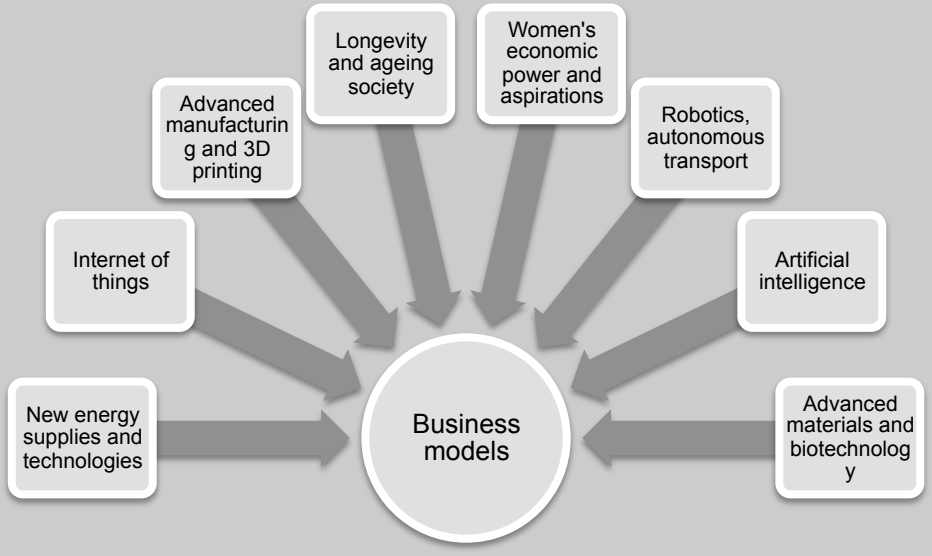
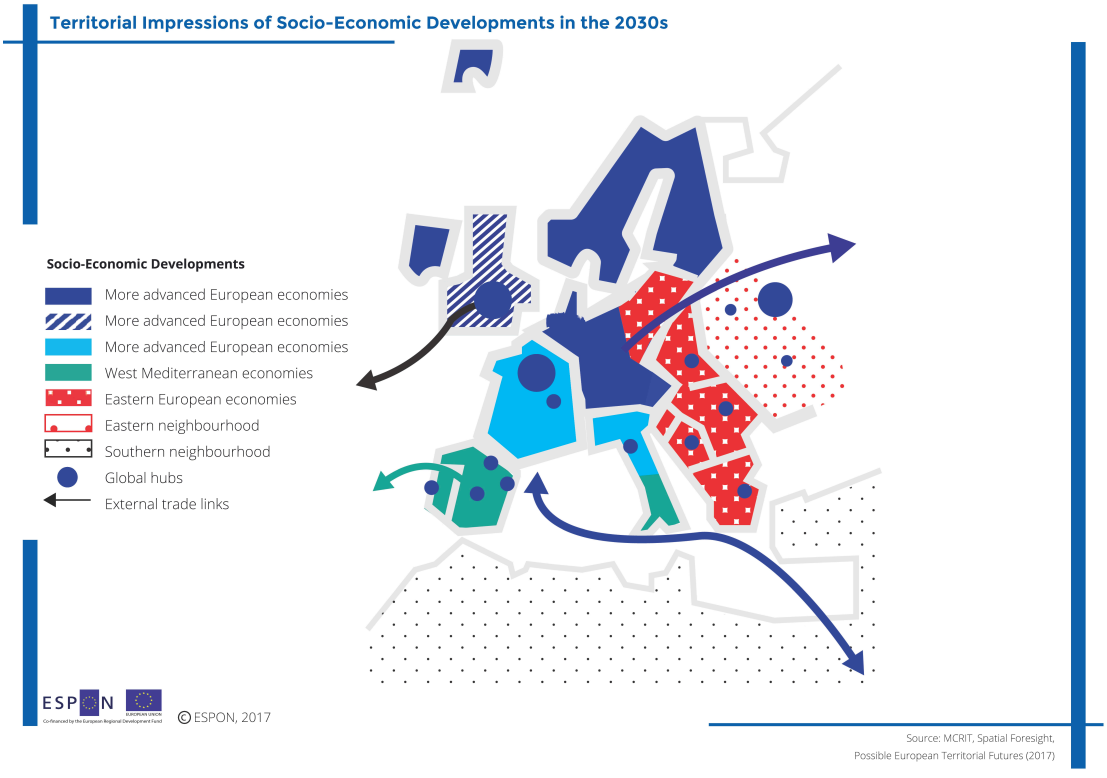


Figure 3.4 Territorial impressions of socio-economic developments in the 2030s



Europe's socio-economic development until 2030 is connected to major uncertainties, some of which are outlined in the ESPAS study (European Strategy and Policy Analysis System, 2015). In particular, factors such as global economic integration and technological changes can lead to very different developments as critical bifurcation points emerge. Further

developing the work of previous ESPON studies (ESPON, 2014c), the text box shows a selection of bifurcation points depending on large scale policy decisions made in Europe or other parts of the world.

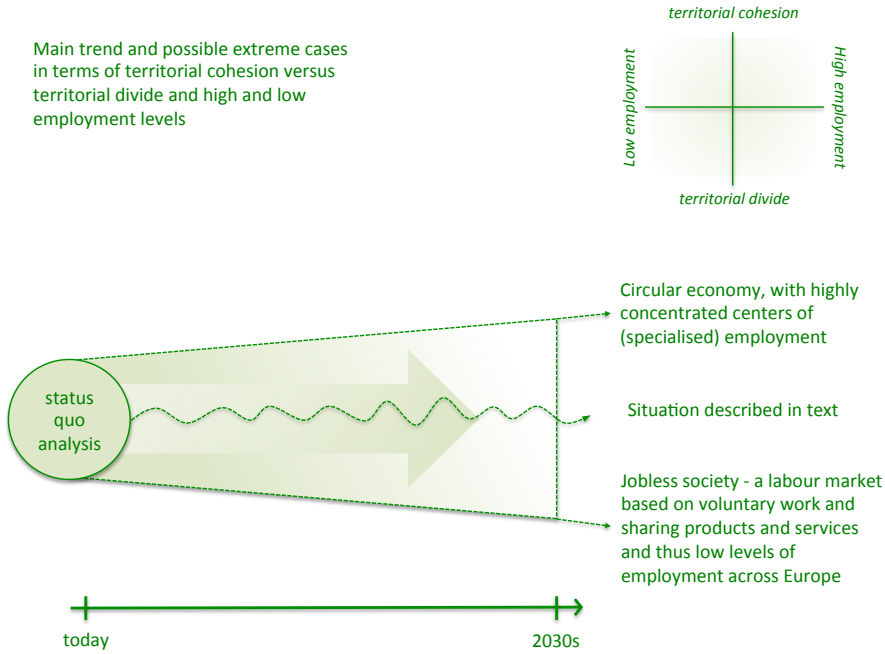
Possible bifurcation points

One of the few certainties about future developments is that they are rarely linear. There are a variety of bifurcation points where developments can take different turns, desired or not. Possible bifurcation points related to socio-economic developments are:

- Changing production systems and levels of productivity, such as technologies allowing new levels of decentralised and tailor-made production through 3D-printing.
- Disruptive technological developments and their societal acceptance, such as artificial intelligence and robotics.
- Changes in international trade, including those caused by increased protectionism, or new trans-continental trade agreements.
- Changing value systems concerning economic developments and related societal behaviour, including environmental and social concerns.
- Radically decoupling of economic growth and job creation.
- Changing levels of demand, such as those caused by a rapidly globally growing middle class or dramatic demographic changes in Europe.
- Radical changes in energy production or supply leading to long periods of very costly or very affordable energy.

The above bifurcation points allow to discuss socio-economic developments presenting alternatives to the general trends presented in the previous sections (see Figure 3.5). The figure illustrates the main trends as described in the previous sections and extreme cases defining the bandwidth of possible socio-economic futures, following the bifurcation points as described above.

Figure 3.5 Range of possible socio-economic futures in the 2030s



Source: ESPON Futures project team

The two extreme cases for socio-economics are based on variations of regional employment levels – a well-functioning labour market without structural shortage of labour or structural unemployment. Employment plays a central role in relation to the other socio-economic factors. Regions with high employment levels tend to have higher levels of wealth and disposable household income.

The first extreme case is characterised by highly concentrated centres of (specialised) employment. Clusters of industrial symbiosis will be formed to optimise residual streams. This would mean clusters of all types of enterprises from high-tech to low-tech and all supporting service related enterprises e.g. expert consultancy to high-tech companies as well as cleaning services. This would imply that all clusters support all kinds of employment and thus have high employment levels.

The other extreme case, illustrating the lower bandwidth of possible socio-economic futures, is characterised by a jobless society. Employment will be rather on return for goods and serviced than for money. Furthermore the society may rely more on voluntary work. This model would be implemented all over Europe supporting the internal market and thus vanishing regional disparities.

4 Environment & climate change

Environmental qualities are different geographically and in all cases challenge the available resources. Europe's lowlands, mountain areas, sparsely populated and coastal zones have specific natural resources and assets.

Climate change is an important factor in increasing differentiation in environmental qualities. Some areas may be dryer, while others experience more precipitation and floods. Climate change is among other caused by today's energy production mainly based on fossil fuels. Therefore this chapter look beside environmental qualities and climate change also in the production of renewable energies.

4.1 Today's situation

Our common environment continues to be under threat from a loss of land to urban development and infrastructure. Urban sprawl, soil sealing – and hand in hand with that, fragmentation of the environment (see map below) – are still increasing around most urban areas in Europe. Certainly, there are considerable variations between countries and regions, not least due to different patterns of land use, settlement structures and population densities.

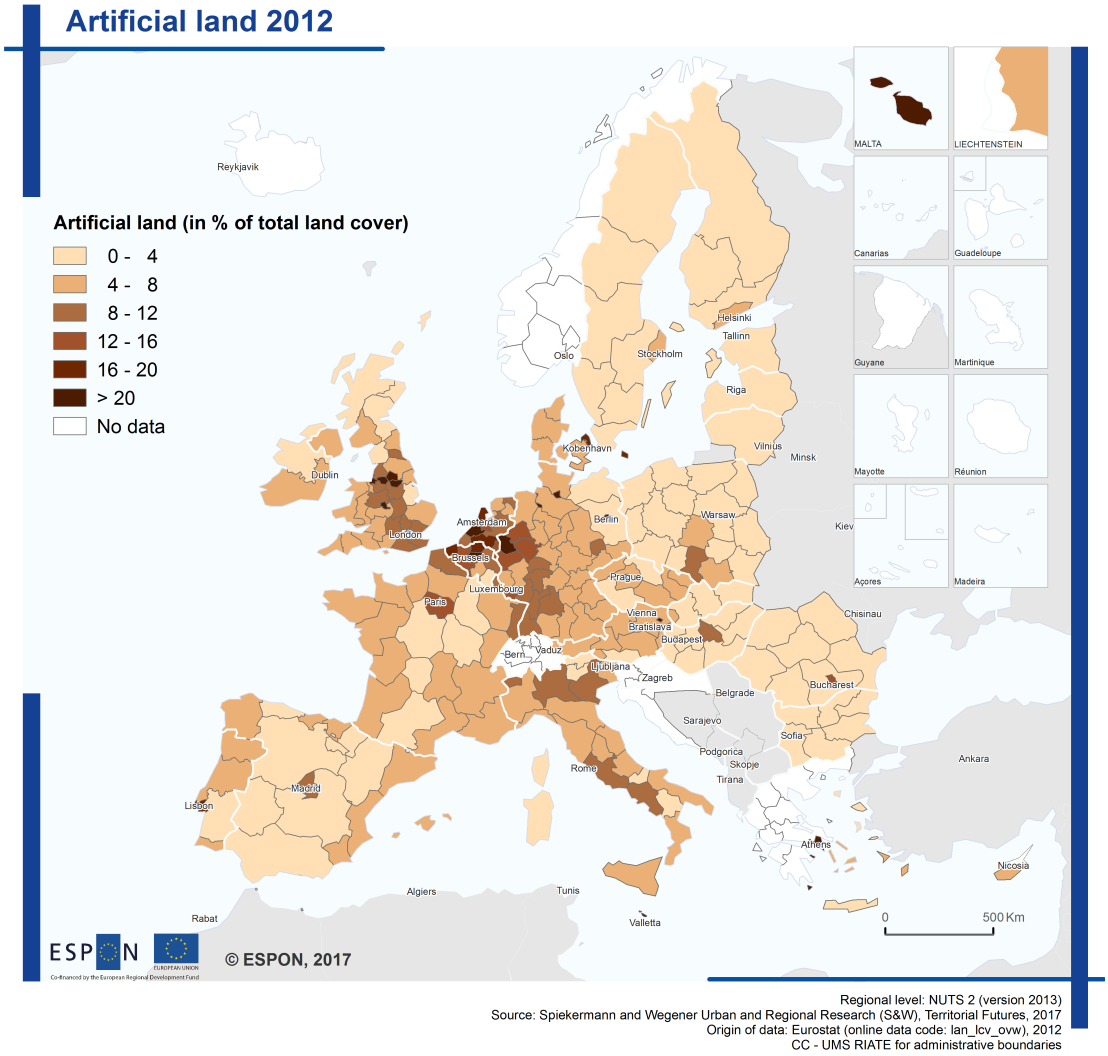
4.1.1 Artificial land use

With increasing urbanisation and sprawl as well as continuous up-scaling of agriculture some natural resources, including natural heritage are becoming scarce. The principal indicator of artificial land can highlight these regional environmental qualities.

High levels of artificial land use in the most urbanised areas. The share of artificial land (see Map 4.1) shows the extent to which different regions in Europe have used land for buildings, infrastructure and other non-natural land uses. Also here, the territorial pattern in 2012 reflects the location of large European metropolitan areas and other higher density territories, but also less intensive land use in the Nordic and Baltic Region, the Danube Region, and many parts of Poland and inland Spain.

Increasing levels of artificial land use outside the most densely populated areas. Recent increases in artificial land use is contrary to today's situation of regions with high shares of artificial land. Whereas regions with an already intense artificial land use have only had slight increases, with a few exceptions in the UK and Belgium, an intensification artificial land use is happening in particular in Eastern Europe and some coastal areas in southern Italy and Spain. In particular, for Eastern Europe, more intense use of land for buildings and infrastructure can be considered as a proxy for economic development in these regions.

Map 4.1 Artificial land 2012



Regional level: NUTS 2 (version 2013)
Source: Spiekermann and Wegener Urban and Regional Research (S&W), Territorial Futures, 2017
Origin of data: Eurostat (online data code: lan_lcv_ovw), 2012
CC - UMS RIATE for administrative boundaries

4.1.2 Climate change

A major concern for territorial development is climate change and measures for mitigation and adaptation at all geographical levels. Different regions in Europe have different vulnerabilities to climate change. Whereas some parts of Europe will have to deal with more water and a rising sea level, other parts are challenged by more drought. Climate change not only impacts nature, seasons and natural hazards but entails many political, economic and social consequences, e.g. water supply. The more challenges a region faces, the more vulnerable it is to climate change. While the issue of a rising sea level affects the North Sea in particular, due to a lack in capacity it is Southern Europe that will be most vulnerable to the impacts of climate change (Lüer et al., 2015).

Climate change has been on the policy agenda for several decades, however the effects of human actions on the global climate continue with increasingly extreme impacts (European Environment Agency, 2017). Regional differentiation can be depicted on different levels.

Regions with severe environmental problems are more vulnerable. This can be regions with high levels of air pollution, or risks of flooding, desertification or deforestation. Taken

together, Europe's southern, eastern, coastal and mountain regions are among the most vulnerable to climate change (ESPON, 2011a). Climate change is likely to have particularly severe physical impact on Atlantic coasts in the north of Europe, where a sea level rise and increasing river floods are to be expected. Furthermore, some mountainous regions may find winter sport tourism threatened and local ecosystems change. Generally, increasing extreme weather events and risks to fragile ecosystems, may impact biodiversity in large parts of Europe.

The socio-economic effects of climate change are higher in more populated areas. Densely populated areas and cities are in particular vulnerable to climate change. This is partly because of higher numbers of people and economic activities affected in these areas, and partly because the concentration of human and economic activities contributes to increased greenhouse gas emissions and consequently climate change.

Capacity to adapt to climate change is higher in wealthy Northern Europe. Addressing climate change challenges also depends on the capacity and willingness of the general public to invest in climate adaptation measures. The general capacity to adapt to climate change overlaps only partly with the most vulnerable areas (ESPON, 2011a). The adaptive capacity, taking together the economic, infrastructure, technology, knowledge and awareness and institutional capacity, seems to be highest in northern Europe including the Alpine regions. Southern and eastern European regions and cities have the lowest adaptive capacity. This picture largely corresponds on the overview of European countries with national adaptation strategies, plans, monitoring, reporting and evaluation systems. There are strategies and plans in western, northern and alpine countries as well as Spain. In Portugal, Italy and most eastern European countries there are fewer adaptation strategies (European Environment Agency, 2017)

The general public's willingness to adapt behaviour to reduce climate change increases. Larger shares of the population agree that actions need to be taken to combat climate change. According to Eurobarometer, 91% of the European public sees climate change as a serious problem, with 69% considering it a very serious problem (European Union, 2015). Almost half (49%) of EU citizens say they took some kind of action to combat climate change over the last six months.

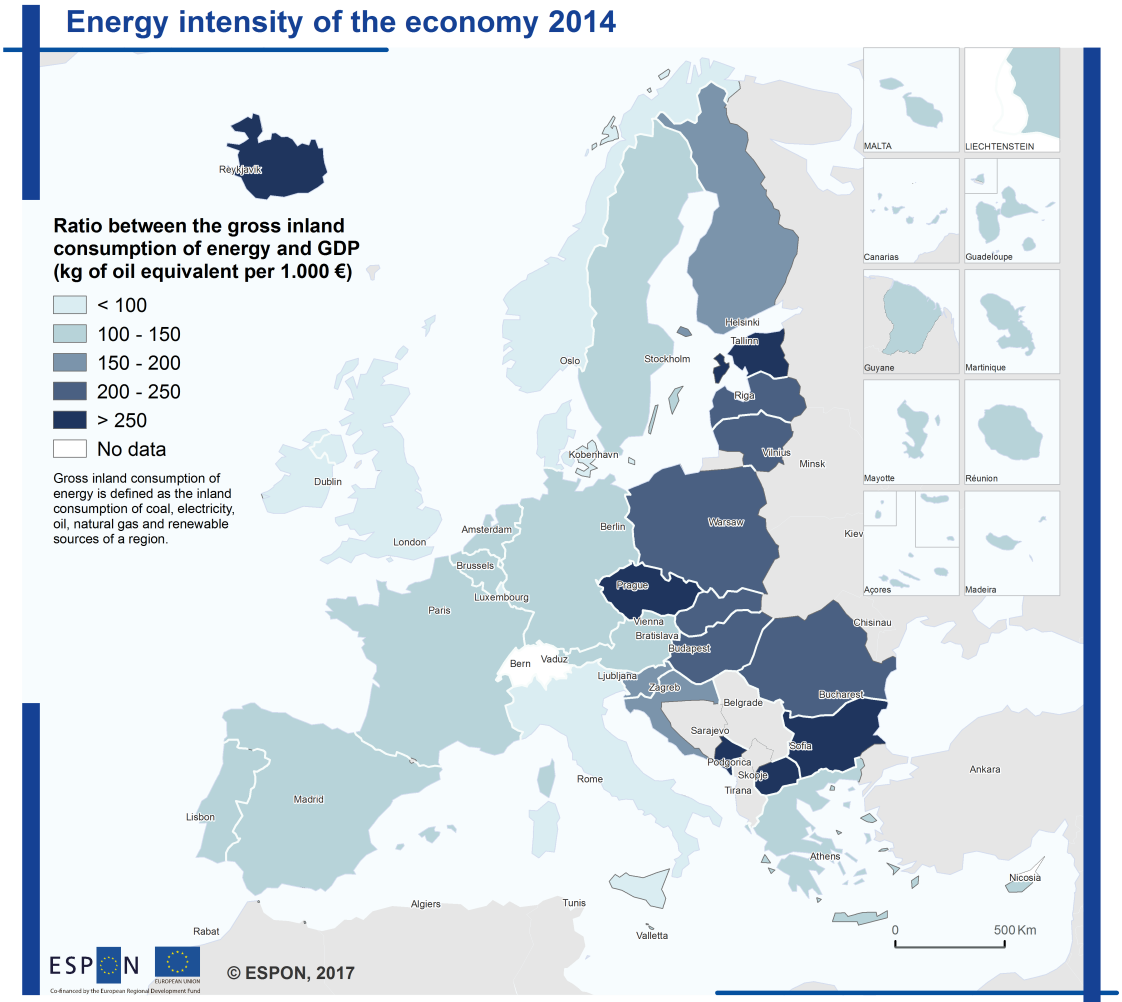
4.1.3 Renewable energy

Energy production and consumption are key factors when it comes to sustainable development and climate change policies. While energy issues are widely discussed in most parts of Europe, both the dependency of the economy on energy and also emissions from energy production differ widely, as does the use of renewable energy sources and the potential to further exploit renewable energy sources.

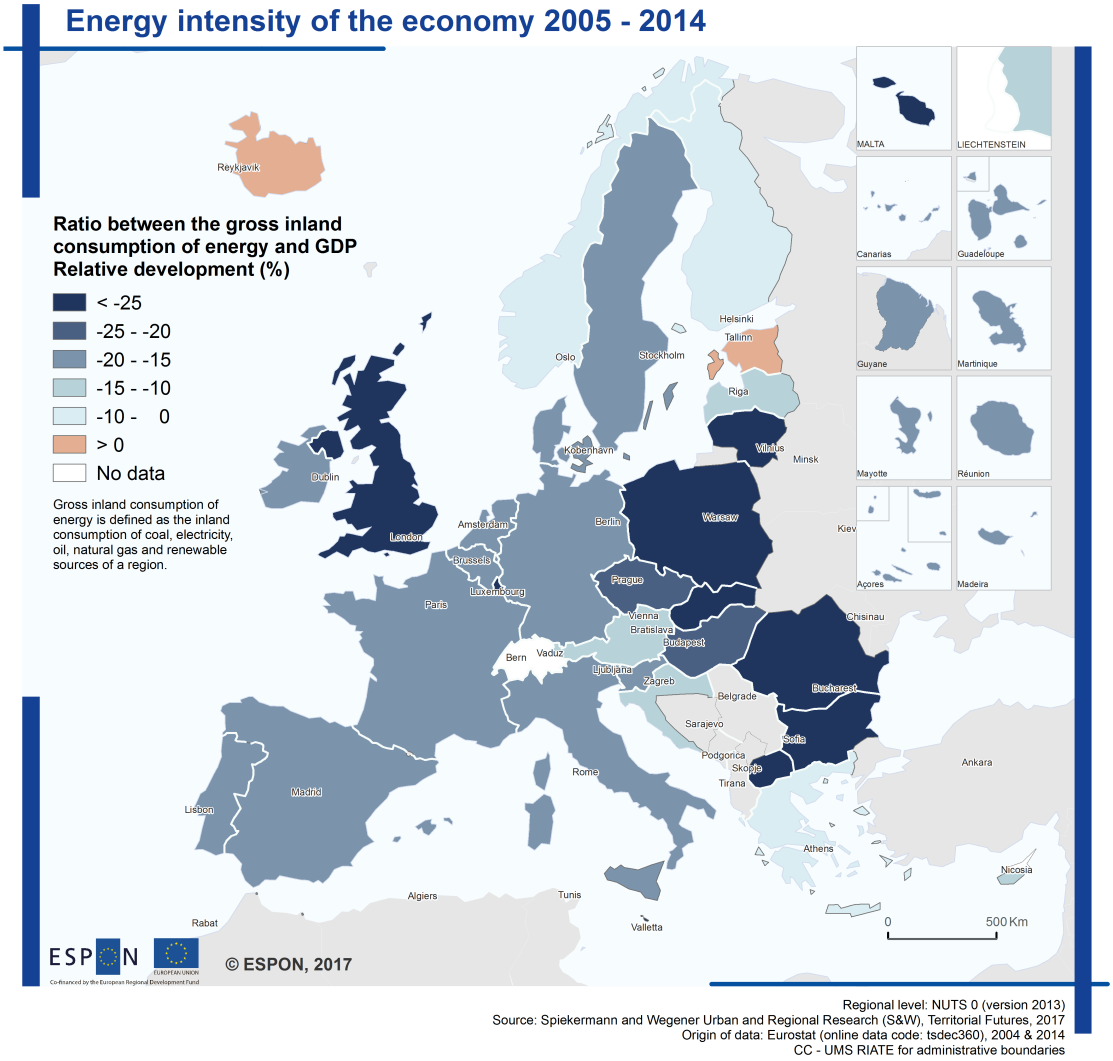
Clear East-West divide in the energy intensity of economies. Some basic figures to understand the status quo show that Iceland and large parts of Eastern Europe have

particularly energy intensive economics. In these countries the energy consumption per GDP is much higher than in most other parts of Europe. Bulgaria, the Czech Republic, Estonia and Iceland head this group (see Map 4.2). It should also be noted that some of these countries have reduced the energy intensity of their economies between 2005 and 2015 (see *Map 4.3*). The counties which changed most substantially are Bulgaria, Lithuania, Romania, Slovakia, and the UK.

Map 4.2 *Energy intensity of the economy, 2014*

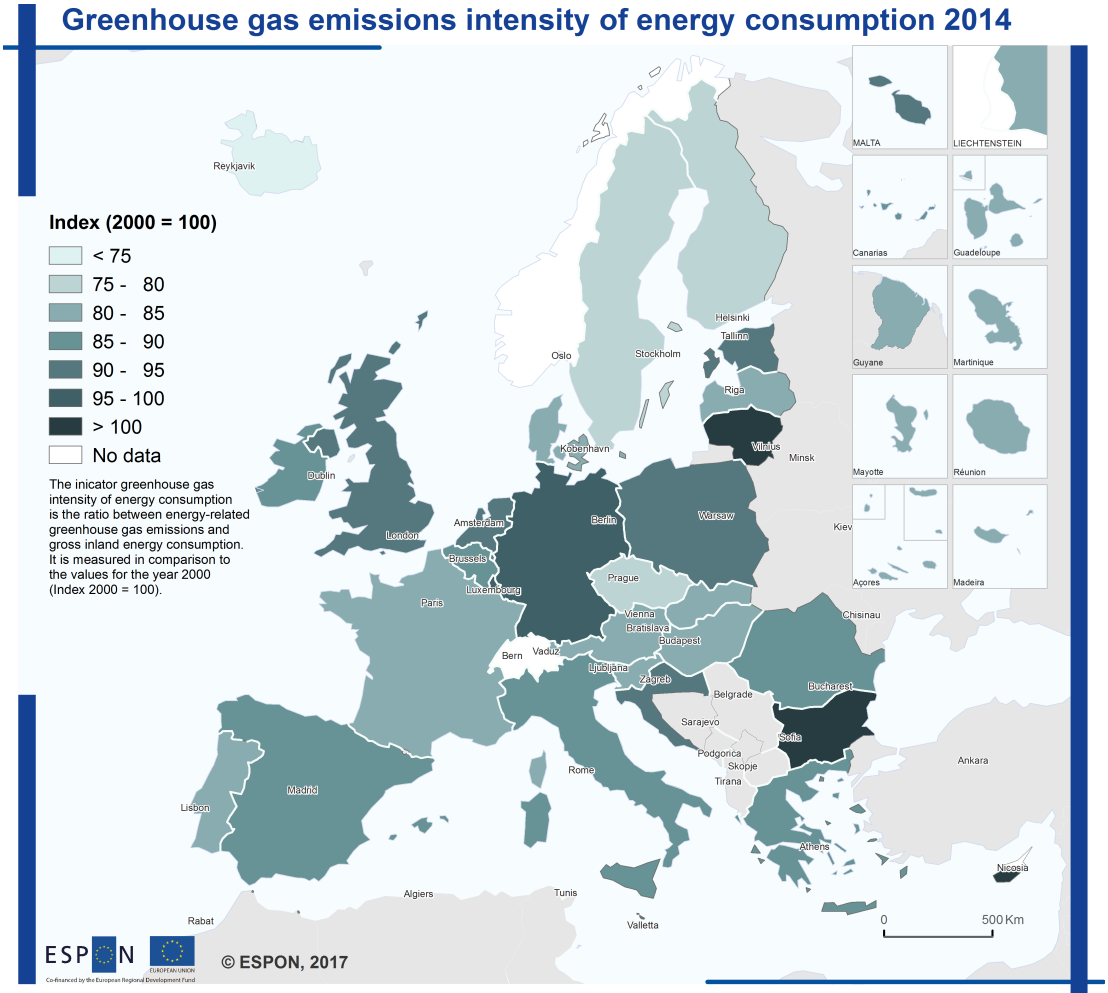


Map 4.3 Energy intensity of the economy, 2005-14



Mixed picture of the share of energy related greenhouse gas emissions. However, energy intensity does not necessarily coincide with emission levels. The ratio of energy-related greenhouse gas emissions and gross inland energy consumption shows a different picture. Indeed, the highest shares are in different countries. Among those with the highest levels are Bulgaria, Lithuania, Germany, Croatia, Estonia, Poland and the UK.

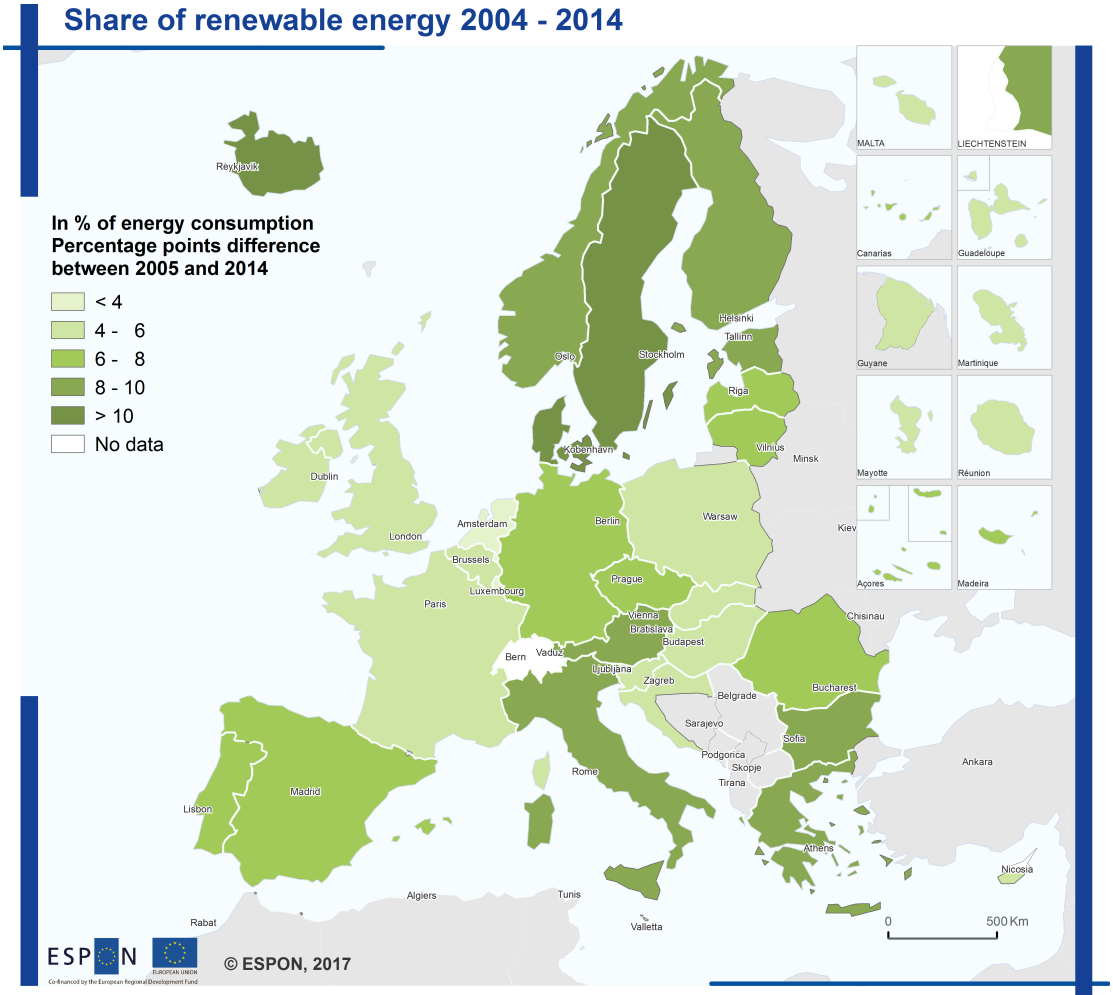
Map 4.4 Greenhouse gas emission intensity of energy consumption, 2014



Regional level: NUTS 0 (version 2013)
Source: Spiekermann and Wegener Urban and Regional Research (S&W), Territorial Futures, 2017
Origin of data: Eurostat (online data code: tsdcc220), 2014
CC - UMS RIATE for administrative boundaries

Energy consumption focus turns renewable. In Europe, renewable energy available for final consumption increased from 8.5% in 2004 to 16.0% in 2014. However, that is not a steady increase. It decreased in 2014 by 1% from 2013. Nevertheless, renewable energy has an increasing share of energy consumption (see Map 4.5). Between 2004 and 2014 the shares increased in particular in Denmark, Iceland and Sweden, but also in Austria, Bulgaria, Estonia, Finland, Greece, Italy and Norway. The lowest increases were in the Netherlands.

Map 4.5 Changing Share of renewable energy consumption 2004-2014



Regional level: NUTS 0 (version 2013)
Source: Spiekermann and Wegener Urban and Regional Research (S&W), Territorial Futures, 2017
Origin of data: Eurostat (online data code: t2020_31), 2004 & 2014
CC - UMS RIATE for administrative boundaries

European regions and cities slowly change their energy mix. Against the backdrop of climate change, geopolitical tensions and energy security, European regions and cities are looking increasingly for other sources of energy. Between 1990 and 2014 primary production of renewable energy sources increased by 174% with an average annual growth rate of 4.3%). Despite this increase, fossil fuels continue to dominate the energy mix.[5]

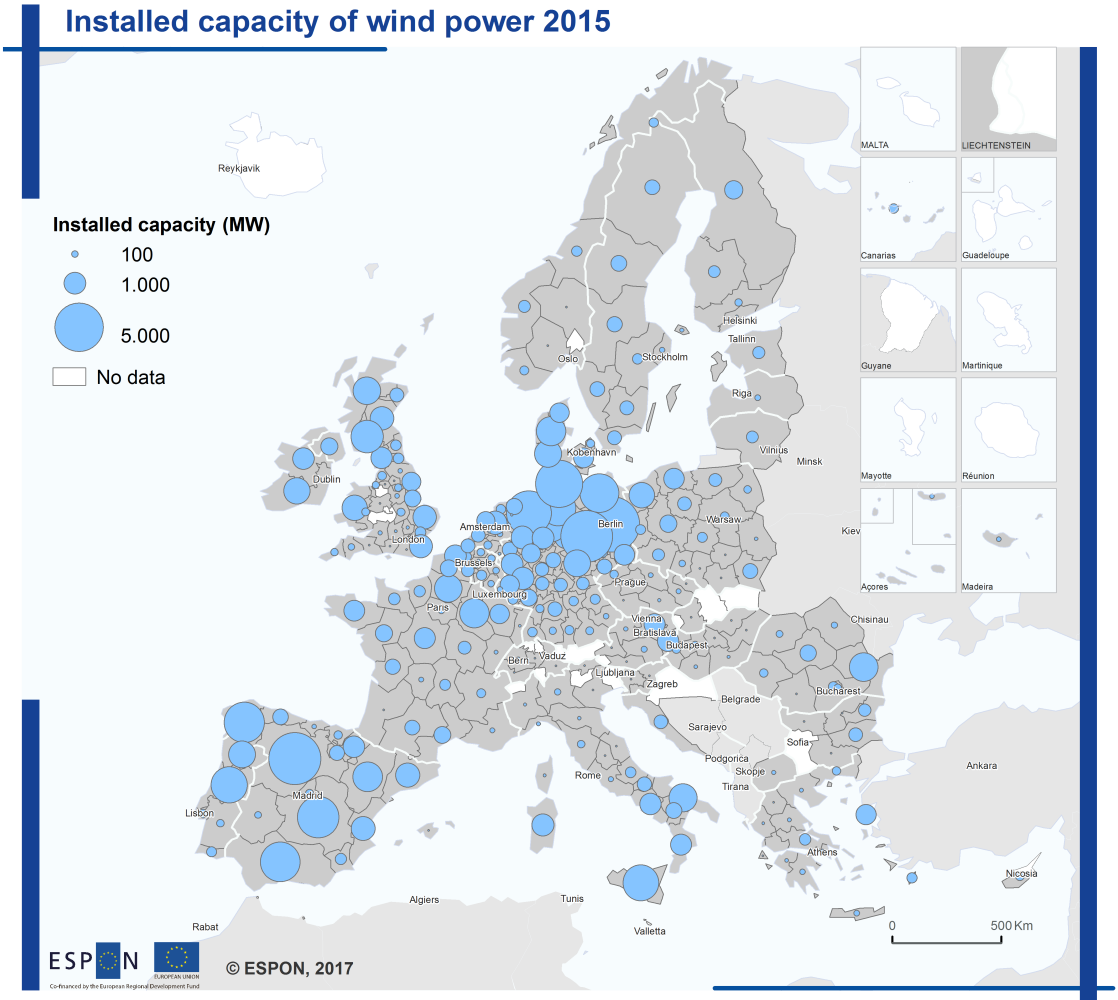
The role of renewable energy sources differs greatly between European regions, with different specialisation per region. Compared to other European regions (Baranzelli et al., 2016):

- **More electricity is generated by biomass** in Polish regions, but also in Slovenia, Croatia and some regions in Greece.
- **More electricity is generated by biogas** in Lithuania, some Italian regions, Spanish regions, Budapest and some Polish regions.
- **More electricity is generated by hydropower** in Northern Sweden and Finland, Alpine regions, Northern Portugal and bordering Spanish regions, Southwest Romania.

[5] Source: http://ec.europa.eu/eurostat/statistics-explained/index.php/Energy_from_renewable_sources

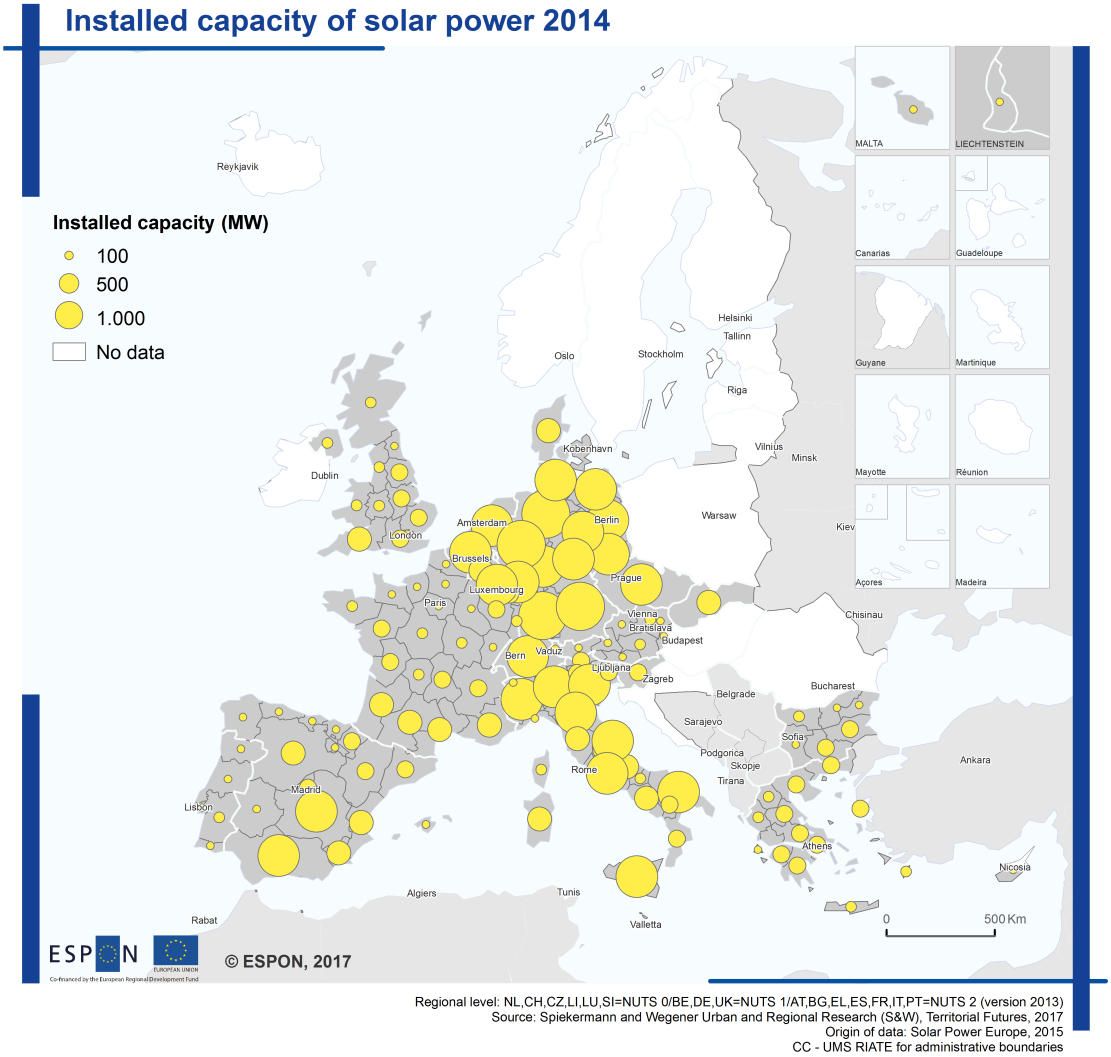
- **More electricity is generated by solar** in eastern Germany, southern Spain and southern Italy (see also Map 4.7).
- **More electricity is generated by on-shore wind** in northern Germany, Spain, Ireland, Scotland and some regions in France, Romania, Greece and Italy (see also Map 4.6).
- **More electricity is generated by off-shore wind** around the UK and in German parts of the North Sea.

Map 4.6 *Installed wind power capacity, 2015*



Regional level: NUTS 2 (version 2010)
Source: Spiekermann and Wegener Urban and Regional Research (S&W), Territorial Futures, 2017
Origin of data: European Commission, JRC, EMHIRES dataset part 1, wind power generation, 2016
CC - UMS RIATE for administrative boundaries

Map 4.7 Installed solar power capacity, 2014



Regional level: NL,CH,CZ,LI,LU,SI=NUTS 0/BE,DE,UK=NUTS 1/AT,BG,EL,ES,FR,IT,PT=NUTS 2 (version 2013)
Source: Spiekermann and Wegener Urban and Regional Research (S&W), Territorial Futures, 2017
Origin of data: Solar Power Europe, 2015
CC - UMS RIATE for administrative boundaries

A mismatch of potential, production and network connections. The actual hotspots of renewable energy production and the potential for production do not necessarily match. As shown by previous ESPON work (2013b) wind power potential is highly variable in its territorial distribution. North western Atlantic areas have the strongest average wind speeds, followed by other western Atlantic areas, the North Sea and southern Baltic. While the highest potential for solar energy can be found in Southern Europe. There are other areas for each type of renewable energy source. However, the picture of renewable energy potential and production does not match in most cases and the energy grid infrastructure is still insufficient.

Example – solar energy on the rise: from macro plant to agrivoltism

Today, solar energy in Europe accounts for 75% of total worldwide photovoltaic capacity. Solar plants are increasingly large and use a growing number of technological solutions. Survey respondents ranked this development as likely and the fourth most effective solution for the future, after “smart grid”, “less space for cars” and “industrial symbiosis”. This development is already on-going in some regions in Europe and might be promising for the future given the first results.

In Spain "Gemasolar” generates electricity even at night, as the heat is stored during the day and released overnight or during periods without sunlight. Another initiative “Desertec” aims at creating a

massive grid of solar plants in north Africa and transferring energy to consumption centres in Europe. In Montpellier producers are testing agrivoltism, a concept that could trigger decentralised solar energy production in Europe by coupling the installation of solar panels above shade-tolerant agricultural crops; because both energy and crop productivity increases, the value of farms could rise by over 30%.

4.2 Tomorrow's development

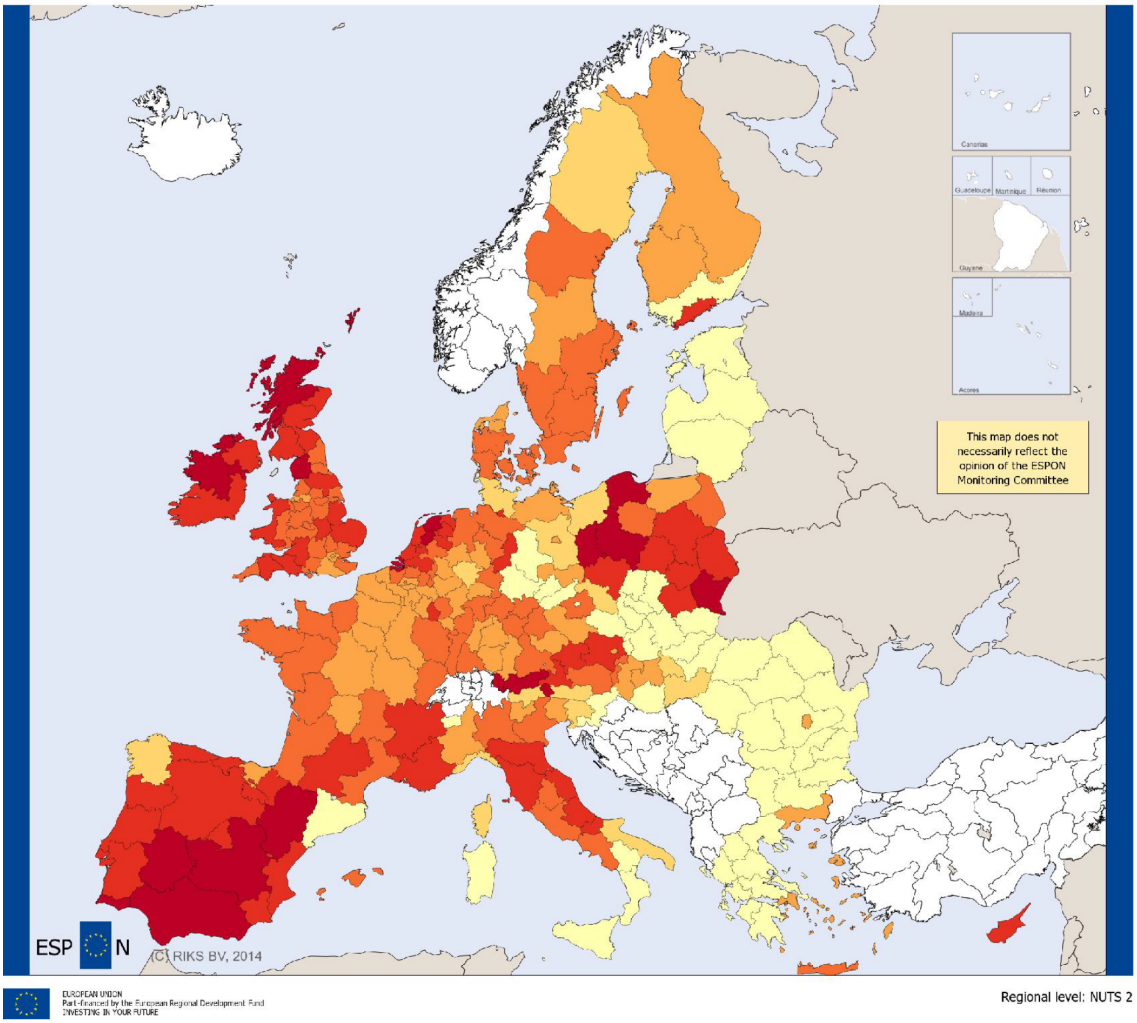
The outlook for the coming decades in terms of environment and climate is not too good. The following provides a quick summary.

Following ESPAS (2015), key projections in terms of climate change, energy and competition for resources until 2030 address access to natural resources, access to water and food and energy consumption.

4.2.1 Further intensification of land use

Following the assumption of a further concentration of population and economic activities paired with a slight population increase until 2030, land consumption is expected to increase further.

Map 4.8 Increase in urban surface 2010-2030



4.2.2 Further climate change

As the Intergovernmental Panel on Climate Change (IPCC) and other international players stress, climate change becomes an ever more pressing issue. Increases in temperature will not be uniform and territorial impacts therefore will also vary widely. In the same way, the contrasts between wet and dry regions will increase, as well the frequency and power of extreme weather events.

Although by 2030, the impact of climate change in the European economy will probably still be limited (European Strategy and Policy Analysis System, 2015), climate change becomes an increasingly pressing issue. This is not least underlined by the fact that even the WEF Risk report 2017 lists extreme weather events, major natural disasters and failure of climate change mitigation and adaptation among the top five global risks in terms of impact (WEF, 2017a).

Natural environment and ecosystems are under increasing stress. The reasons for this are climate change and general natural resource scarcity, which become more pronounced as global economic development and the population continue to grow. Extreme and variable rainfalls, a direct consequence of climate change, will have major impacts on water availability and supply, food security, and agricultural incomes, and will lead to shifts in the production areas of food and non-food crops around the world. There are many pressures on water quality and availability including those arising from agriculture, industry, urban areas, households and tourism. As GDP per capita rises, so does water demand and by 2025 it is estimated that two-thirds of the world's population are expected to be living in water-stressed regions. The replenishing of fresh water and thus the access to fresh water is stable or declining in northern Europe and growing slowly in southern Europe. In past years, floods and droughts have placed additional stresses on water supply and infrastructure (European Commission, 2012).

Several and severe climate change impacts. The IPCC identifies five key risks with climate change: unique and threatened eco-systems, extreme weather events, uneven distribution of impacts, global aggregate impacts and large-scale singular events (e.g. in coral reefs and the Arctic). The work on climate change from previous ESPON projects provides more details on the territorial diversity of climate change impacts (ESPON, 2011a).

Water and food scarcity will also impact Europe. At the same time, global competition for access to natural resources will continue to intensify as will volatility, geo-political tensions and instability. In 2030 managing scarcity of food and water will be a major challenge – made worse by climate change (European Strategy and Policy Analysis System, 2015). According to an estimate of the World Bank, by 2025 climate change will affect 1.4 billion people through shortfalls in food or water. In Europe, water supply difficulties in the south and east are likely to worsen. However, the most affected areas will not be in Europe, but Europe will be affected by the consequences of food and water scarcity in other parts of the world.

Arctic becoming accessible for transport and exploitation of resources. Climate change means also that Artic ice will disappear during summer months, probably sometime between 2020 and 2040. This will have profound impacts on the global environmental balance. However, it also means that the region becomes more accessible for the exploitation of natural resources. It is estimated that between 15 and 30% of undiscovered gas reserves and mineral resources including zinc, nickel and graphite are located in the Arctic. Furthermore, it

opens new global shipping routes linking Europe, North America and Asia. First indications are that an Arctic route could account for up to 15% of total cargo traffic by 2030.

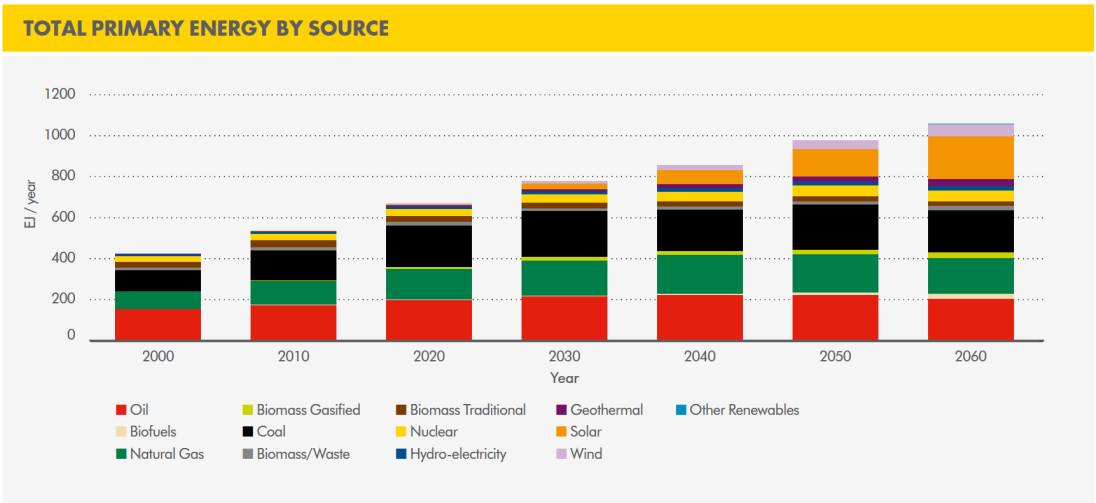
4.2.3 Energy struggles

Increasing energy demands. Overall energy consumption in the world is expected to increase, by 2030 it is expected to be 30% higher than in 2010 (International Energy Agency, 2016). This is mainly due to population growth and rising income levels. Energy savings and the development of renewables will not be sufficient to limit the growth of CO2 emissions by 2030-40 (European Strategy and Policy Analysis System, 2015). Indeed, in Europe by 2030, fossil fuels will still account for a large proportion – even if consumption stagnates and import levels rise from 56% in 2010 to 70% for 2030. Natural gas will play a bigger role, replacing coal in electricity production and possibly oil for some forms of transport.

Example – self-sufficient cities – smart grids

Increasing energy demands and a change in the energy mix leads to increasing intermittence. A continuous supply of energy through the infrastructure cannot be secured due to such factors, as well as weather conditions. A SmartGrid is an electricity network that can intelligently manage the actions of generators and consumers to efficiently deliver sustainable, economic and secure electricity. This type of development has been ranked as the second most likely development for the future after industrial symbiosis.[6] This development is already emerging in some European cities and regions, such as Salzburg, Austria: The “Smart Grid Model Region Salzburg” is an urban pilot carried out by the local distribution operator with the goal of creating a holistic smart grid system that manages energy intelligently. The system provides feedback on residential electricity use and automated switching on and off of household appliances to better synchronise demand renewable supply, avoiding load peaks and increasing the hosting capacity of the grid.

Figure 4.1 Prognosis on primary energy by sources



Source: Royal Dutch Shell, 2013: 7

[6] 16% of the respondents assessed this development as totally likely and 52% as very likely.

Increasing levels of greenhouse gas emissions from energy production. Consequently, the competition for energy resources is expected to continue with substantial shifts in consumption. Furthermore, global economic growth as well as the continued importance of coal in power generation and oil in transport imply continuing growth in greenhouse gas emissions. Greenhouse gases are expected to plateau (or stabilise) from the 2030s to 2050 (Royal Dutch Shell, 2013).

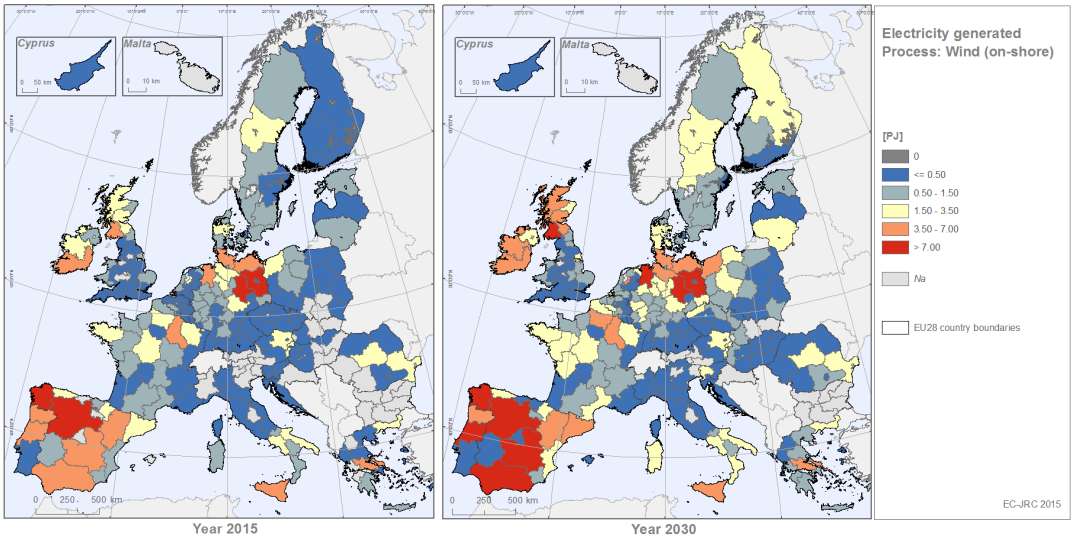
Growing importance of renewables. The growing use of renewable energy – wind, wave, solar, hydro and geothermal – will start to make an impact but, in comparison to other energy sources, their individual share of the mix will still be limited. However, expectations of the role renewables will play by 2030 varies widely depending on the author and whether the total or only parts of the energy sector are addressed. Major energy companies such as BP and Shell see renewables as providing 10% of global primary energy in 2030/40 (see Figure 4.1). On the other hand, the IEA envisages that nearly 60% of all new power generation capacity in 2030 will come from renewables. It also expects that renewables gain ground in providing heat, the largest component of global energy service demand, meeting half of the growth to 2040. In the four largest power markets (China, the United States, the European Union and India), variable renewables become the largest source of generation around 2030 in Europe and around 2035 in the other three countries (International Energy Agency, 2016).

The expected use of renewable energy sources varies across regions in Europe. There is some research concerning regional prognosis for electricity generated from different types of energy resources in 2030 (Baranzelli et al., 2016):

- **On-shore wind:** In most regions, electricity from on-shore wind is expected to increase (see Map 4.9). The largest increases (more than times 2015 levels) are expected in few regions in the Czech Republic, Finland, Lubuskie in Poland, the north-east NUTS2 in Romania, Western Slovakia and Slovenia. For all other regions with an increase in on-shore wind electricity, the average increase is almost 67%. In 2030, the hotspots of on-shore wind are expected to be on the Iberian Peninsula (mainly in Spain) and a few regions in Germany, the Netherlands and Scotland.
- **Off-shore wind:** By 2030, electricity from off-shore wind is expected to increase in all countries with active plants in 2015 (see Map 4.10). Estonia, France, Latvia, Poland and Spain go from having no active plants in 2015 to off-shore wind electricity generation by 2030 when the hotspots are expected to centre around the UK in large parts of the North Sea, and the German coast in the Baltic Sea.
- **Solar:** By 2030, electricity from solar is expected to increase in most European regions (see Map 4.11). The biggest increases (more than five times 2015 levels) is expected in a few regions in Bulgaria, Denmark, France, Greece, Portugal, Sweden, Slovakia, the UK and one region in Italy. The only regions where electricity from solar is expected to decrease are in Greece and Romania. By 2030, the hotspots for solar electricity generation are expected to be in Eastern Germany and Southern Poland.

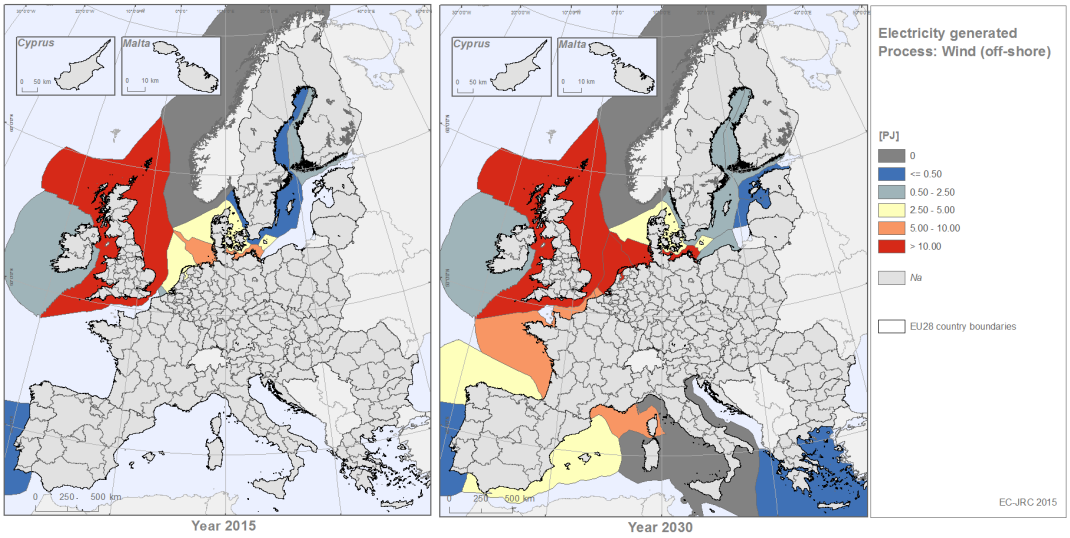
- **Hydroelectric:** The amount of electricity generated from hydropower is expected to increase in Europe by 2030 (see Map 4.12). Exceptions are a few regions in Bulgaria, Czech Republic, Germany, Spain, Greece, Hungary, Portugal, Romania, Sweden and most of the UK. By 2030 the hotspots for hydro-electric energy generation will be northern Sweden and Rhône-Alpes in France.
- **Biomass:** It is expected that almost all European regions will increase the amount of electricity generated from biomass by 2030 (see Map 4.13). The amount of electricity produced in some regions in Bulgaria, Spain, the Netherlands, Romania and the UK, should increase at least five times. A slightly decrease of up to 13% is expected for Denmark and Luxembourg. The hotspots of biomass production in 2030 will be in Poland and single regions in the Czech Republic and Romania.
- **Biogas**: Throughout Europe, 86 regions won't experience any significant change from 2015 to 2030 in the amount of electricity produced from biogas. Decreases are expected in regions in the Czech Republic, Spain, Finland, Hungary, Ireland, Italy (only one region), the Netherlands, Portugal and Slovenia. The sharpest decrease (around 50%) can be in both Irish NUTS2, the Southern Great Plain region in Hungary, central regions in Portugal and Western Slovenia. Conversely, electricity from biogas increases at least eight times in the majority of regions in the UK, Germany, Austria and Hungary.

Map 4.9 Electricity generated from on-shore wind, 2015 and 2030



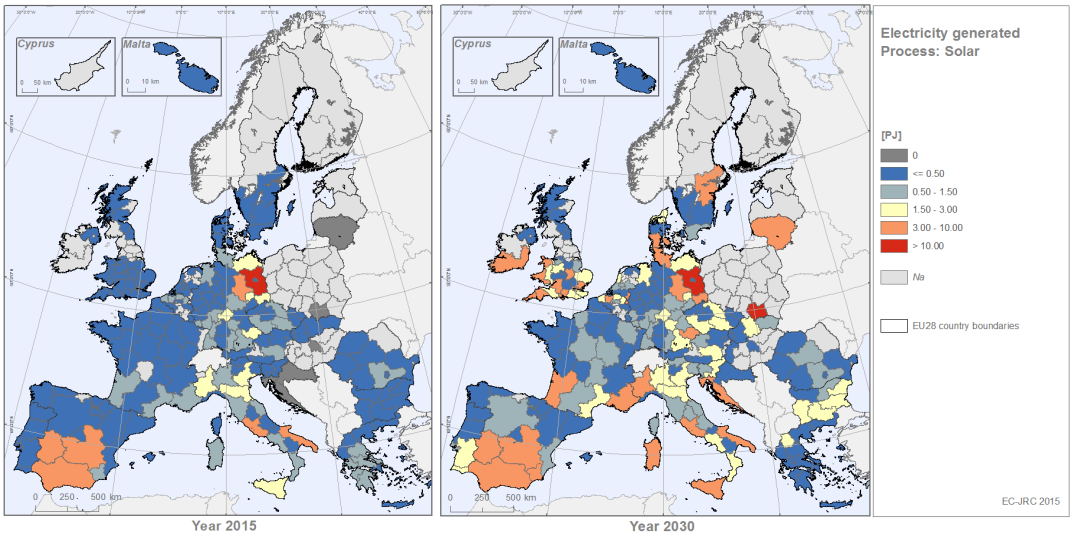
Source: Baranzelli et al., 2016

Map 4.10 Electricity generated from off-shore wind, 2015 and 2030



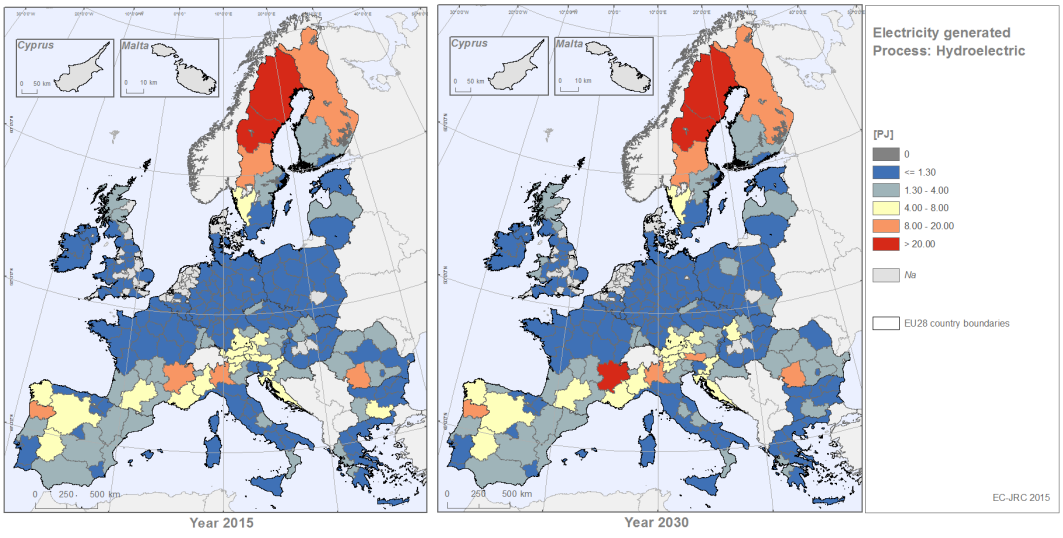
Source: Baranzelli et al., 2016

Map 4.11 Electricity generated from solar, 2015 and 2030



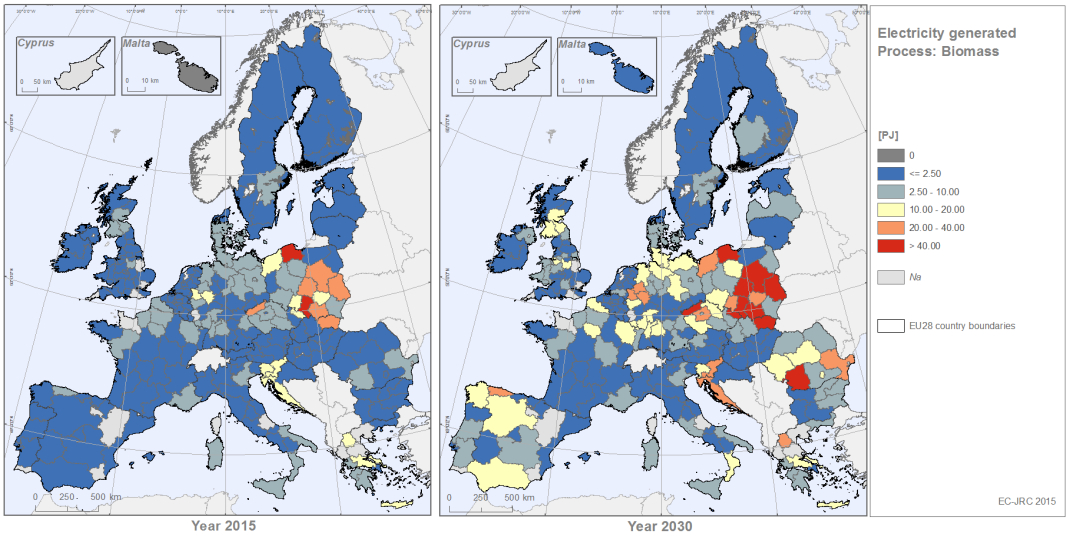
Source: Baranzelli et al., 2016

Map 4.12 Electricity generated from hydroelectric, 2015 and 2030



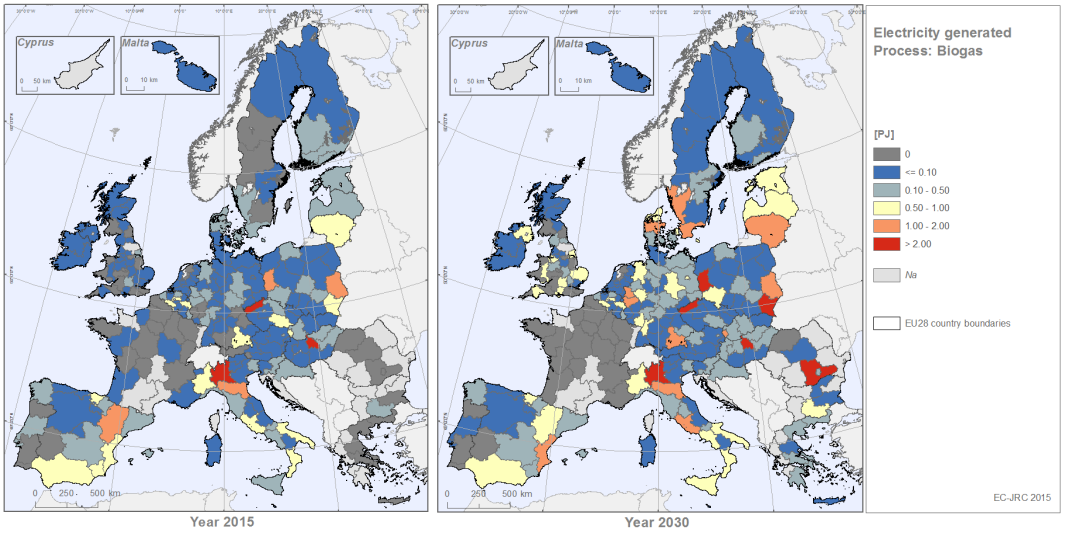
Source: Baranzelli et al., 2016

Map 4.13 Electricity generated from biomass, 2015 and 2030



Source: Baranzelli et al., 2016

Map 4.14 Electricity generated from biogas, 2015 and 2030



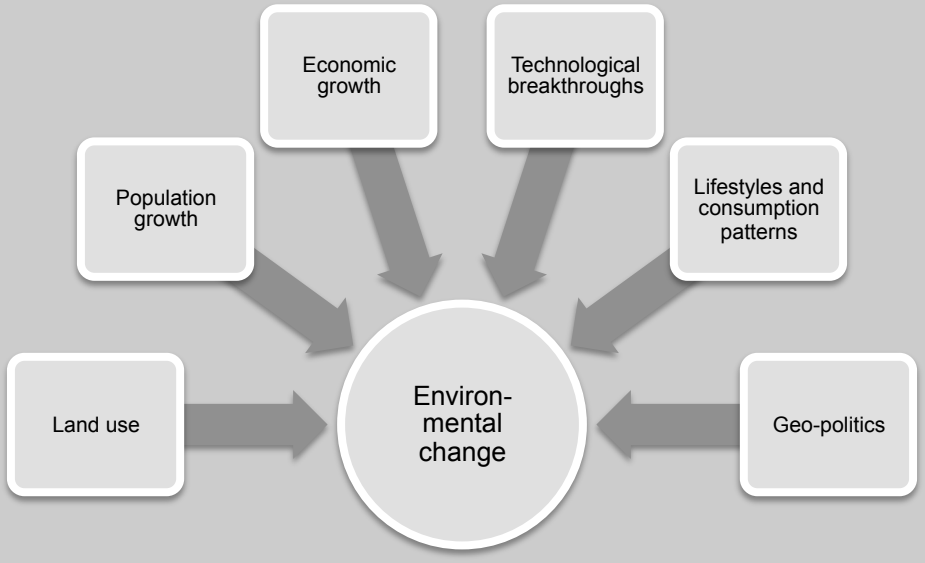
Source: Baranzelli et al., 2016

4.2.4 Further outlooks

Summing up the above, the environmental outlook does not look too positive and even if Europe makes major efforts in the shared global ecosystem these would not be sufficient. The main drivers for development sketched above are continued population and economic growth accompanied by increasing land use and consumption. Change towards more a positive future would largely be driven by technological breakthroughs or substantial changes in human behaviour, including lifestyle and consumption patterns.

Drivers for environmental change

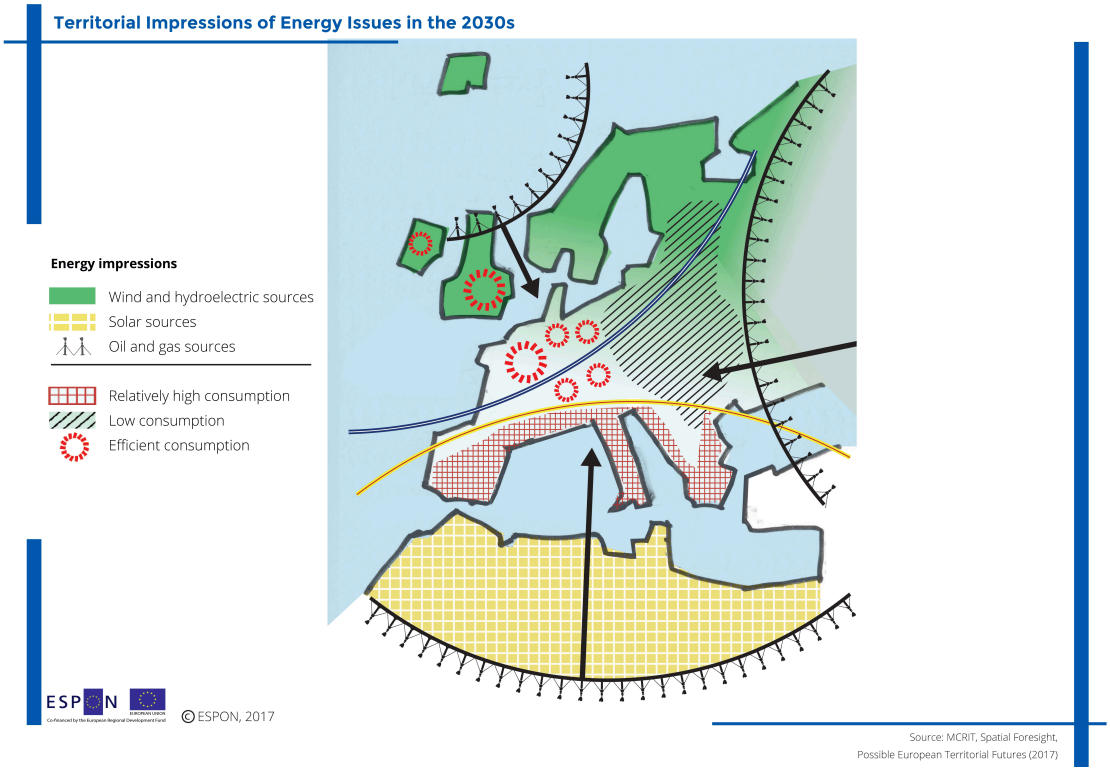
The figure below illustrates some of the drivers for environmental change which may become relevant in further discussion of European possible futures.



Picking up some of the key features of the future environmental situation, Figure 4.2 provides a sketchy image of the expected territorial diversities. Key messages shown in that figure include:

- Europe is to a large extend energy dependent. Fossil energy needs to be imported from neighbouring areas, either the North Sea, Russia, Middle East or the North of Africa (black circles and arrows)
- There is a territorial potential for wind (blue line) and solar energy production (yellow line, yellow zone in the north of Africa). To a large degree there is a divide between south and north.
- Centres of energy consumption in terms of major urban agglomerations (red circles), with high relative energy efficiency contrasting with energy intensive economies in Eastern Europe (grey pattern) as well as in the Mediterranean areas (red pattern).

Figure 4.2 Territorial impressions of energy issues in the 2030s



Europe's environmental development until 2030 is connected to major uncertainties such as the implementation of international environmental agreements, increasing consumption (due to demographic and economic growth) as well as technological breakthroughs. The textbox below shows a selection of bifurcation points depending on large scale policy decisions made in Europe or other parts of the world.

Possible bifurcation points

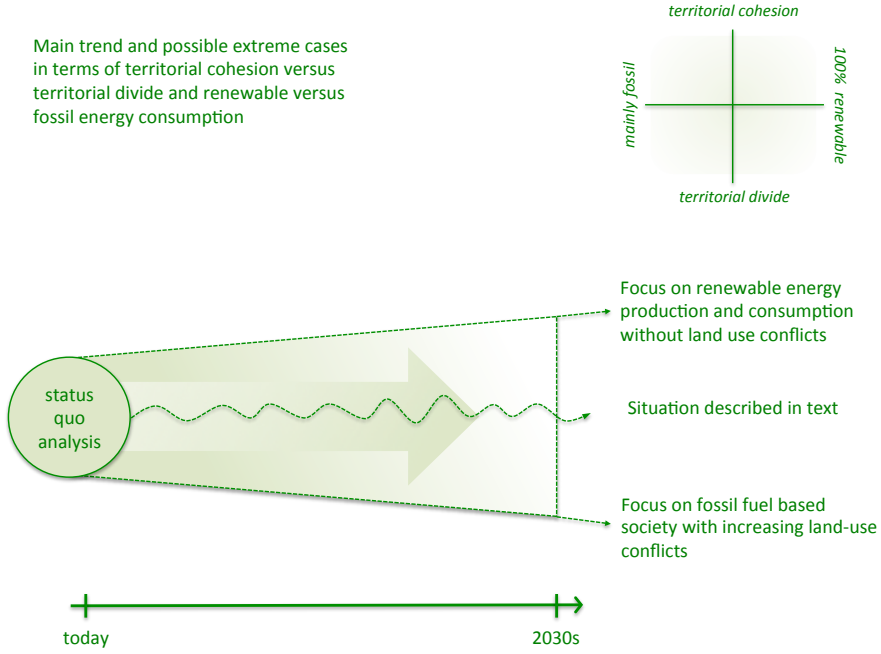
One of the few certainties about future developments is that they are rarely linear. There are a variety of possible bifurcation points at which developments can take different turns, desired or not. Possible bifurcation points related to environmental developments are:

- Technological breakthroughs which can increase energy production and reduced consumption so energy demands drop substantially.
- Technological breakthroughs in the production of renewable energy which increase the share of renewable energy production substantially and also distribute it through appropriate grids.
- Technological breakthrough in fusion technology allowing nuclear fusion reactors to replicate the sun's energy on Earth – with limited energy input.
- Geo-political halt to climate change agreements, which will imply a dramatic reduction in global efforts to address climate change challenges.
- Dramatic behavioural change of large parts of the population leading to a substantial change in energy consumption (tipping point awareness).

The above bifurcation points allow to discuss environmental situations presenting alternatives to the general trends presented in the previous sections (see Figure 4.3). The figure illustrates the main trends as described in the previous sections and extreme cases defining the

bandwidth of possible environmental futures, following the bifurcation points as described above.

Figure 4.3 Range of possible environmental futures, the example of energy



Source: ESPON Futures project team

The two extreme cases for the environment are based on energy production and consumption. This factor plays a central role in relation to the other two environmental factors. Energy can be seen as solution to climate change, but has also a large impact on land-use.

The first extreme case is characterised by 100% renewable energy production in support of territorial cohesion, which would be realised without land-use conflicts. The production will be balanced between different European regions. A super grid might support to limit intermittence between different renewable energy sources in the different regions and support equal access to renewable energy for European citizens.

The other extreme case, illustrating the lower bandwidth of possible environmental futures, is characterised by fossil fuel energy production and clear territorial disparities (divide) between the regions with fossil fuel sources or easy access, and regions poorly connected to an energy grid. Those regions specialised in energy production might be challenged by land-use conflicts, either as result from extraction (e.g. loss of biodiversity, earthquakes, etc.) or as result from increasing pollution and the effects of climate change.

5 Technological change

Economic patterns across the world will change, as new technologies lead to what is called the 4th industrial revolution, of production systems. Revolutionary technological changes will lead to fusions of technologies and blur the lines between physical, digital and biological systems. The important question is which regions will be affected by the changes ahead, and which will be shaping the future.

European, national and regional policies try to pave the way by supporting the development of a knowledge driven economy as well as a forward looking reindustrialisation of Europe's cities and regions. With support from their Smart Specialisation Strategies, regions invest in research, innovation and technologies. However, the innovative character of Europe's regions is not equal. Determinants for regional innovation performance are research and education levels, which have shown increasing imbalances in Europe.

For this discussion, the next section provides insights on today's situation for Europe's territorial diversity when it comes to R&D, innovation, education and new patents. This is followed by a section which points out a number of trends and possible territorial differentiations of these.

5.1 Today's situation

Innovation, technology, research and the human resources to further develop in this area are key components of regional characteristics. With a view to future developments in these areas, it is important to see which of today's profiles and comparative advantages various cities and regions can build on.

5.1.1 Research, development and innovation

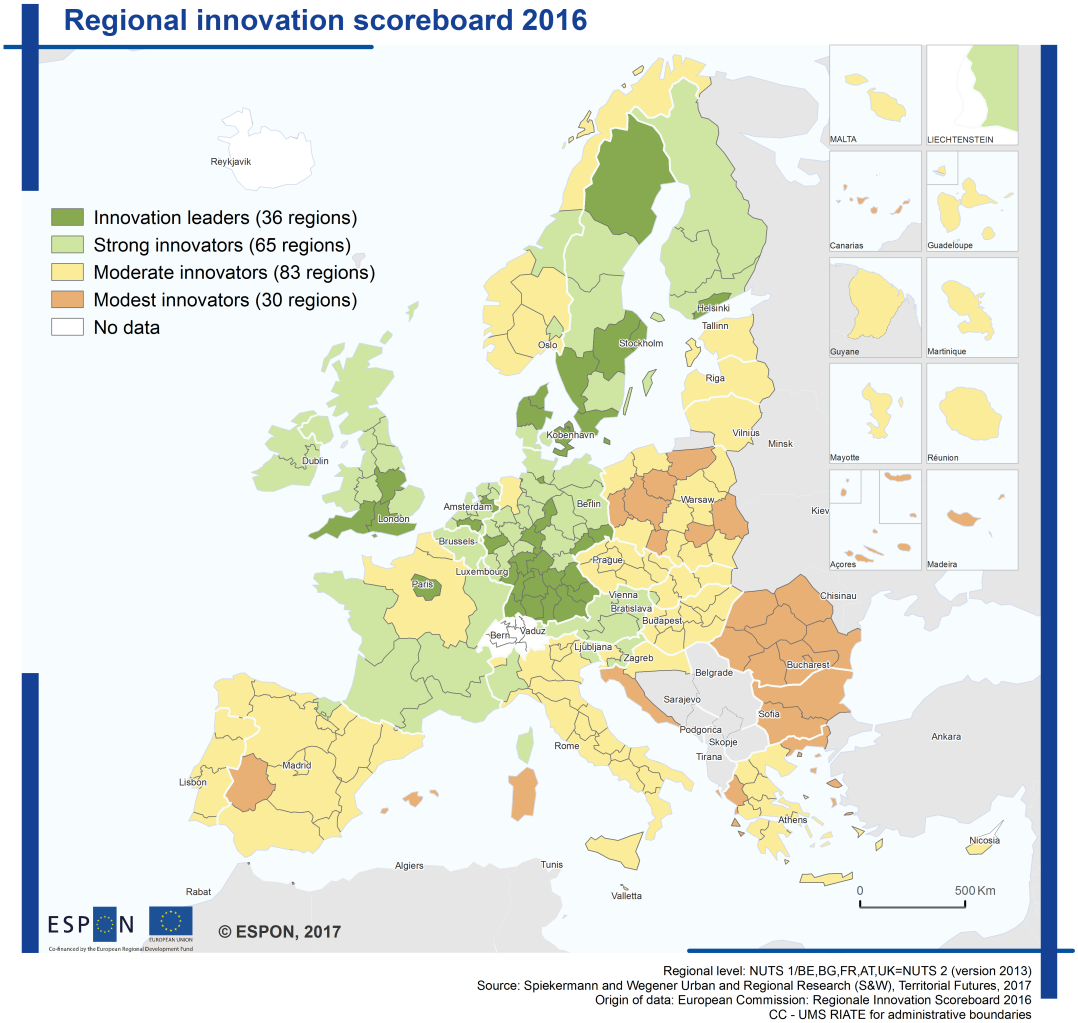
Striving towards technological change and staying ahead of the field, innovation, research and development are important. These factors differ widely across Europe, as does the use of research results and innovation. While some regions host major centres for research and innovation, other regions are home to well-connected entrepreneurs, tuned in to translating innovations into new or improved goods and services.

Regional innovation performance has increased over time, although in recent years overall performance has declined, especially for the least innovative regions. The European Commission frequently assesses regions' innovation performance based on a variety of indicators. Regional capacity to innovate may contribute to finding solutions to some of society's main challenges, such as an ageing population, energy security, climate change, disaster risk management, or social inclusion (Eurostat, 2016). Europe has a long tradition of excellence in R&D and innovation with regional differences in innovation performance. The Regional Innovation Scoreboard differentiated four types of regions (Hollanders et al., 2016):

- **Innovation leaders** (mostly in southern England, southern Germany, Île de France, Sweden and Denmark)
- **Strong innovators** (mostly in the rest of the UK, Ireland, the Nordic countries, the rest of Germany, Austria, Benelux and large parts of France)
- **Moderate innovators** (mostly in southern and eastern countries, southern Norway, parts of France)
- **Modest innovators** (Mostly in Bulgaria, Romania, some regions in Poland, Croatia and Greece)

Between 2007 and 2016 more regions were classified as moderate or strong innovators, suggesting a partial convergence as the gap to innovation leaders became smaller. For the first seven years a convergence of innovation performance has been noted for all regional types (175 regions). However, between the two most recent years (2014 and 2016) innovation performance has declined for all groups and 154 regions. This recent decline in innovation performance is mainly due to weakening in four SME indicators - share of SMEs innovating in-house, SMEs collaborating with others, SMEs with product or process innovations, and SMEs with marketing or organisational innovations.

Map 5.1 *Regional Innovation Score Board 2016*



Regional level: NUTS 1/BE,BG,FR,AT,UK=NUTS 2 (version 2013)
Source: Spiekermann and Wegener Urban and Regional Research (S&W), Territorial Futures, 2017
Origin of data: European Commission: Regionale Innovation Scoreboard 2016
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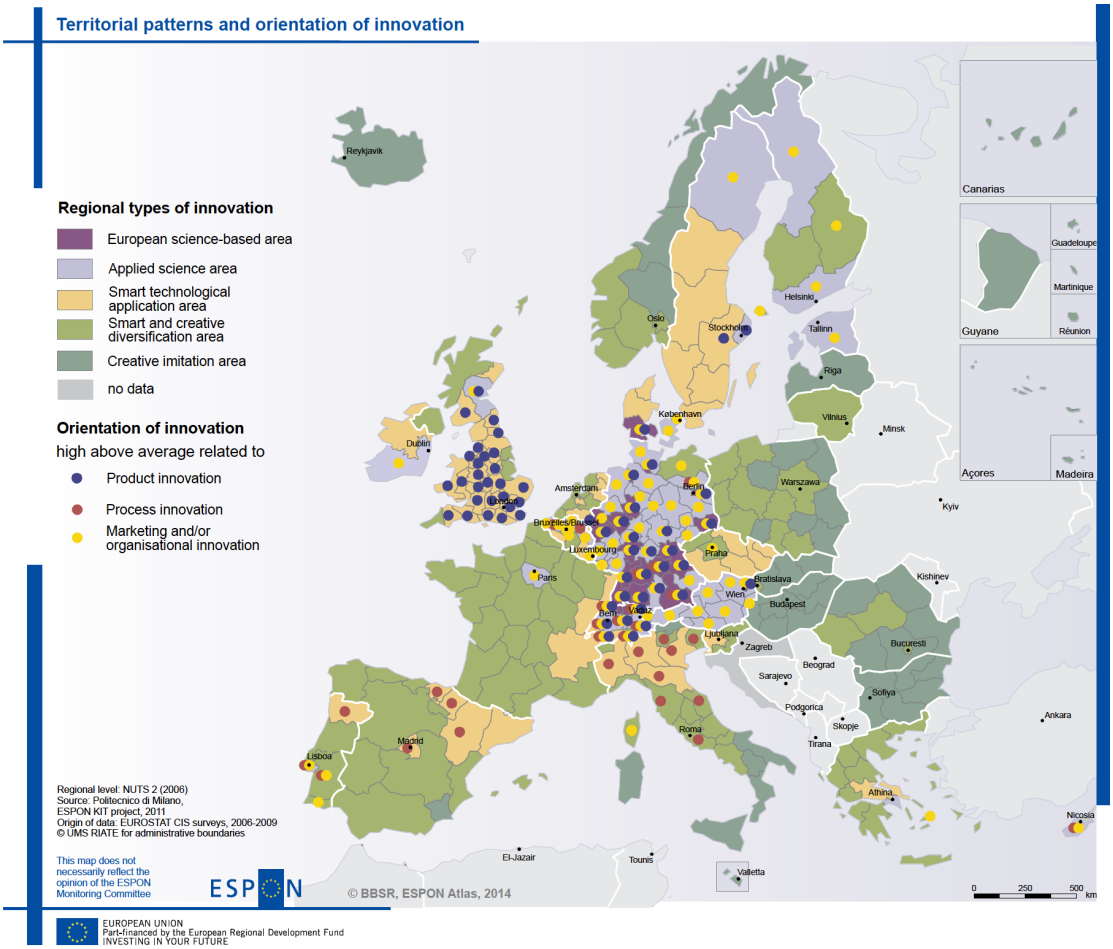
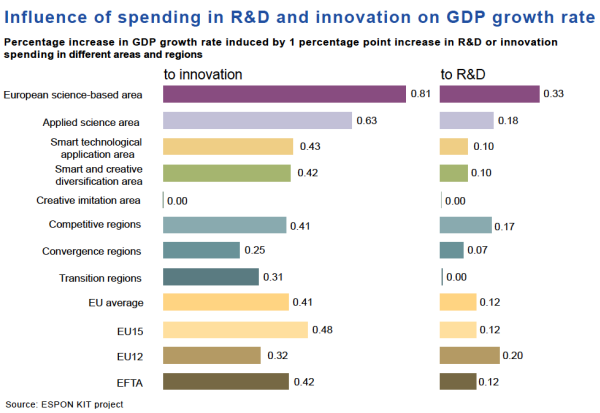
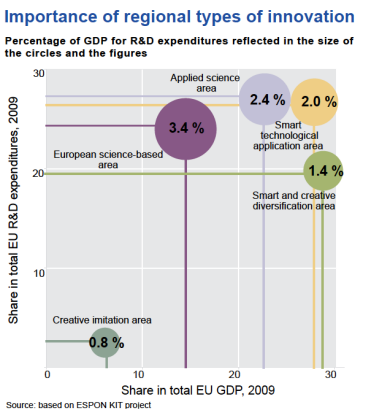
R&D concentrates in capital city regions and regions with high technological activities. R&D expenditure is widely used as another indicator to discuss the extent to which regional economies are prepared to stay ahead in forthcoming developments. Mostly regions in the Nordic countries and Germany have high levels of R&D intensity, based on R&D expenditure relative to GDP levels of NUTS2 regions for 2013. Areas where R&D expenditure is concentrated are often around academic institutions or specific high technology industrial activities and knowledge-based services, which foster a favourable environment, attracting new start-ups and qualified personnel so the competitive advantage of these regions is further intensified (Eurostat, 2016).

Map 5.2 Territorial patterns and orientation of innovation (KIT project)







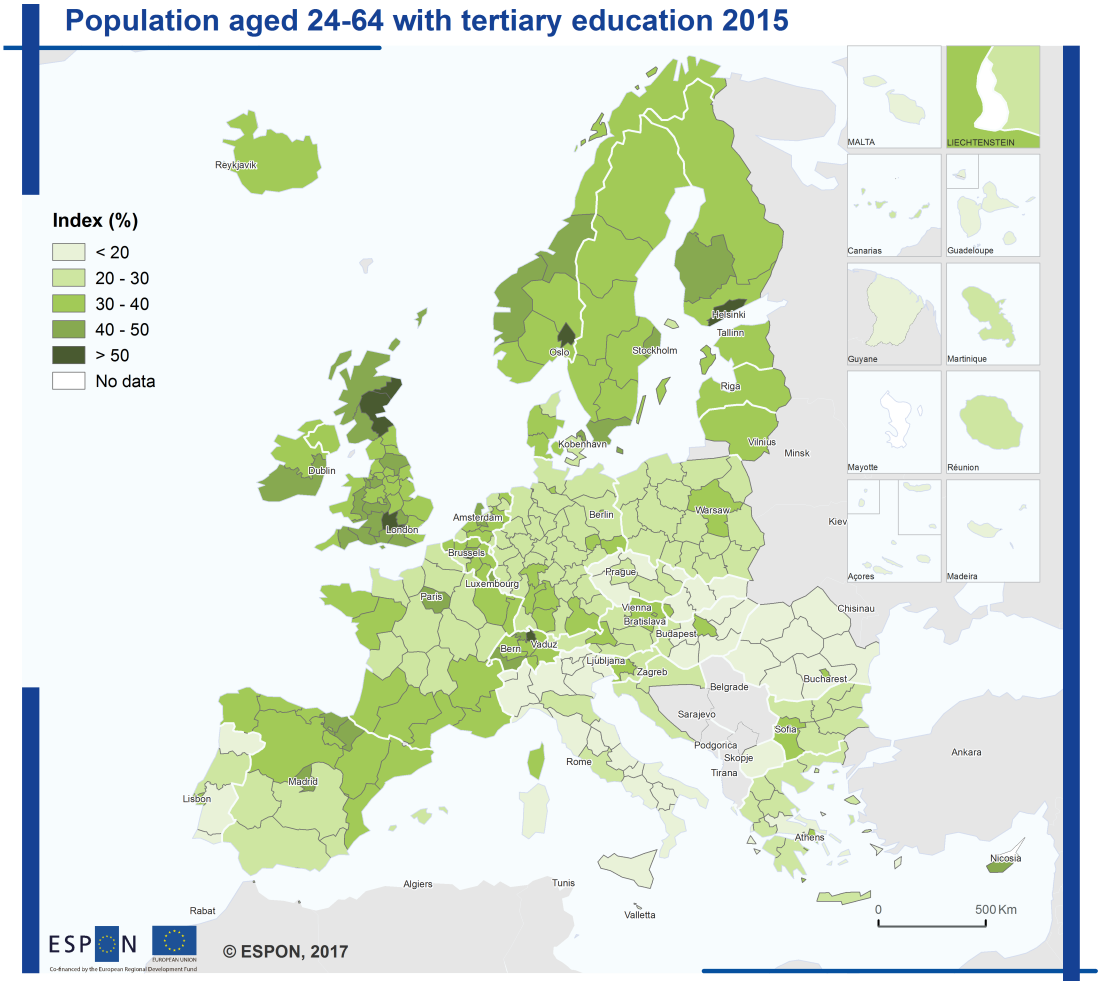
At the same time, previous ESPON research has shown that R&D expenditure and even the share of people working in high tech sectors or in research do not necessary indicate that research and innovation are translated into economic development. The ESPON KIT project differentiated between European science-based areas, applied science areas and smart technological areas, as areas where innovation plays an important role one way or the other (ESPON, 2012). Furthermore, it also identified areas where innovation plays less of a role (see Map 5.2).

5.1.2 Education as pre-condition

Regardless of the research and innovation profile a city or region has, to allow enterprises and research organisations to position themselves for future-oriented technological developments, highly qualified people are a precondition.

Highly qualified young women move to capital city regions. About one third of the working age population in Europe has a tertiary education, however there are territorial differences (Map 5.3).

Map 5.3 Population aged 24-64 with tertiary education 2015

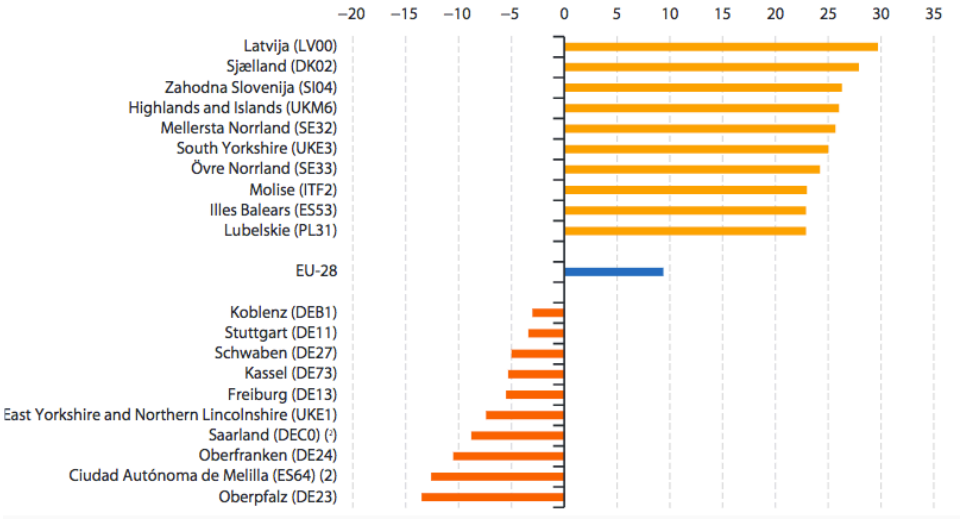


Regional level: NUTS 2 (version 2013)
Source: Spiekermann and Wegener Urban and Regional Research (S&W), Territorial Futures, 2017
Origin of data: Eurostat (online data code: edat_lfse_04), 2015
CC - UMS RIATE for administrative boundaries

The fewest degrees are in parts of the Danube Region. Here, tertiary education is only available for about 20% of the working age population. Italian regions are in the same range, whereas other Mediterranean regions are higher, but below the European average. Central and Alpine regions are around the European average, but Switzerland is clearly above. There is high educational attainment in North-West Europe and the highest is in Baltic and Nordic countries. On average, around 40% of the population has tertiary education. In the capital regions this share even increases to over 50%.

The EU 2020 target for tertiary education is on track with an increasing share of the 30-34 year olds being highly qualified (Eurostat, 2016). The group of 30-34 year olds can be considered a proxy for the efforts of European governments to invest in the education of their labour force. The European average is now almost 40% of that age group. In principle, in all regions there was a clear improvement in the educational level of this cohort compared to the total labour force. This development contributes to a knowledge driven economy which increasingly demands highly skilled labour. Despite the positive overall development of highly skilled people, there are territorial differences.

Figure 5.1 *Gender gap for the share of persons aged 30-34 with tertiary education attainment*[7]



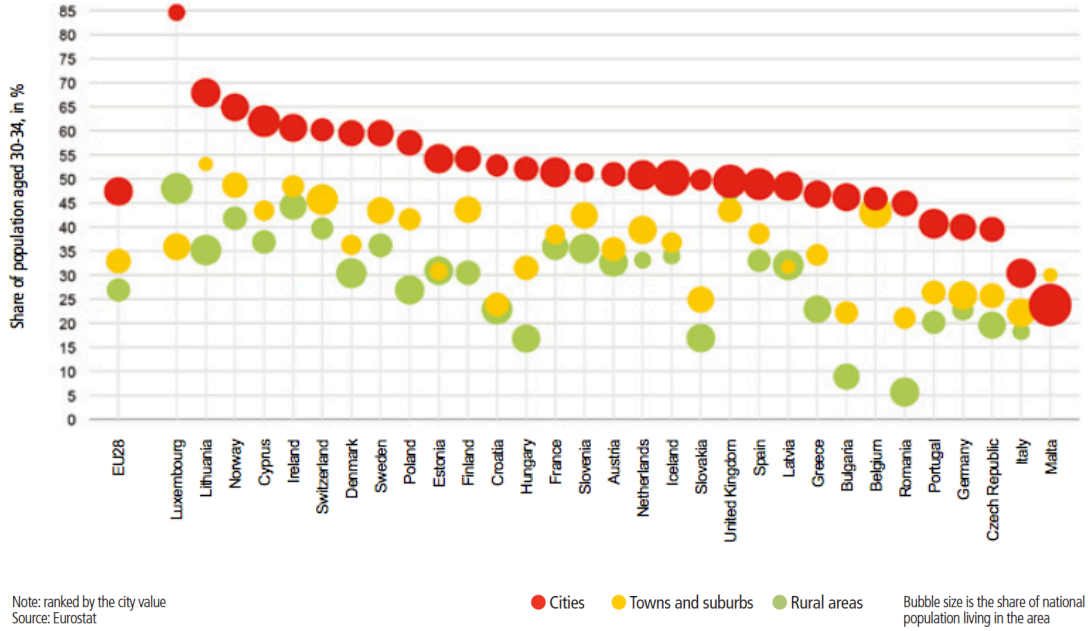
Source: Eurostat, 2016

First, the proportion of young women aged 30-34 with a tertiary education was 9.4% higher than for young men (Figure 5.1). Some university cities across Europe already note a surplus of women, whereas some rural areas without major education centres have a surplus of men. Those regions may face socio-economic challenges, an imbalance between men and women

[7] The figure shows the 10 NUTS 2 regions with the widest gender gaps for men (in yellow) and women (in orange), as well as the EU-28 average (in blue). Saar (Germany) and Ciudad Autónoma de Melilla (Spain): 2014. Severozapaden (Bulgaria) and Cornwall and Isles of Scilly (the United Kingdom): 2013. Trier (Germany), Ionia Nisia (Greece), Ciudad Autónoma de Ceuta (Spain), Corse, Guadeloupe, Martinique, Guyane, Mayotte (France), Valle d'Aosta/Vallée d'Aoste (Italy), Algarve, Alentejo, Região Autónoma dos Açores, Região Autónoma da Madeira (Portugal), Åland (Finland) and Cumbria (the United Kingdom): not available. Includes data of low reliability for some regions.

has negative effects on demographic development, the labour force and the image of the region.

Figure 5.2 Population aged 30-34 with tertiary education by degree of urbanisation, 2014



Source: European Commission and UN Habitat, 2016: 108

Second, well qualified young people are concentrated in capital city regions (European Commission and UN Habitat, 2016). In all countries, except for Malta, the share of population aged 30-34 with tertiary education is higher in the capital than in other urban and rural regions. The highest urban-rural discrepancies for tertiary education are in Luxembourg, Hungary, Slovakia, Bulgaria and Romania (see Figure 5.2). Highly qualified young people tend to move to capitals as they are associated with business opportunities (Eurostat, 2016). As a consequence, this may result in brain drain, with some regions lacking the necessary skilled labour for scientific and technological development.

Health and medical care, education and skills and the protection of environment are issues that respondents mention as priorities for science and technological development and on which, at the same time, respondents expect that science and technological innovation and people's actions and behaviour, will have a positive impact 15 years from now (European Union, 2014).

5.1.3 Preparing for the future

As highlighted above, it is unclear which types of technological innovation will be the main drivers for future developments. At the same time, it is known that location advantages will be based on past legacy, access to the 'right' people and suitable support mechanisms (e.g. risk capital, intermediators).

As discussed in the section on socio-economic developments, key enabling technologies may be one way forward. SMEs traditionally play an important role in the first processes of

innovations. So, these fields are used to illustrate territorial diversity to be considered when discussing possible future developments.

Example – Innovations making houses 100% self-sufficient

By combining different technological innovations, buildings may become self-sufficient for power, water, sewage, etc. This development might support sparsely populated, geographically specific areas such as poorly accessible mountain regions or islands, in their provision of housing. This development has been assessed as the second most likely and third most effective development for the future in an online survey.[8] Actors in different regions have been adapting different technological developments to function off the grid, for example in Slovakia and Italy:

Ecocapsule is a Slovak solar powered pod-home sold for €80 000, with a wind-turbine and rain water storage allowing it to be lived in for up to a year with no need for water or electricity infrastructure. It can be transported and used in different locations. BioCasa82 in Italy was granted the LEED award for being built by with 99% recyclable materials, 100% of rainwater collected and 100% of energy production from a photovoltaic system with a highly efficient geothermal plant for heat, hot water and cooling. The house has less than 30 kW/m^2 of annual energy consumption.

Specialisation in key technologies is positively linked to regional innovation performance. Key enabling technologies take a broad perspective of a variety of sectors. Key enabling technologies describe six technologies that provide the basis for innovation in a range of products across different economic sectors. The specific technologies comprise advanced materials, advanced manufacturing technologies, industrial biotechnology, nanotechnology, micro- and nano-electronics, and photonics. The estimated economic potential of these technologies is considerable, as products strongly dependent on them account for EUR 953 billion or 19% of total EU production (Hollanders et al., 2016: 23). Looking at the number of patent applications linked to key enabling technologies, the distribution is highly skewed in favour of the more innovative regions who apply for about 90% of all patents. Referring back to Map 5.1 it is largely the innovation leaders and strong innovators which are also strong in key enabling technologies. Regions with a positive specialisation in key enabling technologies are found across the whole of Europe, especially in Austria, Belgium, Southern France, Germany, the Netherlands, Portugal , Spain and some regions in Finland but also in Greece, Italy and Poland (Hollanders et al., 2016: 25).

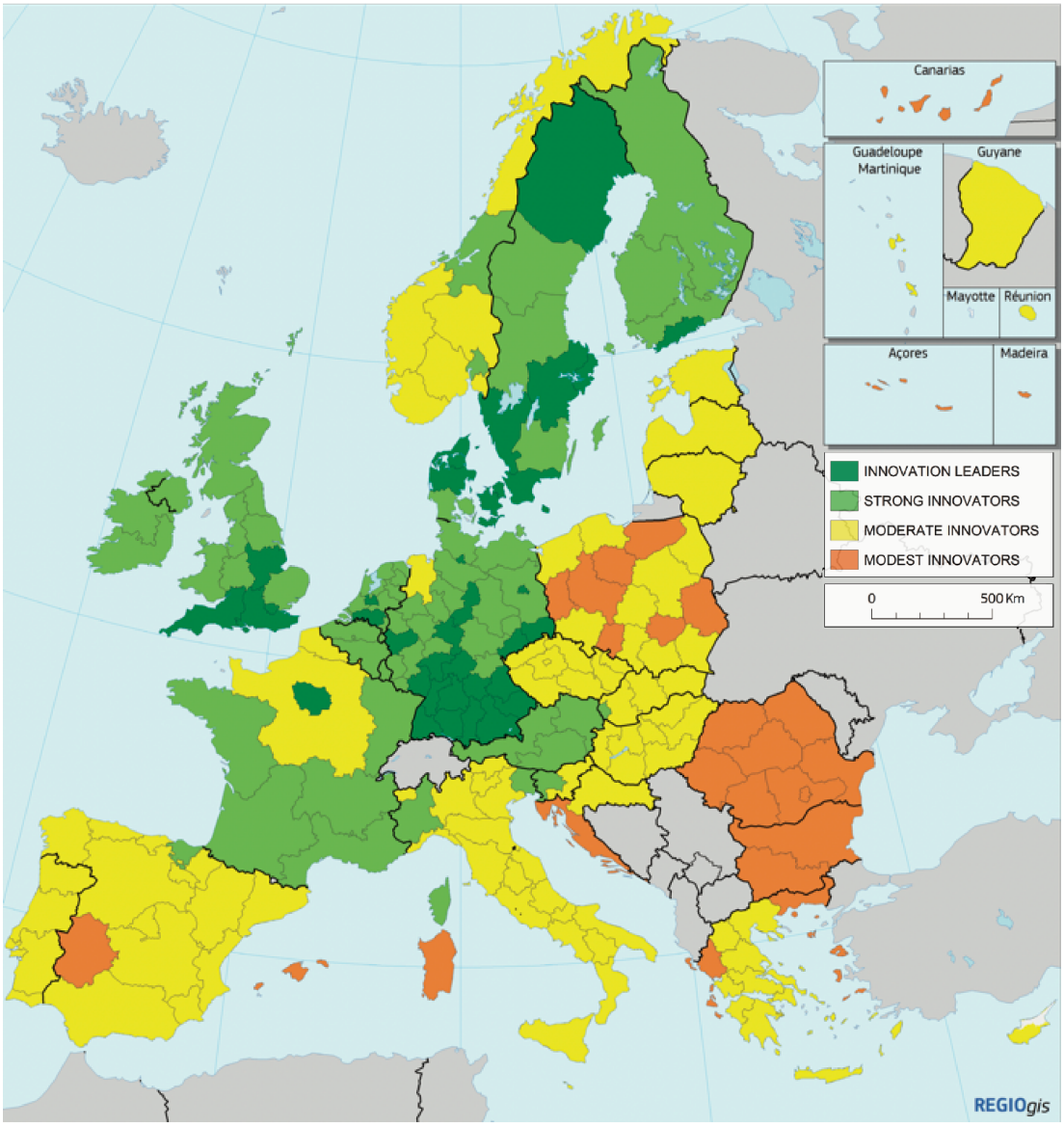
Considerable territorial differences in the share of SMEs introducing innovations. Since SMEs often play a major role in innovation and particularly in turning innovations into new products or services, the Region Innovation Score Board provides interesting insights into a region's share of SMEs introducing process or product innovations. The 20 regions with the highest scores are (in descending order) Kassel, Karlsruhe, Schwaben, Rheinhessen-Pfalz,

[8] 19% of the respondents assessed this development as certain and 46% as very likely. Only taxation for temporarily residence has been assessed as a more likely development. Furthermore 4% of respondents expect this measure to be totally effective and 46% expect it to be very effective for future developments. Only industrial symbiosis and less space for cars has been assessed as more effective for the future.

Niederbayern, Chemnitz, Trier, Münster, Berlin, Stuttgart, Oberpfalz, Darmstadt, Thüringen, Oberfranken, Dresden, Veneto, Freiburg, Hamburg, Lüneburg, and Saarland (Hollanders et al., 2016). All of these regions, except for the Italian region of Veneto, are in Germany. This underlines the point that the share of SMEs that introduced a product or process innovation is to some extent determined by the national context.

Looking at the national context, the highest shares of product or process innovators are in regions in Austria, Belgium, Denmark, Finland, Germany, Italy, the Netherlands, Portugal, and Sweden. The lowest shares are in regions in Croatia, Bulgaria, Hungary, Poland, Romania, Slovakia, and Spain.

Map 5.4 *Share of SMEs introducing product or process innovations*

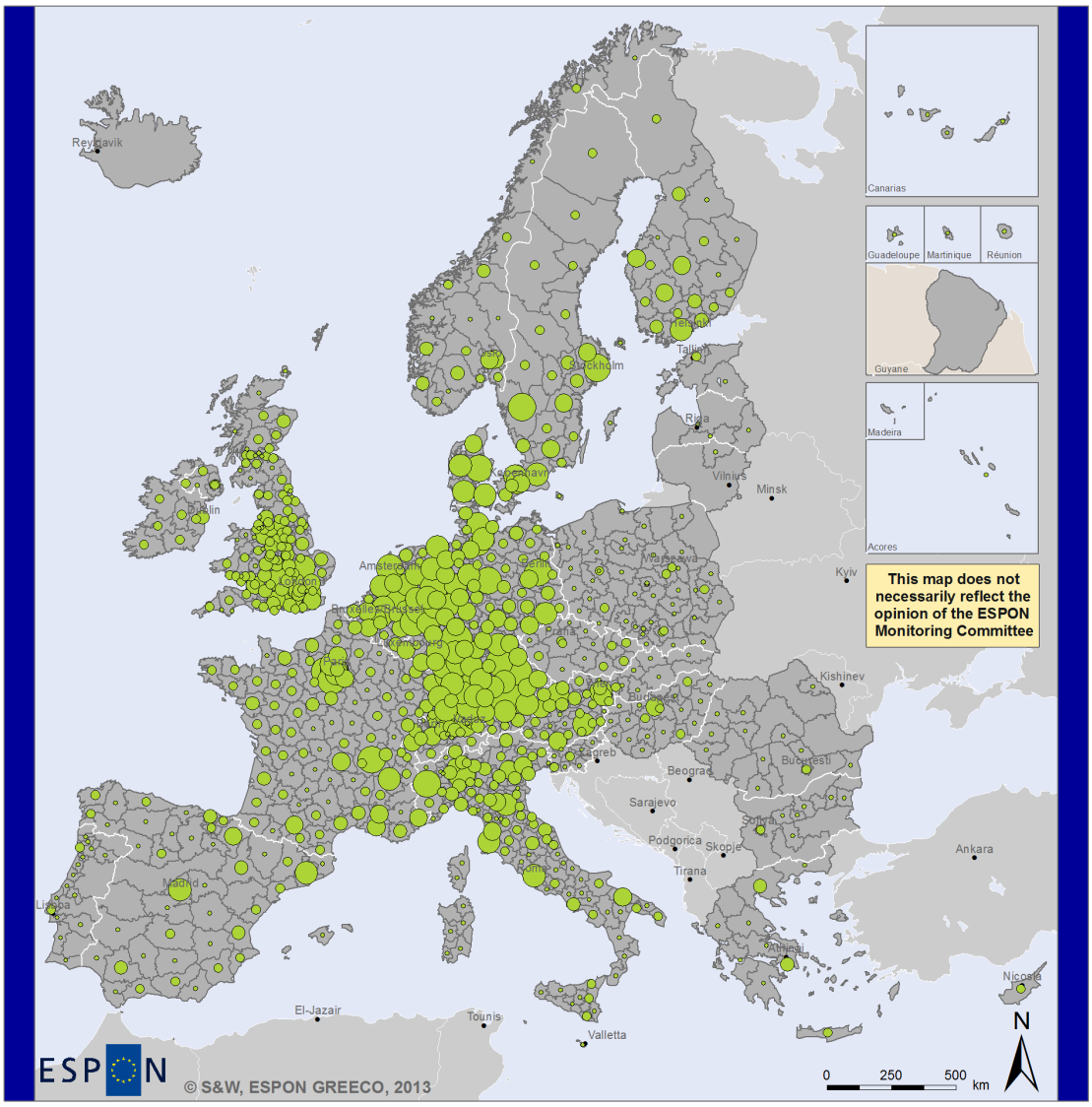


Source: Hollanders et al., 2016: 37

Environment and green technology innovations are concentrated in a few European areas. Greentech seeks to enhance regional competitiveness through more sustainable use of natural resources, preservation of environmental capital and a reduced exposure to a

range of external shocks such as climate change and extreme weather events. New process or product developments can contribute to this.

Map 5.5 Green patents 2001-2010



EUROPEAN UNION
Part-financed by the European Regional Development Fund
INVESTING IN YOUR FUTURE

Regional level: NUTS 0,2,3
DE: OECD TL3
Source: OECD Statistics, 2011
Origin of data: European Patent Office (EPO)
© EuroGeographics Association for administrative boundaries

Green patents, 2001-2010

< 5	100 - 250
5 - 25	250 - 500
25 - 50	500 - 1000
50 - 100	> 1000

Improved product designs and more efficient energy use simultaneously strengthen economic performance and reduce the use of resources. Green patents reflect green technological development in a region and thus its future capacity for green growth. Green patents, environmentally-friendly technologies leading to process or product development, submitted

to the European Patent Office between 2001 and 2010 show a concentration of green technology in western and southern Germany, Denmark, southern UK and parts of Belgium and the Netherlands. Other green patent hotspots are metropolitan and capital areas mainly in Western Europe. This includes the wider area of Paris and Lyon in France, northern Italy, Madrid and Barcelona in Spain, wider Gothenburg and Stockholm regions in Sweden and Southern Finland (ESPON, 2013a).

There is a gap in the number of patents submitted between the above listed regions and regions in eastern and southeast Europe, and Portugal and Greece, the rest of Spain and France. Among these regions are regions submit fewer green patents (see Map 5.5). This does however not imply that they are less developed regarding the green economy. As discussed earlier, these regions are more focused on applied knowledge with local skills, creativity and entrepreneurship (see pages 55-56).

5.2 Tomorrow's development

In the next decades, the most prominent economic change may come from the technology sector. Current technological changes are expected to develop into a 4th industrial revolution linked to automation and data exchange in production processes and service deliveries (Schwab, 2016). This will build on the growing maturity and convergence of digital technologies, which are likely to have far-reaching impacts on productivity, income distribution, well-being and the environment by 2030.

5.2.1 4th industrial revolution

By 2030, it is estimated that firms and industry will be predominantly digitised, enabling product design, manufacturing and delivery processes to be highly integrated and efficient. The so-called internet of things, supported by big data analytics, artificial intelligence and machine learning tools will enable smart machines that will be increasingly adjustable through sensor technology, cheap computing power and the real-time use of algorithms. This will disclose opportunities for new business models and entrants, together with new challenges concerning the substitution of labour (technological unemployment) and the role of the European economy in new patterns of production at world level. The extent to which the off-shoring of labour-intensive activities from OECD to China and India is going to continue is uncertain, due to higher wages in these developing countries. On the other hand, the fast-emerging middle class in China and India, could make demand-side factors still important for offshore production and distribution. In any case, it is expected that digitisation will make China and emerging markets gain shares in service and trade against Europe and OECD countries.

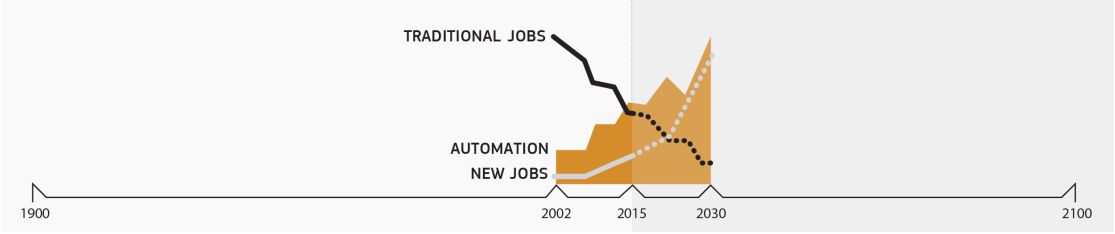
This is expected to alter ways of living, working and interacting in society. Such major trends are highlighted in robotics, big data and the internet of things. Some of the related trends are (Böhme et al., 2016):

- **Robotics and digitisation increase productivity and growth** as new possibilities emerge for interaction with humans (WEF, 2015). Nowadays, the ICT sector is directly

responsible for 5% of European GDP and contributes far more to productivity growth with 20% directly from ICT and 30% from ICT investments. Future-proofing services and production processes will be important for the competitiveness of enterprises (Sirkin et al., 2015). Additive manufacturing, also called 3D printing, already opens new ways in which complex three dimensional products can be produced. It will also allow new models of decentralised local production based on high level global designs. It is expected that this technology may bring production back to Europe and generate enormous revenues. The figures vary between EUR 10 and 100 billion annually by 2030 indicating the level of uncertainty.

- **Robotics and digitisation replace humans** even in highly skilled and service sector jobs, where artificial intelligence may displace many layers of workers. In other words, job replacement will not only affect standard manufacturing jobs but will reach far into the service sector. At OECD level about 9% of jobs are likely to be automated in the coming years. Additionally, for 25% of jobs some 50-70% of tasks conducted today are likely to change significantly because of automation. In other words, a lot of jobs as we know them today will disappear or change radically. There are estimates that 45-60% of all workers in Europe could be replaced by automation before 2030. However, there are limits as machines will not have enough empathy, imagination, creativity or ideas. At the same time this creates opportunities as new types of jobs emerge (Ross, 2016). As with previous industrial revolutions, it is difficult to say beforehand what these new jobs will be and what new sets of skills they will require (see Figure 5.3). Possible new jobs are blockchain developers, IoT architects and cognitive computer engineers.
- **Big data is key for a digital future** fuelled by the convergence of social, mobile and cloud capability as well as growing demand for anytime, anywhere access to information. This will change how technology is used for private and business purposes. Related technological trends include quantum and cloud computing (European Commission, 2014b; Ross, 2016).
- **Internet of things will make the world much smarter** than today. Some 75–80 billion items are expected to be connected to the internet by 2020 (Case, 2016). In Europe this will be an increase from approximately 1.8 million in 2013 to almost 6 billion in 2020, generating revenues of more than €1,180 billion in 2020 (European Commission, 2014b)

Figure 5.3 Increased automation of work



Source: Joint Research Centre, 2016

5.2.2 What might happen where?

These trends will not bring an end to geography. Indeed, a number of considerations of territorial implications suggest that these trends will contribute to further increases in territorial disparities as location factors change. The following contain a few points for consideration.

Winner takes all – advantage for early adapters. To a large degree it is expected that increased digitisation and the 4th industrial revolution lead to 'winner takes all' markets, products and people. In other words, best performers are expected to capture a very large share of the rewards, and the remaining competitors are left with very little (Réchard et al., 2016).This implies that early adopters are likely to lead the way. During the 3rd industrial revolution some early adopters and innovators paving the way for technological innovations were located in Europe (e.g. for mobile telephony, Skype and Spotify). Maintaining this attitude, spirit and collaboration between key players may provide Europe with a head start to the 4th industrial revolution. This implies being among those leading the way in terms of technology and economic development. The challenge is to keep that position and even encourage more players in more places to test the field and dare to develop new solutions (Böhme et al., 2016). However, it also means being first to deal with any social impact, especially the need to find good solutions to social setbacks.

The policy and legal environment matters. Preparation for early adaptors is not only about creating the right environment in terms of innovation environments, human capital, technological infrastructure and venture capital. It is also about adjusting regulatory and legal frameworks to suit upcoming technologies. Countries and regions that succeed in establishing tomorrow's preferred international norms in the new digital economy (5G communications, commercial drones, the internet of things, digital health, advanced manufacturing, etc.) will reap considerable economic and financial benefits. According to some experts (Schwab, 2017), the five cities best placed globally with the most effective policy environment to foster innovation are New York, London, Helsinki, Barcelona and Amsterdam. In that sense Europe seems to be well prepared, hosting four of the top five locations for developments to come.

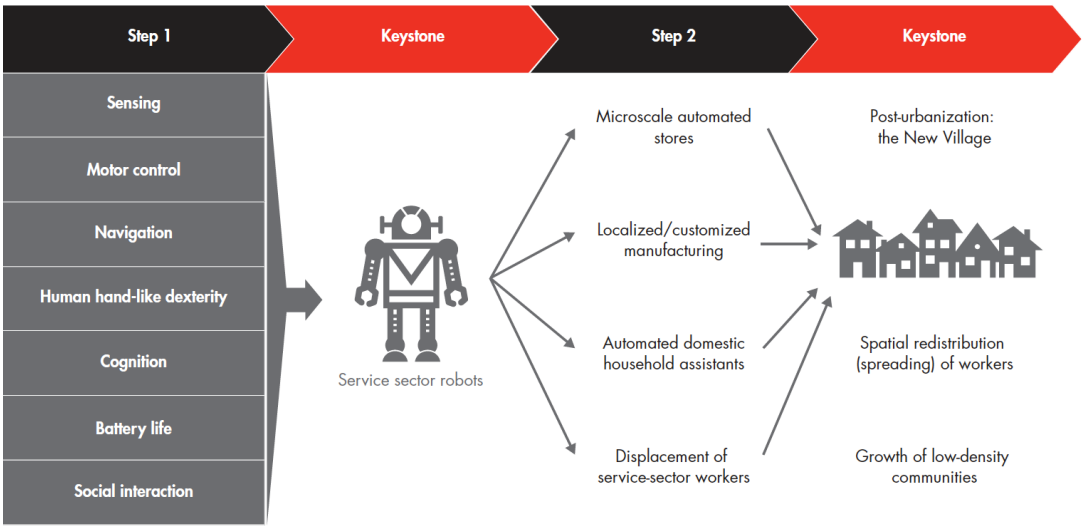
Declining agglomeration advantages and cost of distance – the new glocal. At a lower geographical level, it is expected that there will be increasing links between local and more decentralised locations and the global economic sphere. These increasing links imply reduced agglomeration advantages and probably an increasing sprawl of settlement structures, As the cost of distance declines, companies will be able to deliver economic output in a larger geographical area. Advances in service robotics, 3D printing and logistics technology are already reducing costs in manufacturing and service, allowing small scale production to be profitable. The expected levels of automation of many tasks (e.g. by service robots) could lead to a sharp reduction in the minimum efficient scale for many businesses, especially those providing consumer-oriented services (Bain & Company, 2016).

- **Additive manufacturing and digitisation allow decentralisation away from major locations and hubs.** 3D printing reduces the cost of distance as it allows local

production of standard parts and complex one-off items, reducing the need for central manufacturing and warehousing. Storing designs electronically and using a standard set of printer substrates to build products eliminates the need for large warehouses while increasing the variety of parts that smaller units can inventory. That development allows for a shift to more small-scale and decentralised economic structures in close proximity to end-users. Consequently, huge production and storage depots and hubs for cheap land transport of mass products may lose some of their importance.

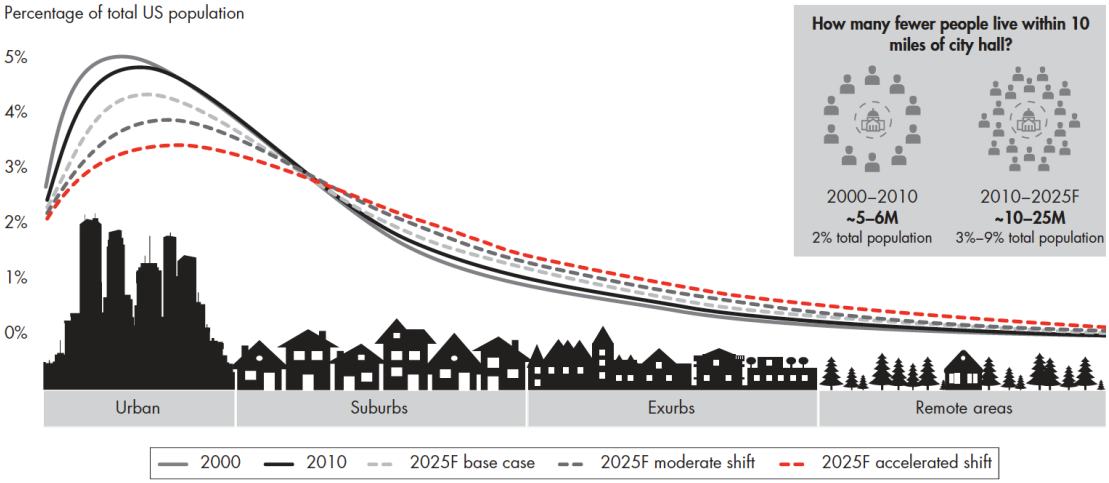
- **New mobility will support decentralisation and sprawl.** New technologies enabling autonomous vehicles and delivery drones are expected make transportation more efficient in the coming decade, lowering costs, especially for the last mile. Advances in logistics technology and drones will continue to improve last-mile economics and allow businesses to deliver goods to consumers' homes faster and at lower cost. This will further support trends towards decentralisation but will also increase the risk for urban sprawl.
- **Increasing urban sprawl.** Looking at land use, Bain & Company (2016) expect that over the next decade, the growth of households in rural and exurban areas compared to city centres will start to look like a barbell. Some cities will continue to grow successfully, attracting the wealthy, the young and empty nesters. However, in general the number of people living in urban agglomerations is expected to decrease as agglomeration advantages related to working life and consumption decline. Bain & Company even talk about a 'post-urban economy', in which people choose where to live based on lifestyle characteristics and amenities (e.g. good weather, vibrant social and cultural offers, proximity to recreational activities, family or peers).

Figure 5.4 Key developments combining technologies and spatial economics



Source: Bain & Company, 2016: 16

Figure 5.5 Urban sprawl caused by new technologies



*As defined by the US Census Bureau, for each metropolitan statistical area (MSA), city hall for the largest city has been used as a proxy for the area's central business district. Chart shows US Census data for 366 MSAs, about 85% of US population
†Increase in spatial dispersion for an MSA has been calculated as share of total MSA population staying within 0–10 miles of a city hall in 2000 minus that in 2010
‡2010 population equivalent is the distribution of population if the total population in a given year were the same as 2010, excluding the effect of birth rates, death rates and migration

Source: Bain & Company, 2016: 18

Technology to soften the impact of ageing. As outlined earlier, ageing is an important challenge for large parts of Europe. Technological changes may help to cushion some impacts, both for the labour force needed to produce goods and services (economic growth) and also the labour force needed to cover increasing demands in the care sector (sustaining welfare services).

Social inequalities will increase. While the above highlight increasing differences between locations, disparities within single locations will also increase. There will be an increasing social gap between key players in technological change and those left with an increasingly precarious economic and social outlook (Réchard et al., 2016).

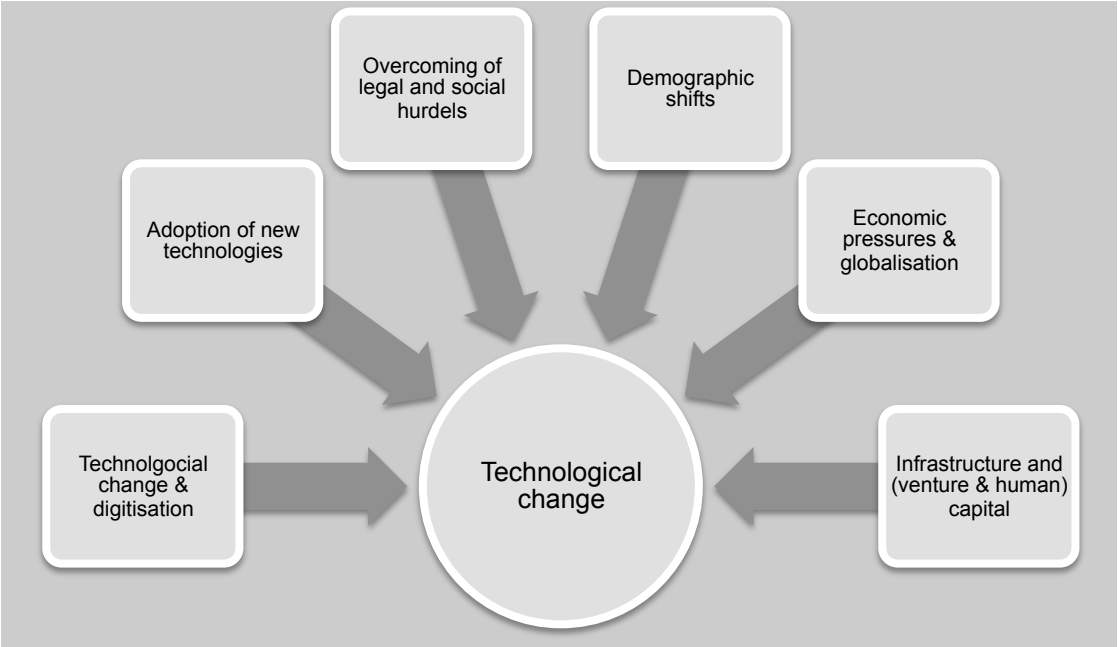
5.2.3 Further outlooks

There will be major impacts on economic development in Europe, and a clear challenge will be to stay ahead of developments and to provide frameworks where corporate and social players are among the first to shape the 4th industrial revolution. This concerns also social impacts.

Technological developments are driven by a number of factors. The text box below addresses some of the key drivers for technological change.

Drivers for technological change

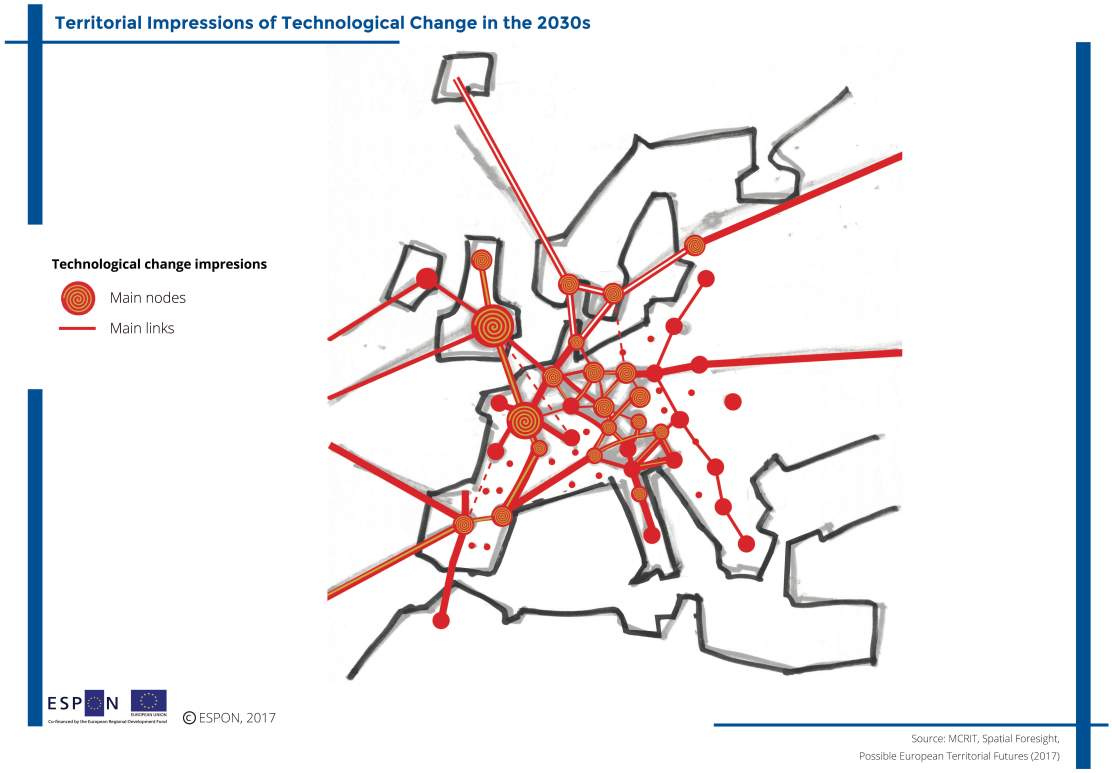
The figures below illustrate some of the drivers of technological change, which may become relevant in the further discussion of possible European futures (Joint Research Centre, 2016).



Picking up some of the key features of the future technological change, Figure 5.6 provides a sketchy image of the expected territorial diversities. Key messages from this figure include:

- The focus is on the increasing importance of networks (represented in red links and circles). Networks (transport and communication networks, energy grids…) are represented integrated in a single cross-border network linking territories inside Europe as much as globally. The network has more density in the centre than in the periphery.
- The main nodes in those networks are large and medium-size talented cities where key innovators and early adopters provide the basis and long-lasting advantages for local and regional development (circles). RDI capacities will continue to concentrate in Europe's capital city regions and regions with high technological activities. There will probably be strong territorial, economic and societal concentration processes, as innovation leaders will have the most advantages, while adapters will benefit less.
- New technologies may reduce agglomeration advantages and bring more decentralisation, especially production processes, but will also increase urban sprawl (this is represented in the map by isolated red points)

Figure 5.6 Territorial impressions of technological change in the 2030s



Europe's technological development until 2030 is connected to major uncertainties. This concerns both which technological changes will have a breakthrough, when these come and how this will affect advantages and disadvantages of locations in Europe. In particular, with regards to factors such technology, legal frameworks, social acceptance and economic pressure, developments can take very different directions from critical bifurcation points. Further developing the work of previous ESPON studies (ESPON, 2014c), the textbox shows a selection of bifurcation points.

Possible bifurcation points

One of the few certainties about future developments is that they are rarely linear. There are a variety of possible bifurcation points at which developments can take different turns, desired or not. Possible bifurcation points related to technological developments are:

- Technological breakthroughs could provide key disruptions. The type and pace of technological change (e.g. automation) can imply exponential growth[9] of new technologies or technological progress limited to the fine tuning of current applications.
- Social and political acceptance of new technologies can easily turn into critical bifurcation points. This can range from frenetically embracing new technological solutions to complete non-acceptance and political or social protection against technological change.

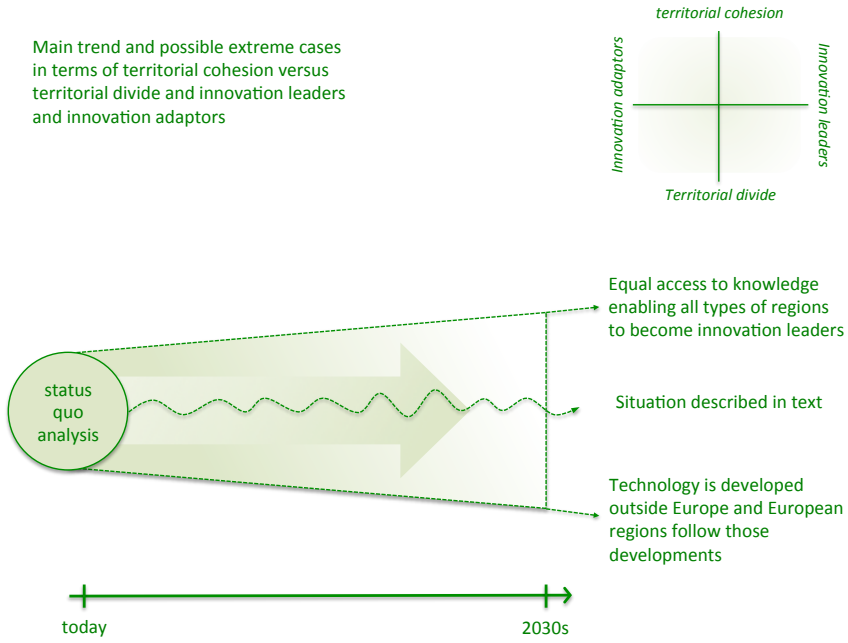
[9] If machines were to develop an understanding of natural language on a similar level to humans, automation would advance, notably in retail, finance, insurance and health care. Artificial intelligence could potentially open the way for unlimited automation.

- Cyber security or even wars hold the potential for major bifurcation points. Generally, an inability to maintain cyber security would severely limit societal trust in new technologies and subsequently the automation of white collar jobs.
- The environmental impact may also result in bifurcation points. So far there is no agreement among experts whether expected technological changes will increase the efficiency of resource use and thus contribute to a better environment or lead to an explosive growth in consumption of (plastic 3D printed) goods, potentially increasing the environmental burden?

The above bifurcation points allow to discuss technological developments presenting alternatives to the general trends presented in the previous sections Figure 5.7). The figure illustrates the main trends as described in the previous sections and extreme cases defining the bandwidth of possible technological futures, following the bifurcation points as described above.

The two extreme cases are based on regional innovation capacities and levels – in short innovation leaders and innovation adaptors. The innovative capacity of a region illustrates its 'future proofness'.

Figure 5.7 Range of possible technological futures



Source: ESPON Futures project team

The first extreme case is characterised by easily accessible knowledge that is shared without barriers – tacit knowledge has disappeared as ICT and technological development made everything accessible – allowing all types of regions to make use of this knowledge and become innovative leaders. A balance between different regions will be established as regions can be mutually dependent on each other's innovations and knowledge and their regional innovation systems might be complementarily specialised.

The other extreme case, illustrating the lower bandwidth of possible socio-economic futures, is characterised by polarising and competing regions regarding new knowledge and innovations coming from outside Europe. Europe will be only capable of adopting knowledge, rather than inventing new products and services which leads to competition between the regions in being the first to successfully adopt the new technology in their context.

6 Key conclusions on territorial cohesion

The state of European territory and the outlook for 2030 described in the above chapters allow some initial conclusions as to whether Europe moves towards more or less territorial cohesion.

In short the key messages in terms of territorial cohesion are:

- **Increasing polarisation of settlement patterns.** The territorial concentration of population has several dimensions which are expected to become stronger and which may even mutually reinforce each other:
  - **Focus on metropolitan areas.** There are polarising trends between metropolitan and non-metropolitan regions which are expected to increase in the years to come. This also implies a greater urban-rural divide.
  - **Focus on urban centres in Western and Northern Europe.** General trends in favour of population growth in urban centres are accompanied by the effects of a territorial imbalanced age structure. These pose more challenges for regions in Eastern Europe and many rural regions.
  - **Sub-urbanisation process.** Technological developments might support medium-sized settlements and more 'rural' areas close to urban centres.
  - **Territorial concentration and challenges are accelerated by migration.** Migration within countries as well as at a global level might accelerate concentration tendencies described above. As new phenomena, Europe might need to cope with increasing emigration of young talents to other parts of the world.
- **Increasing concentration of economic activities.** Developments towards socio-economic cohesion in Europe have been stalled by the crisis starting in 2008. Since then, and probably also for the future, asymmetric growth and developments are expected:
  - **Concentration of GDP growth.** Over the last decade and also for some time to come, economic wealth is expected to concentrate in the European core extending from Switzerland and southern Germany to the Czech Republic, Slovakia and south western Poland to the east. The catching-up process in Eastern and Southern Europe is expected to be cumbersome and take a long time – if it happens at all.
  - **Metropolitan areas performing better than other types of territories.** As with demographic developments, increasing economic disparities between metropolitan and rural areas are expected. This concerns both GDP and employment.
  - **Increasing social inequality.** At various geographical levels, socio-economic development is expected to increase social inequality. This concerns inequality between different parts of Europe, between regions in the same country and between people living in the same city or region. Basically this means the rich becoming richer and poor becoming poorer.

- **New economic ideas may rock the boat.** A number of fundamental economic considerations are on the table right now. If some of them turn mainstream and cause actual adjustments to the economic system, things will change.

- **Climate change and environment are growing concerns.** Increasing soil sealing and artificial land use as well as energy production and consumption remain important territorial development issues tightly linked to climate change in the years to come:
  - **Increasing levels of artificial land use especially around urban areas.** The increasing concentration on urban areas leads to increasing land use around metropolitan areas. This is particularly pronounced on the Iberian Peninsula and in Poland, the UK and Ireland.
  - **Territorial imbalances between climate change vulnerability and adaptive capacity.** Taken together, Europe's southern, eastern, coastal and mountain areas are most vulnerable to climate change. At the same time, the capacity to adapt to climate change is highest in the wealthy northern parts of Europe. This creates substantial imbalances between vulnerability and adaptive capacity.
  - **Eastern European economies have the highest energy intensity.** The energy input needed for economic activities various considerably across Europe. Declining substantially in the past years in Eastern Europe, though energy intensity there is still considerably higher than in Western Europe.
  - **Territorial potential for renewable energy not sufficiently used.** The potential for renewable energy production depends largely on territorial specificities (wind, sun, geothermal, land for biomass production, etc.). Comparing areas with high potential and where renewable energy is produced and is expected to grow, shows severe mismatches.

- **Technology and innovation hold the potential to make new regional stars.** As in earlier cases (see the breakthrough of information and communication technologies), it is expected that major technological innovations including robotics and fusion technology will reduce the importance of location. In other words, production can be decentralised (e.g. through 3D-printing) and people can work from wherever they like. However, until then it seems that location does matter.
  - **Urban areas in Northwest Europe are innovation locations.** Innovation and its use is largely concentrated in capital cities and Northwest Europe. Looking more particularly at key enabling technologies and SMEs, the picture is more balanced. Still, the most challenged regions are in Croatia, Bulgaria, Hungary, Poland, Romania, Slovakia and Spain.
  - **Green tech innovations are even more concentrated.** In the light of green growth and a green economy, particular innovations in these fields may hold the key for future developments. Counting patents, western and southern Germany, Denmark, southern UK and parts of Belgium and the Netherlands lead the way. Other hotspots are metropolitan and capital regions mainly in Western Europe.

- **4th industrial revolution accelerates territorial differences.** To a large extent it is expected that the next wave of technological changes (the 4th industrial revolution) will exacerbate the differences between technological/economic players and also between cities and regions. It is assumed that over the coming decades the advantages will be on early adapters as 'the winner takes it all' will be the driving principle.
- **Decreasing agglomeration advantages and increasing sprawl.** Urban sprawl is expected to increase as new forms of mobility paired with decentralisation possibilities reduce agglomeration advantages. In some cases even the advantages of major transport hubs for goods can be questioned.

Putting all this together, it seems that general development trends point to an increasing role for metropolitan regions but not necessarily balanced across the European territory. So, there is potential for polycentric development but at the same time territorial cohesion is become an ever more distant idea. In other words, if territorial cohesion remains a policy objective it is unlikely to be achieved by itself.

Pointers for policies

If territorial cohesion is to be achieved, major efforts need to be undertaken to ensure more balanced development at all geographical levels. Single measures addressing single drivers will not be sufficient to turn developments towards territorial cohesion. The below are a few suggestions or pointers for policies – both high and low level:

- **Rural-urban partnerships and inner peripheries.** In policy terms rural-urban partnerships and inner peripheries have been less emphasised in recent years, given growing disparities this choice could be reconsidered.
- **EU Cohesion policy to diminish disparities.** To reduce increasing socio-economic disparities the basic idea behind EU Cohesion Policy might need to be revamped and instruments reconsidered with regard to their contribution to that objective.
- **Make better use of renewable energy potential.** Territorial potential for renewable energy is not used to the maximum extent possible. Increasing the use of territorial advantages to produce renewable energy can boost development substantially. This needs to be paired with development of the necessary infrastructure and grids.
- **Increase adaptive capacity to climate change.** In particular, areas with a high vulnerability to climate change and a medium to low adaptive capacity, may need more intensive work.
- **Ensure attractiveness of all places.** To ensure that not only selected metropolitan areas are key points of attraction and drivers for development, all locations need to be empowered for further development. Services of general economic interest may be an important vehicle for this.
- **Place-based policy making.** The principles of place-based policy making for governance and the involvement of relevant players may still hold the key to improving the situation.
- **Wide European and national policies.** In many cases the key to increased territorial balance lies not necessarily with regional policy but with a 'tailor-made' mix of sector policies at various levels.
- **The policy and legal environment matters.** Preparing for early adaptors in key innovations and technologies is not only about creating the right environment in terms of innovation environment, human capital, technology infrastructure and venture capital. It is also about adjusting regulatory and legal frameworks to suit upcoming technologies. This may decide which locations are winners in the end.

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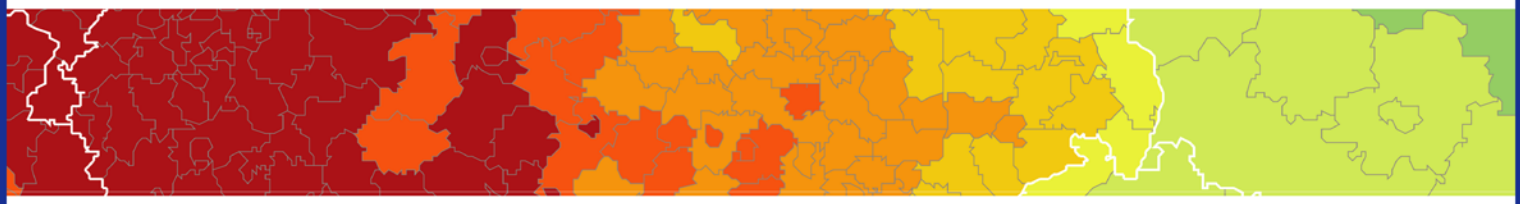

ESPON 2020 – More information

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