ESPON

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Inspire policy making by territorial evidence

Possible European Territorial Futures

Applied Research

Final Report
Volume D – Place Based Circular Economy

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Possible European Territorial Futures

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Abbreviations

EC	European Commission
ESPON	European Territorial Observatory Network
EU	European Union
GDP	Gross domestic product
GVA	Gross value added
IoT	Internet of things
NGO	Non-governmental organisation
NSRR	North Sea Resources Roundabout
NUTS	Nomenclature of Territorial Units for Statistics
PPS	Purchasing power standard
R&D	Research and development
R&I	Research and innovation
RDI	Research, development and innovation
SME	Small and medium-sized enterprise

1 Introduction

This report provides background information and nuanced considerations concerning the territorial foresight for a place based circular economy presented in Volume A of the Final Report.

Following conceptual clarification in this chapter, chapter 2 summarises what the European territory would look like if it were a place based circular economy and includes reflections on how much this would support various territorial scenarios.

Chapters 3-5 address the territorial dimension of three specific components of a place based circular economy, i.e. (chapter 3) resource efficient production, (chapter 4) resource efficient consumption, and (chapter 5) changes in the transport and flow of goods. Building on literature studies, two online surveys, two focus groups and one webinar, key factors in each of the three components have been identified to illustrate the territorial dimension.

Chapter 6 highlights that a European future in a place based circular economy may look very different, depending on which component is put at the forefront. This is illustrated with the help of two scenarios.

Finally, chapter 7 sums up the results of the report and provides pointers for policy development.

2 The place based circular economy Europe we wake up in

A place based circular economy brings together the idea of the circular economy (see Ellen MacArthur Foundation et al., 2015; European Commission, 2015a; European Environment Agency, 2016; World Economic Forum, 2014, 2015) with the idea of place based policy making (see Barca, 2009; European Commission, 2015b; Zaucha et al., 2013). In the place based circular economy Europe we wake up in resource efficiency is key to economic activities, particularly production. This includes reducing waste to a minimum while maintaining the value of products, materials and resources in the economy for as long as possible. In a circular economy the amount of newly produced products declines as reuse and repair become mainstream. This implies that territorial patterns change shaped by the key assumptions presented in the textbox below.

Key assumptions

The transition to a place based circular economy implies drastic transition in all cities and regions involving:

- **Resource efficient production systems – changing production patterns**
  - Reducing waste to a minimum
  - The value of products and resources remains in the economy for as long as possible
  - Less products are produced
  - Repair, reuse and recycling implies a shift from large to smaller production sites

- **Resource efficient use- changing societal and behavioural patterns**
  - Focus on use rather than ownership, sharing resources
  - The understanding of prosperity moves beyond GDP

- **Place based – balancing local and global interaction**
  - Making the best use of a region's endogenous resources
  - Involvement of local population and local influencers
  - Transport and trade continue
  - Migration continues

Based on the above understanding and key assumptions of a place based circular economy answers to the question "What could be the territorial consequences if Europe had a place based, circular economy by 2030?" can be explored.

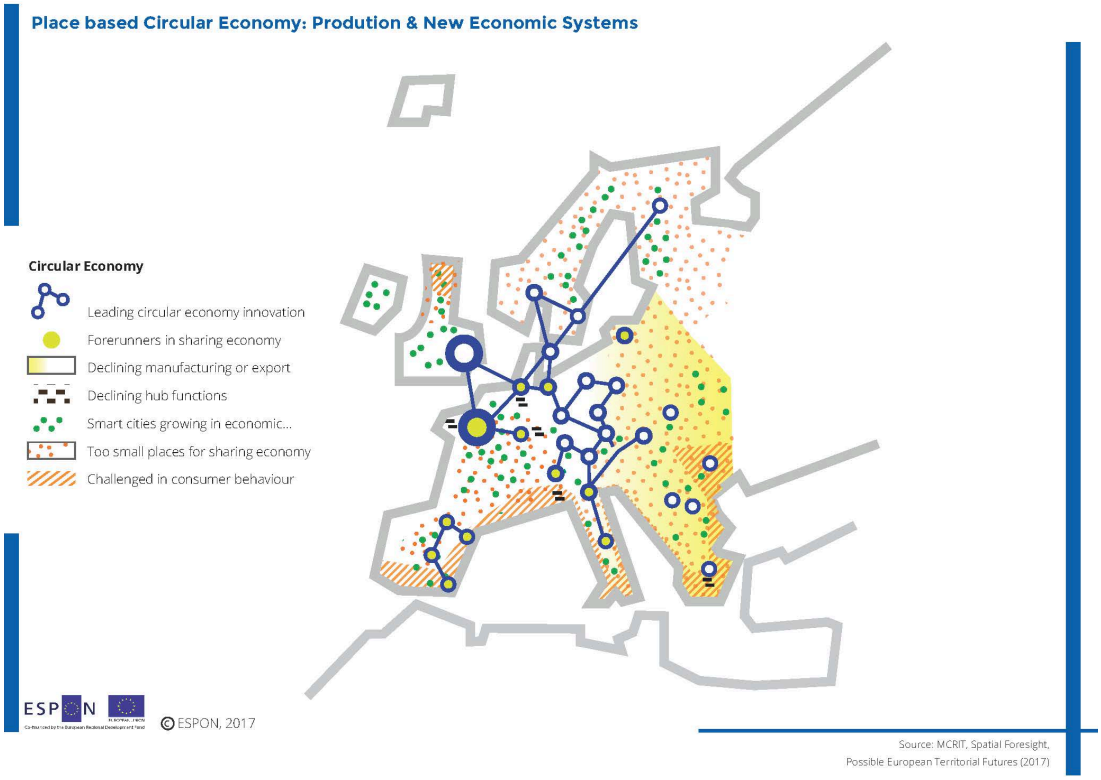
Europe's territorial diversity in a place based circular economy:

The project identified a number of key components for the territorial dimension of a place based circular economy in the 2030s, adapting the approach to territorial impact assessment developed within ESPON. Impacts are defined through the exposure and sensitivity of a territory to a specific component.

- **Exposure:** Taking different components of the foresight topic as starting point, exposure is determined by asking: Is a region/territory likely to be (positively or negatively) affected by the change?
- **Sensitivity:** Taking regional characteristics as starting point, sensitivity is determined by asking: To what degree will regional development be affected? What is the intensity of impacts due to specific regional characteristics?

Europe's territorial structure under a place based circular economy will differ from the one we know today. This economy will imply dramatic changes for all parts of Europe and will also affect urbanisation and territorial balance. At a European level, the differences between strong socio-economic areas and the lagging regions may reduce under a place based circular economy. The map below illustrates the potential for small and medium-sized towns, as well as the challenges for sparsely populated areas and inner-peripheries. It also highlights the importance of networks in driving innovations in a circular economy and leading areas in the sharing economy. Furthermore, the map shows areas which could expect particular transition challenges in consumer behaviour (including tourists) and changing manufacturing structures.

Map 2.1 Territorial impacts of the transition to a place based circular economy



Source: ESPON Futures project team

Key aspects of changes in territorial patterns from today and indications on how the patterns may differ in a place based circular economy are described as follows, under three components; production, consumption and transport flows.

Resource efficient production systems. In a European place based circular economy, resource efficiency is key to economic activities, particularly production. This includes reducing waste to a minimum while maintaining the value of products, materials and resources in the economy for as long as possible. In a circular economy the total amount of newly produced products declines. In territorial terms, this means that key patterns change:

- **Large scale manufacturing will experience significant economic transition,** adjusting to reduced production quantities and industrial symbiosis. This will be a challenge to all cities and regions with significant manufacturing employment and contribution to GDP. In particular, areas with low resource efficiency will face particular transition challenges. The same goes for cities and regions with a limited variety of manufacturing activities which can cooperate to establish residual streams. Among the areas facing particular transition challenges are regions in the Czech Republic, most rural regions in eastern Romania, regions with high levels of manufacturing in Bulgaria, rural Poland and partly rural areas in Estonia. Some of these regions may lose considerable parts of their manufacturing capacity in a circular economy if they do not manage the transition well.
- **Innovations are needed for a transition to circular economy production systems.** Areas with strong innovation profiles, especially eco innovation and the green economy, face less of a transition challenge. This further underlines the focus on the core and Northwest of Europe as drivers of the change. Ile de France, the south coast in the UK, Switzerland, large parts of Southern Germany as well as most urban agglomerations in Germany, Northern Denmark, the Øresundregion, metropolitan regions of Sweden, plus Northern Sweden and the capital region of Finland may increase their standing as areas where key innovations serve the economic transition across Europe.
- **The strong focus on 'repair, reuse and recycle'** implies the creation of new jobs in labour intensive sectors. In a place based circular economy these new jobs will be generated throughout Europe. While in economically stronger regions this will partly help to replace jobs lost in other sectors, economically weaker areas should see new job opportunities. The emergence of new economic activities to 'repair, reuse and recycle' should follow the territorial logic of providing services of general interest meeting 'everyday demands'. In other words, these activities will be strengthened in all major settlements, though inner peripheries some way from the next large settlement will not profit from this upswing.

Resource efficient use. A place based circular economy cannot be implemented as a purely technical solution. Indeed, it is not only about the way we produce goods but also about the way we use them. Resource efficient use of products will be a key feature strongly influencing behaviour and social capital.

- **A focus on 'repair, reuse and recycle'** implies households becoming more resource efficient and household waste an exception as the focus is on reuse and recycling. Areas

that already have limited levels of household waste and significant recycling will be frontrunners in that transition. Areas with high levels of household waste per capita and limited recycling will face a more drastic transition. In many cases these are areas where high numbers of tourists or visitors increase the amount of household waste. Among these are Malta, Cyprus, tourist areas in Scotland, along the Atlantic coast of France and regions along the Mediterranean coast in France, Greece, Italy, Spain, Croatia and the Algarve in Portugal, as well as tourist urban nodes, such as Venice, and winter sport destinations

- **The sharing economy** is important for increasing resource efficiency. This can either be done through internet sharing platforms or on the basis of informal and small scale collaboration. A significant increase in product sharing (beyond occasional car or ride sharing) towards a large range of products and most of society implies major societal transitions. Cities and regions which are already forerunners in sharing and collaboration initiatives should have an easier transition, in particular if they have a critical mass of inhabitants. The level of societal trust also plays a major role. Among potential frontrunners are urban agglomerations in France, Ireland, Latvia, Croatia, Germany, Estonia, Romania, Spain and Italy. Areas with limited use of sharing and collaboration platforms, low population density and/or low levels of societal trust face more dramatic challenges in the transition. Among these areas are rural regions in Cyprus, Malta, the Czech Republic, Portugal, Finland and Lithuania.
- **Changing understanding of prosperity.** Given the above transition, a place based circular economy may be accompanied by developments towards a post materialistic social model, or at least an understanding of prosperity going beyond GDP. The territorial dimension of such a transition is hard to judge. The European social progress index (European Commission, 2016) and the European quality of sub-national government index (European Commission, 2014: 171) provide insights into the expected capacity to cope with and support societal transition in promoting a place based circular economy. This may be particularly challenging in regions with low quality government, such as South-Eastern Romania, Eastern Bulgaria and Southern Italy.

Balancing local and global interactions - transport and flows between territories. A place based circular economy implies changing transport patterns. Among others, the amount of goods and raw materials transported over long distances is expected to decline considerably. Less material goods will be produced and these will be used, shared, reused and repaired, so they last considerably longer. In addition, industrial production symbiosis will lead to production sites clustering. This contributes to changing patterns for European urban areas and in the role some cities play.

- **Major international freight transport hubs lose importance.** Cities and regions which host major freight ports and airports and have a high share of employment in the logistics sector are challenged by declining transport in a place based circular economy. Some

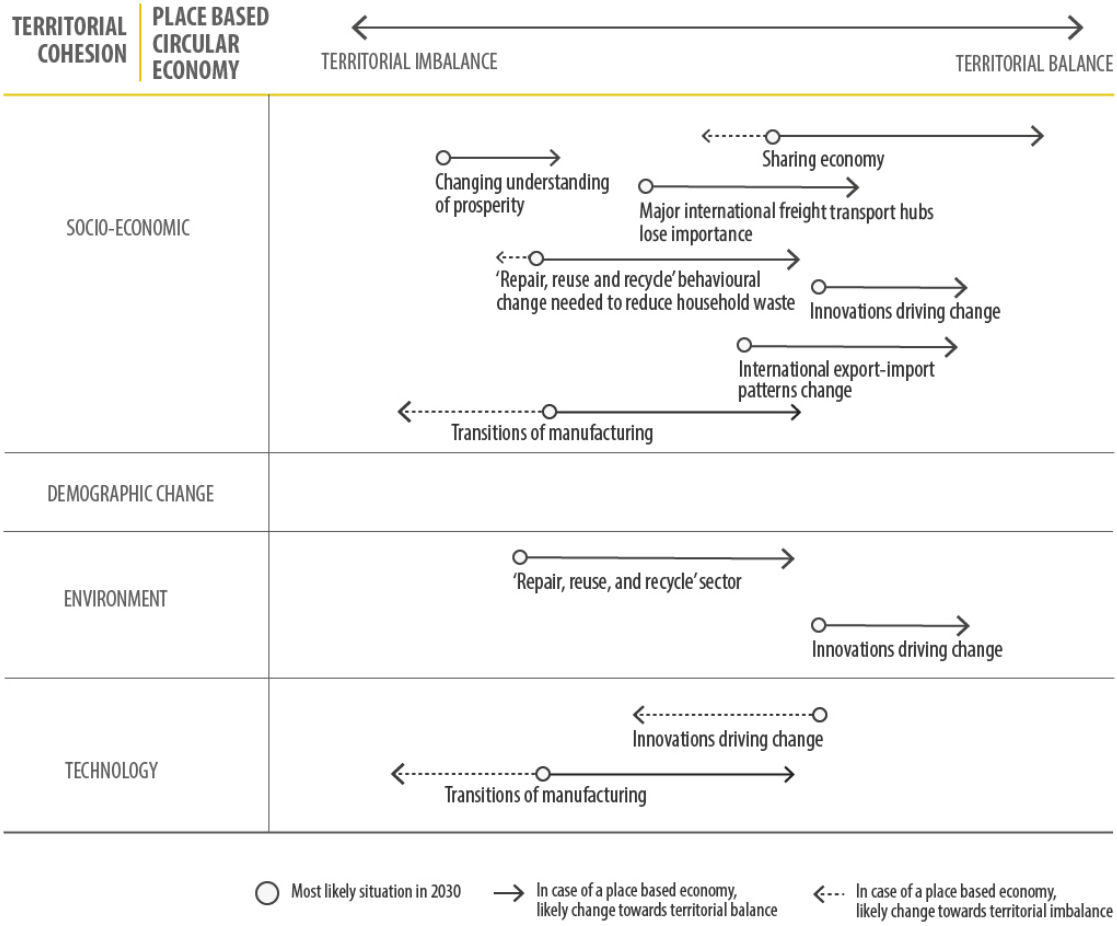
major urban agglomerations may lose some of their dominance. Among these are metropolitan regions, some of which have major ports, including Rotterdam, Antwerp, Bremerhaven, London, Paris, Genoa, Helsinki, Riga and Athens.

- **International export-import patterns change.** The transition of production systems to a circular economy implies changing export and import patterns. Cities and regions with highly international economies and economic players highly dependent on international imports and exports face particular transition challenges. These include manufacturing regions in Belgium, the Netherlands and Ireland, which will be less prominent in future.

Taking all these points together, a place based circular economy implies dramatic changes for all parts of Europe as well as the European urban system and territorial balance. At a European level differences between socio-economic strong points and lagging regions may become less pronounced in a place based circular economy. However, this will be highly dependent on the capacity of lagging regions to adopt innovation systems and offer job opportunities that encourage a place based circular economy.

To conclude and stimulate further thinking, the below figure presents an attempt to summarise in what way a place based circular economy might change the expected territorial outlook presented in Volume B. The figure illustrates the results with regard to the single factors used in the analysis and main topics for describing the current territorial situation of Europe and future outlook presented (see volume B). The arrows indicate whether a place based circular economy is expected to give a push towards more territorial imbalance or balance at European level.

Figure 2.1 Place based circular economy impacting on tomorrows territorial patterns



Source: ESPON Futures project team

At the same time, things may turn out differently if particular aspects are emphasised (see box).

Scenarios for different approaches to a place based circular economy

Key features of alternative futures can e.g. develop along variations of the aspects listed below under 'place based' and 'network based'. These points have been further developed to more full fleshed alternative scenarios in chapter 6 looking into global industrial waste management and local behavioural change.

Place based:

Such an economy implies drastic transitions for all cities and regions. These include:

- Transition to a low-carbon economy;
- Use of advanced nano- and biomaterials;
- IoT optimisation;
- Additive manufacturing;
- Virtualisation;
- Automated production and logistics;
- Collaborative consumption;
- Zero waste and nature based solutions.

Network based:

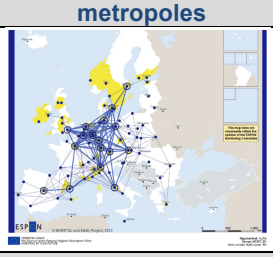
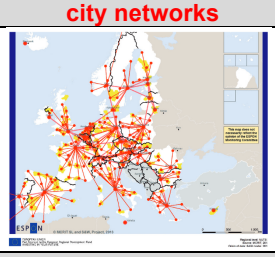
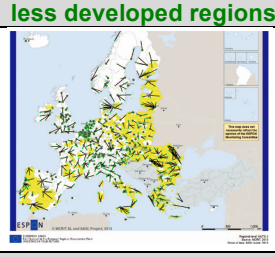
Multiple players in business and research, supported by policy makers and investors, reconceive key manufacturing processes and flows of materials and products, establishing standards for recycling components and materials. They close material loops on a global level, achieving tipping points that bring a high volume of quality materials back into the system, through established markets. The paradigm shift from disposability to restoration could almost eradicate waste. Eco-design makes products more durable and easier to repair, upgrade or remanufacture. The consumer is replaced by the user.

The place based circular economy creates more potential for territorial cohesion in Europe, as aspects such as additive manufacturing, a stronger focus on 'reuse, repair and recycle' as well as the declining importance of transport hubs, provide opportunities for smaller, more peripheral and lagging areas to grow, while some dominant urban agglomerations lose importance, as a declines in production and transport of goods reduce agglomeration advantages and challenge hub functions.

At the same time a place based circular economy may also emphasise territorial disparities in Europe. Some regions that heavily depend on large scale manufacturing may fall behind, regions leading in green technology solutions may become even more dominant, and some behavioural changes may affect convergence regions more than leading regions.

To see whether the expected territorial changes imply a move towards more territorial cohesion (see analysis in volume B) the following table highlights the expected change based on three policy scenarios developed by the ESPON ET2050 project. These scenarios focus on polycentricity at three different geographic scales based on networks of (a) major global or European metropolis, (b) urban areas of national or transnational importance, so-called secondary cities, and (c) cities of regional importance.

Table 2.1 Place based circular economy contributions to ET2050 scenarios

	Focus on large metropoles	Focus on secondary city networks	Focus small cities and less developed regions
			
Resource efficient production systems			
Transition of manufacturing	↓ Central large-scale manufacturing places will decline	↑↑ Stronger focus on decentralised production	O Only secondary effects for small cities
Innovations driving change	↑↑ Centres of innovation will be very centralised	↑ All areas will benefit as innovations are quickly shared across territories.	↑ All areas will benefit as innovations are quickly shared across territories.
'Repair, reuse & recycle' sector	↑ All areas will benefit from new local jobs in the repair and reuse sector	↑ All areas will benefit from new local jobs in the repair and reuse sector	↑↑ Increase of jobs throughout the territories, also in small centres
Resource efficient use			
'repair, reuse and recycle'	↑ Household waste will decline in all areas	↑ Household waste will decline in all areas	↑ Household waste will decline in all areas
Sharing economy	↑ Bias towards urban centres with a critical mass	↑↑ Bias towards urban centres with a critical mass	↓ Small places may face challenges establishing a sharing economy
Changing understanding of prosperity	↓ Agglomeration advantages might become less important	↑ Changing value systems may hold potential for secondary cites	↑↑ Changing value systems hold potential for lagging regions
Transport and flows between territories			
Major international freight transport hubs lose importance	↓ Major metropolitan areas face decreasing importance	↑ Stronger focus on decentralised production	O Only secondary effects for small cities
International export-import patterns change	↓ Export dependent major cities see declining economies	↓ Large scale manufacturing cities see declining economies	↓↓ Connectivity for rural and peripheral areas may decline

↑↑ Strong developments in support of this scenario
↑ Development in support of this scenario
O Neutral with regard to this scenario
↓ Developments counteracting this scenario
↓↓ Strong development counteracting this scenario

3 Component – Resource efficient production systems

This section addresses the territorial dimension, identifying crucial characteristics of this component and discusses territorial exposures and sensitivities.

3.1 Why this component is important

In short, a place based circular economy implies more resource efficient production of goods. This is at the forefront of the EU Circular Economy strategy as well as the mainstream discussion about the circular economy being a perspective of future growth (EASAC, 2016; Ellen MacArthur Foundation et al., 2015; European Commission, 2015a; European Environment Agency, 2016; World Economic Forum, 2014, 2015).

A circular economy could reduce the primary use of resources by 32% by 2030, which would translate into a cost reduction for final users of 42% and a 0.3% annual increase in economic growth (Aachener Stiftung Kathy Beys et al., 2017).

A place based circular economy also implies changes in the way industries and production systems are designed and integrated into each other. To reduce material input, making use of the residuals of one process as a resource in another process, upscaling recycling and remanufacturing will necessitate a number of changes. In short, the focus will shift towards a comprehensive networked production system instead of production being concentrated in big firms and sites. New types of knowledge creation and transfer are needed and innovation potential is an important asset in a place based circular economy.

Concrete examples of single enterprises moving towards a circular economy can be found in leading news media[1] as well as in a book on the Blue Economy presenting a large collection of real case examples (Pauli, 2010).

3.2 Territorial exposure and their sensitivity

A place based circular economy implies the more resource efficient production of goods. It also implies a comprehensive networked production system instead of production being concentrated in big firms and production sites. In this context, new types of knowledge creation and transfer are needed and innovation potential is an important asset.

While this applies to all cities and regions in Europe, exposure to the transition to a place based circular economy varies between territories. Not all areas undergoing major adjustment are equally sensitive. For some areas, adjustment may address substantial parts of their socio-economic environment, others may be better prepared.

- Areas with a high share of manufacturing and production will undergo greater transition than areas based on services (see section 3.3).

[1] See e.g. the Economist at https://www.youtube.com/watch?v=xaK452BF3Cw

- In areas with high levels of manufacturing, areas with industries that have low levels of resource efficiency[2] or limited reuse and recycling of resources are probably more sensitive to change than other areas.

- Highly specialised, mono-sector regions with big firms and corporate activities dominated by a few business groups may need more structural changes than regions with many small firms which often have higher adaptive capacity (see section 3.4).
  - Areas with highly specialised / single sector industries and regions with low levels of entrepreneurship or few SMEs are probably more sensitive to the change. Regions with high levels of entrepreneurship will probably find it easier to adjust and develop their production systems towards a circular economy.
- The transition process will also require a fair amount of innovation, research and development so production processes move towards a 'zero waste' or 'circular' economy. Accordingly, regions with institutionalised and connected R&D and education infrastructure will thrive (see section 3.5).
  - Among regions with low levels of innovation those with low shares of green economy or eco-innovation will be more challenged.

Local or regional characteristics imply different levels of potential and challenge for the transition to more resource efficient production systems in a place based circular economy.

3.3 Role of manufacturing and resource efficiency

Resource efficient manufacturing and goods production is a key characteristic of a place based circular economy in Europe.

Example: Industrial symbiosis in Helsingborg, Sweden

The idea behind Industry Park of Sweden (IPOS) in Helsingborg, Sweden, is industrial symbiosis. Innovative resource cooperation creates added value to reduce costs and environmental impact. IPOS is a fully developed site for industrial symbiosis, hosting some 20 companies in chemicals, food, logistics and services. All these companies collaborate around energy, material, utilities, logistics, infrastructure and services. An important part of the industrial symbiosis is that recovered energy is shared.

In addition to energy, collaboration around material flows is just as extensive, as the product or by-product from one plant becomes the raw material of another. In addition to saving costs and emissions from transportation, material collaboration increases resource efficiency and reduces waste streams and the consumption of new materials.

The added value of this is:

[2] See overall approach : http://ec.europa.eu/environment/resource_efficiency/targets_indicators/scoreboard/pdf/EU%20Resource%20Efficiency%20Scoreboard%202015.pdf

- 600 GWh of energy is recovered every year to replace the consumption of primary fuels for companies within IPOS and Helsingborg City.
- Recovered energy is the base load of the district heating network in Helsingborg, accounting for a third of demand.
- The recovered energy is produced by exothermal reactions and by heat recovery from product flows. If the corresponding volume of energy were to be produced by for example natural gas, yearly emissions would be 120,000 tons CO2/year.
- The energy-efficient central compressor plant replaced 30 decentralised smaller compressor units in 2010 and saved 2.4 GWh of electricity per year.

Source: http://www.circulary.eu/project/kemira-industrial-symbiosis/

3.3.1 Exposure

The ideas for a circular economy presented in the EU policies are highly relevant for regions with high levels of manufacturing and physical production. Economic players in these have to adjust their processes and activities, far more than economic players in regions with more services. The territorial implications are discussed here.

About 2 million enterprises, some 9% of all enterprises in the ESPON space, are classified as manufacturing. These employed about 30 million people in 2013. This means that of the NACE sections in the non-financial business economy, manufacturing was the second largest contributor to employment (22%) which was 26% of the Gross Value Added (GVA) in the non-financial business economy.

Areas with high levels of manufacturing can either be defined by the share of employment, or their GVA.

The northern Italian region of Lombardy (including the city of Milan) and the French capital city region of Île de France had the highest number of persons employed in 2013 in manufacturing. The regions with the next largest manufacturing workforces were Stuttgart (Germany) and Veneto (Italy). Overall, the top 20 regions in 2013 were dominated by eight German regions, accompanied by five regions from Italy, three from Poland, two from France, and one each from Spain and Portugal. These 20 regions accounted for 26.7 % of the EU-28's manufacturing workforce in 2013.

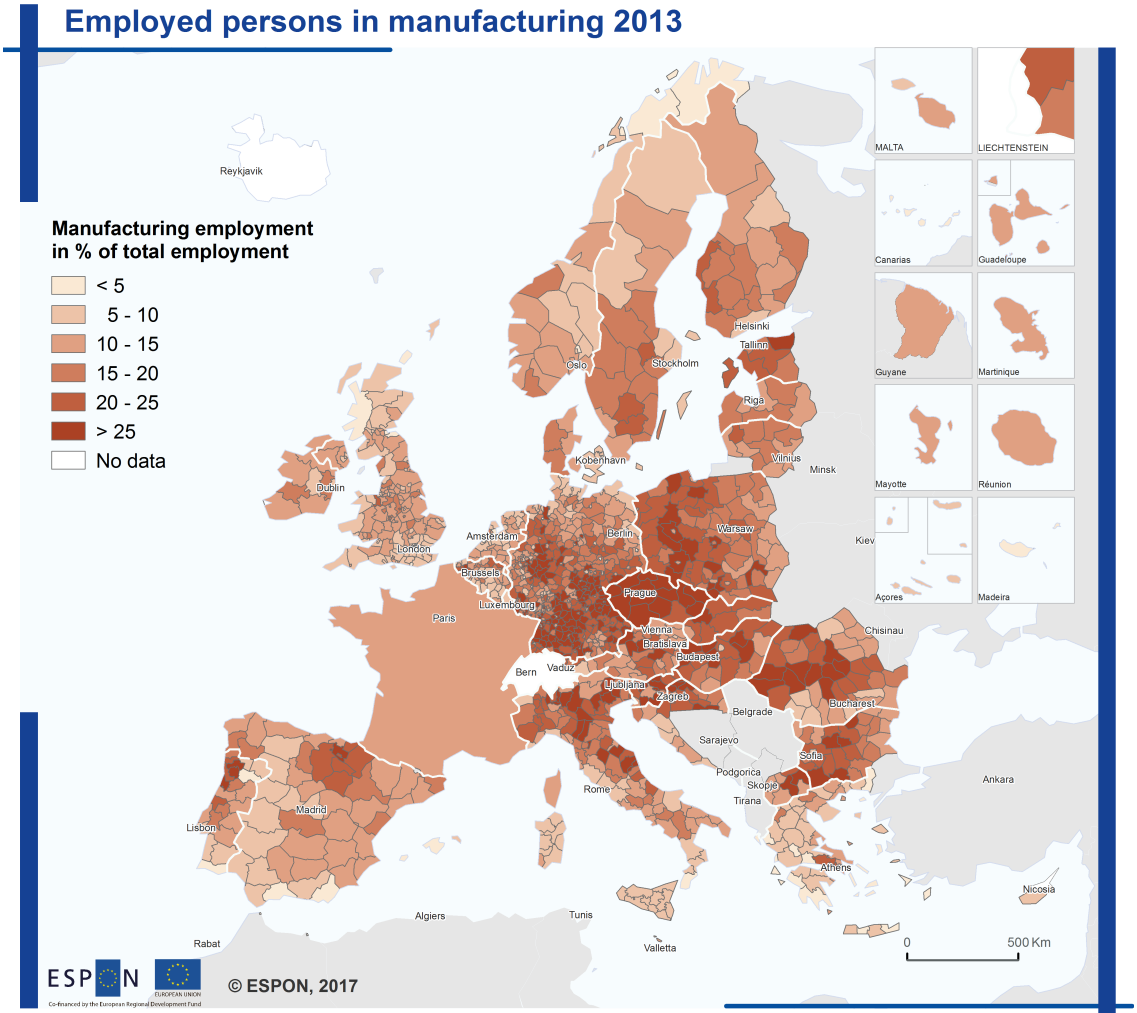
The relative importance of manufacturing can be analysed by comparing employment in this sector with the non-financial business economy workforce. Employment in manufacturing was concentrated, with some regions recording very low shares of manufacturing employment in the non-financial business economy. At the top end of the scale, the two Czech regions of Severovýchod and Střední Morava had manufacturing shares of 45.5 % and 44.5 % respectively, just over double the median share for all EU regions. In 45 regions,

manufacturing contributed more than 30.0 % of the non-financial business economy workforce. These were largely concentrated in central Europe and northern Italy: eight in Poland, six in the Czech Republic and five in Italy, five regions each in Hungary and Romania, and three regions each in Slovakia and Bulgaria, as well as one or two regions each in Sweden, Spain, Germany and Austria, Portugal, Slovenia and France.

At the other end of the scale, regions with the lowest share (10.0 % or less) of the non-financial business economy manufacturing sector were in Spain and the Netherlands (three regions each), the United Kingdom (seven regions), two regions in Greece and one in Portugal. The lowest share (1.1 %) was in the British capital city region of Inner London.

In general, GVA in manufacturing reflects the share of employment.

Map 3.1 *People employed in manufacturing, 2013*



Regional level: NUTS 3/ FR=NUTS 0 (version 2013)
Source: Spiekermann and Wegener Urban and Regional Research (S&W), Territorial Futures, 2017
Origin of data: Eurostat (online data code: nama_10r_3empers; nama_10_a64_e), 2013
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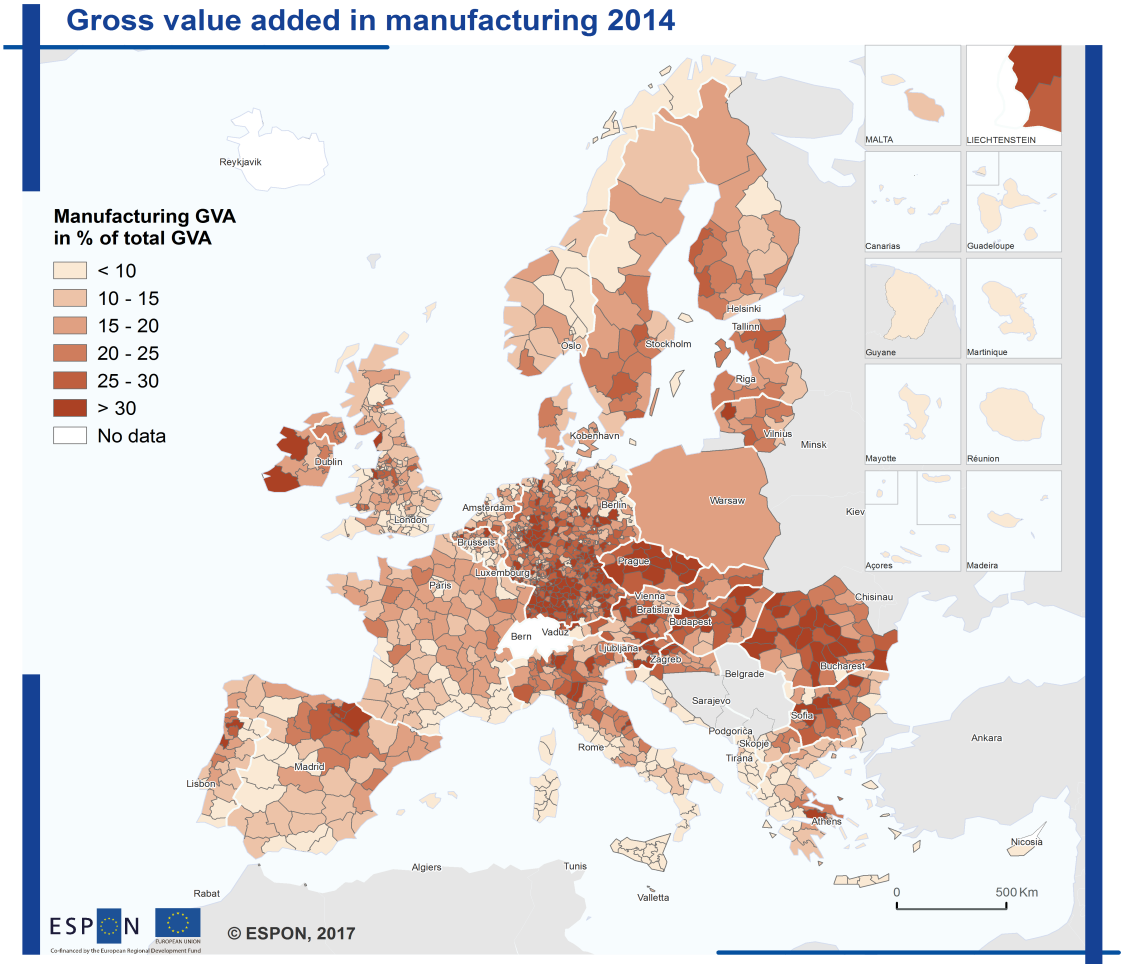
Map 3.2 Gross value added in manufacturing, 2014



Regional level: NUTS 3/PL=NUTS 0 (version 2013)
Source: Spiekermann and Wegener Urban and Regional Research (S&W), Territorial Futures, 2017
Origin of data: Eurostat (online data code: nama_10r_3gva; nama_10_a64), 2014
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3.3.2 Sensitivity

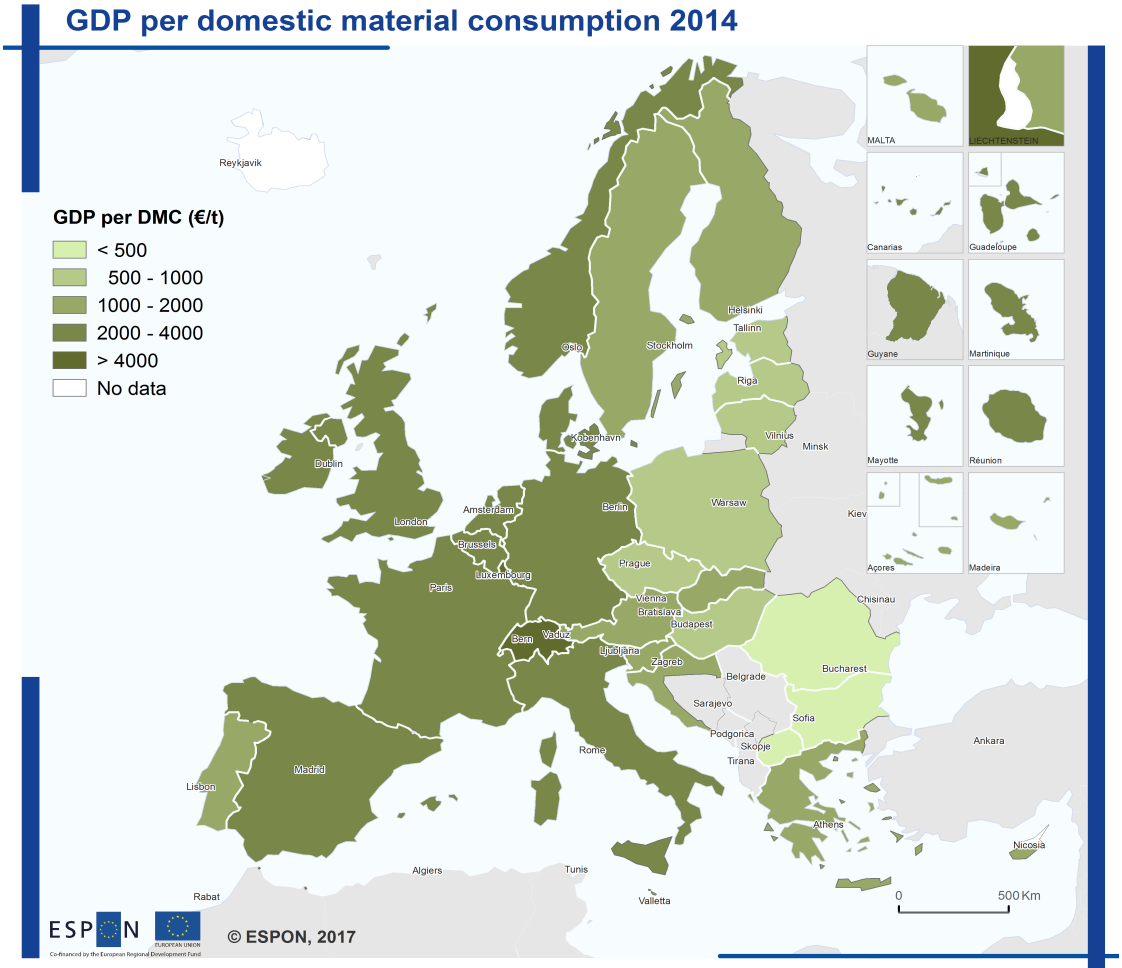
Areas with a larger share of economic activities that need to transition to a circular economy, in particular areas with industries with low levels of resource efficiency and/or low levels of reuse and recycling of research, show particular sensitivities to the change.

In terms of resource productivity[3] (see Map 3.3) Switzerland is the best performer. This is followed by Norway, Luxembourg, the Netherlands, the United Kingdom, Spain, Italy, France, Belgium and Germany. Generally, resource productivity in PPS is higher in countries with high income and in economies with large service sectors (financial services, tourism, arts and recreation, healthcare and public administration). This group of countries is followed by countries with medium-to-high resource productivity. Typically these are countries with high income and export-oriented manufacturing (e.g. Austria and Sweden), countries with large agricultural or extractive sectors (e.g. Ireland and Slovenia) and countries with tourism-based economies (e.g. Malta, Greece and Cyprus). Countries with lower GDP and large industrial

[3] This indicator looks at EUR /Kg i.e. the ratio between GDP and domestic material consumption. The Domestic Material Consumption indicator is based on the Economy-wide Material Flow Accounts.

and primary extractive sectors (e.g. forestry and/or mining) are less productive. These tend to be on the fringes of the EU. (European Commission DG Environment, 2016)

Map 3.3 GDP per domestic material 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: enc_ac_mfa, nama_10_gdp), 2014
CC - UMS RIATE for administrative boundaries

3.3.3 Impact

Among the areas affected through high levels of manufacturing, areas with low resource efficiency[4] or limited reuse and recycling are probably more sensitive to this change.

- **The most challenged by transition** are highly exposed areas with high levels of manufacturing and high sensitivity due to low levels of resource productivity**.** These include most regions of the Czech Republic, most rural regions in Eastern Romania, regions with high levels of manufacturing in Bulgaria and rural Poland and partly also in rural Estonia.
- **Highly challenged by transition but with the potential to cope** are areas highly exposed but with low sensitivity. These include the Basque country in Spain, large parts

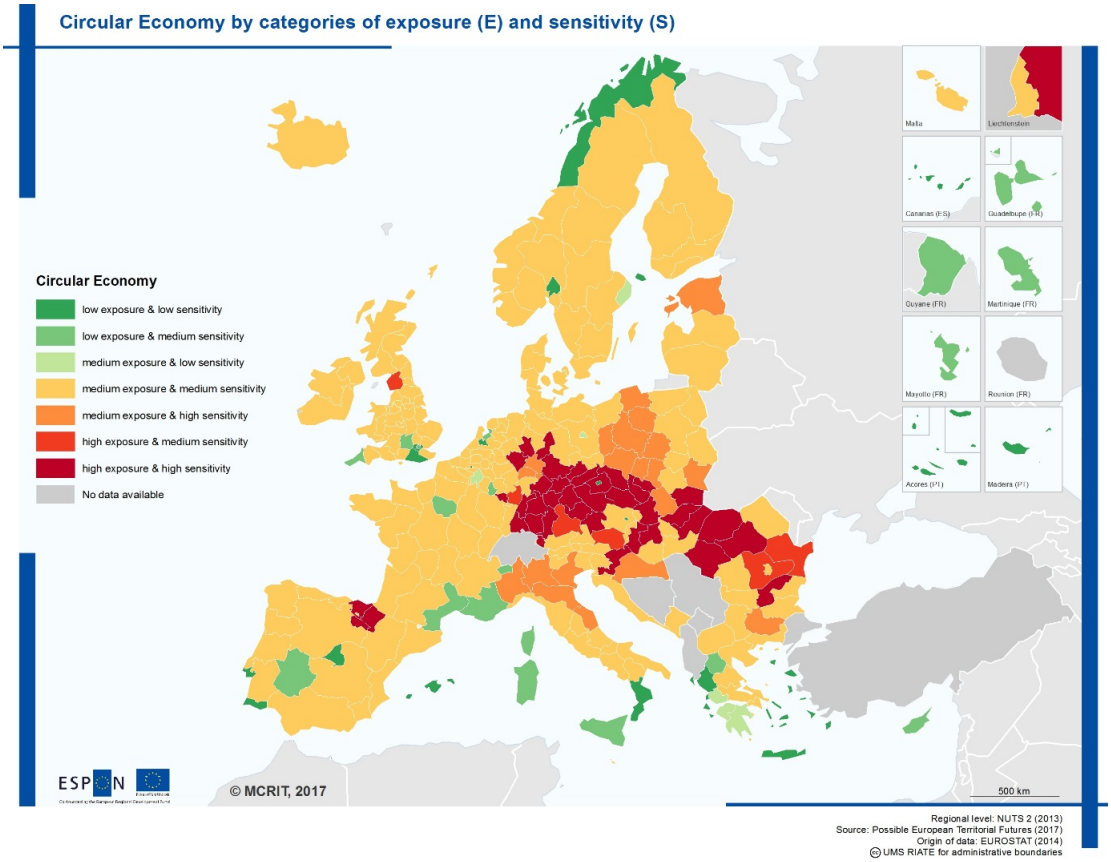
[4] See overall approach : http://ec.europa.eu/environment/resource_efficiency/targets_indicators/scoreboard/pdf/EU%20Resource%20Efficiency%20Scoreboard%202015.pdf

of Northern Italy and Marche in Italy, as well as large parts of Southern and metropolitan Germany.

- **Least challenged by transition.** Areas with low levels of exposure and low levels of sensitivity include regions with low levels of manufacturing in Switzerland, the UK, Ireland, large parts of the Benelux, and single regions in Norway, Sweden, Germany and Italy.

Concentrating only on the share of GVA (as exposure) and employment in manufacturing (as sensitivity), the territorial pattern differs (see Map 3.4). Areas facing the highest transition challenges are located in a stretch from mid- or southern Germany to Romania and northern Bulgaria. Furthermore the Basque country in Spain faces high transition challenges.

Map 3.4 *Territorial impact of the place based circular economy due to strong manufacturing sectors*



3.4 Highly specialised economies and entrepreneurship

In a place based circular economy, the territorial division of labour will be less pronounced. Regions with highly flexible and entrepreneurial players have an advantage in the shift to this new economic model.

Example: North Sea Resources Roundabout

Entrepreneurship and innovation are essential to enable the transition to a circular economy in the North Sea Resources Roundabout (NSRR). The NSRR builds on experience of the collaborative Green Deal approach in the Netherlands to give circular initiatives a boost.

In this international Green Deal a small group of European frontrunners in the circular economy (France, the UK, Flanders and the Netherlands) are working together to tackle barriers that hamper the trade, transportation and uptake of secondary resources. The European Commission is involved as an observer and supports the NSRR, among other things by facilitating online sharing for information and knowledge. The NSRR was signed in early March 2016. It is due to last for five years and the aim is to tackle ten secondary resource streams.

For each stream of secondary resource, a small team of private and public (policy and inspection) experts analyses the problems and proposes practical solutions. Basic principles are:

- Integral cooperation: value chain partners, businesses and NGOs, public-private partnerships, cross silo, policy makers, inspection and enforcement.
- Bottom-up: Practical case-by-case approach.
- Action and short-term orientated.
- Voluntary and not legally binding.

Source: http://www.circulary.eu/project/north-sea-resources-roundabout/

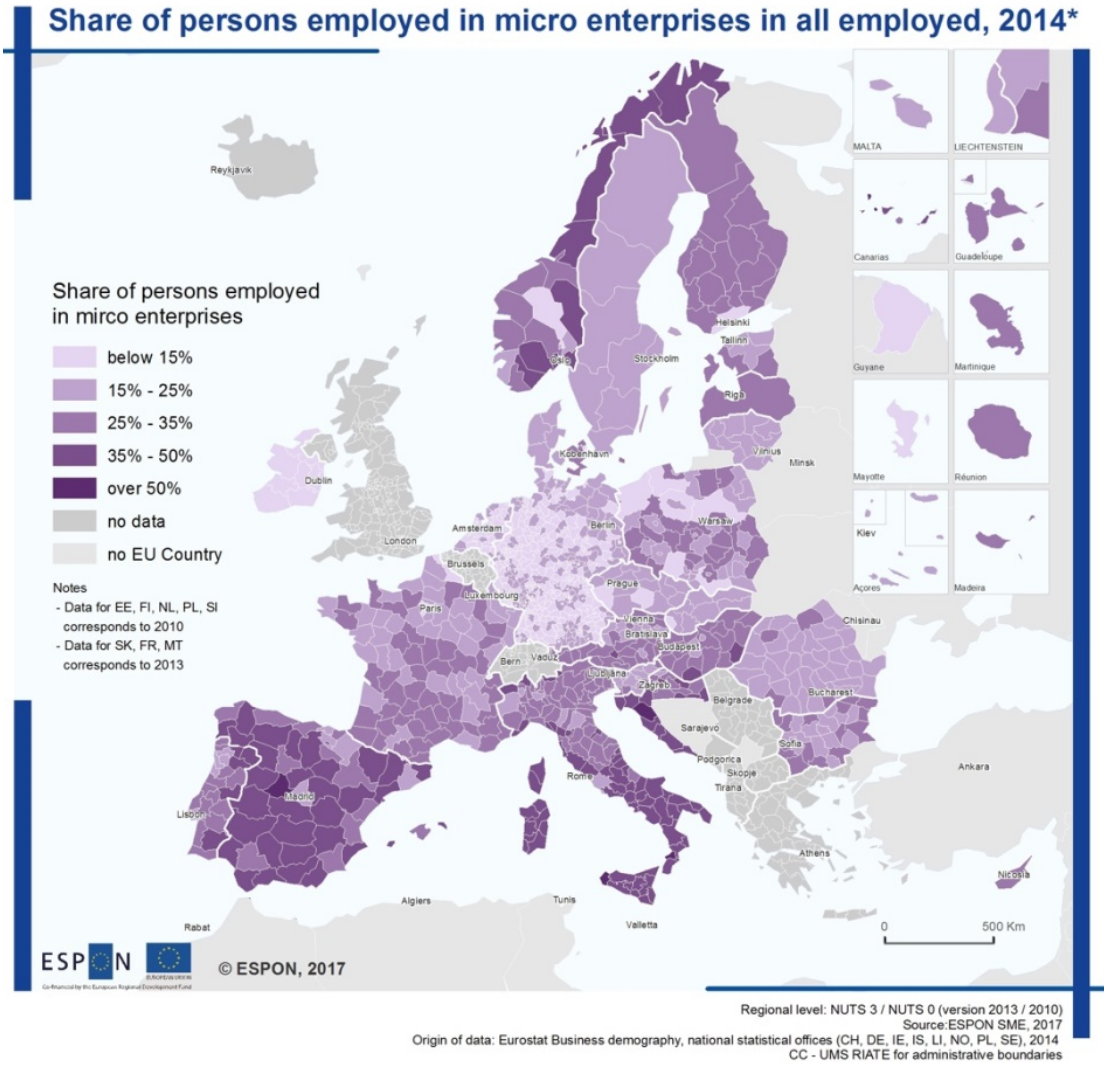
3.4.1 Exposure

Areas with highly specialised, single sector industrial profiles dominated by big firms need more substantial structural changes than regions with many small firms.

Areas with many SMEs and micro enterprises may have greater adaptive capacity. 77% of people employed in northern Portugal work in micro-enterprises. The share of people employed in micro-enterprises is high in Spanish rural regions as well as the Canary Islands, Southern Italy, coastal regions in Croatia and large parts of Norway. In these countries the share of people in micro-enterprises is considerably lower in capitals and other urban regions, for example only 16% in Madrid and 24% in Barcelona, compared over 50% in La Palma (Canary Islands).

Employment in SMEs is highest in Swedish regions, eastern Germany, the north of Poland and in Lithuania, with the exception of the capital region. There are particular sub-national differences in France, Italy and Romania.

Map 3.5 Share of persons employed in micro enterprises, 2014

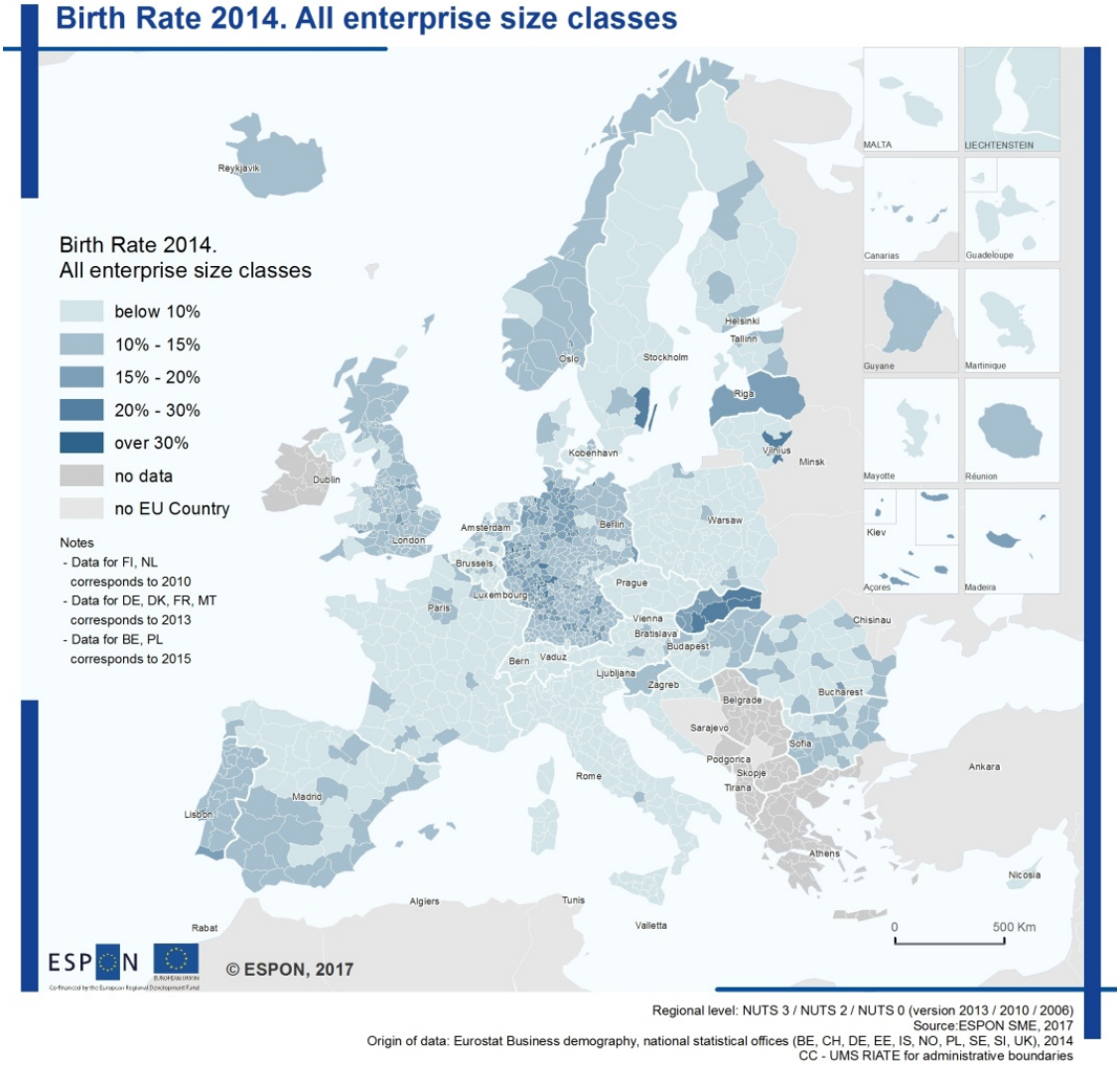


3.4.2 Sensitivity

Areas affected through their highly specialised / single sectoral industries, regions with low levels of entrepreneurship or a low share of SMEs are more sensitive to the change than other areas. Regions with high levels of entrepreneurship will probably did find it easier to adjust to the transition and develop production systems towards a circular economy than regions with low levels of entrepreneurship.

Enterprise birth rates provide an indication of regions which have high or low levels of entrepreneurship. Regions with the highest levels of enterprise birth rates are in Slovakia, Vilnius in Lithuania, as well as Kalmar and Gotland in Sweden. There are low enterprise birth rates in large parts of Sweden, Finland, Poland, the Czech Republic, Austria, Croatia, Switzerland, Italy and France.

Map 3.6 Birth rate of micro enterprises, 2014



3.4.3 Impact

Among the areas that are highly exposed due to a low share of micro-enterprises, regions with high levels of entrepreneurship can probably more easily transition to a place based circular economy.

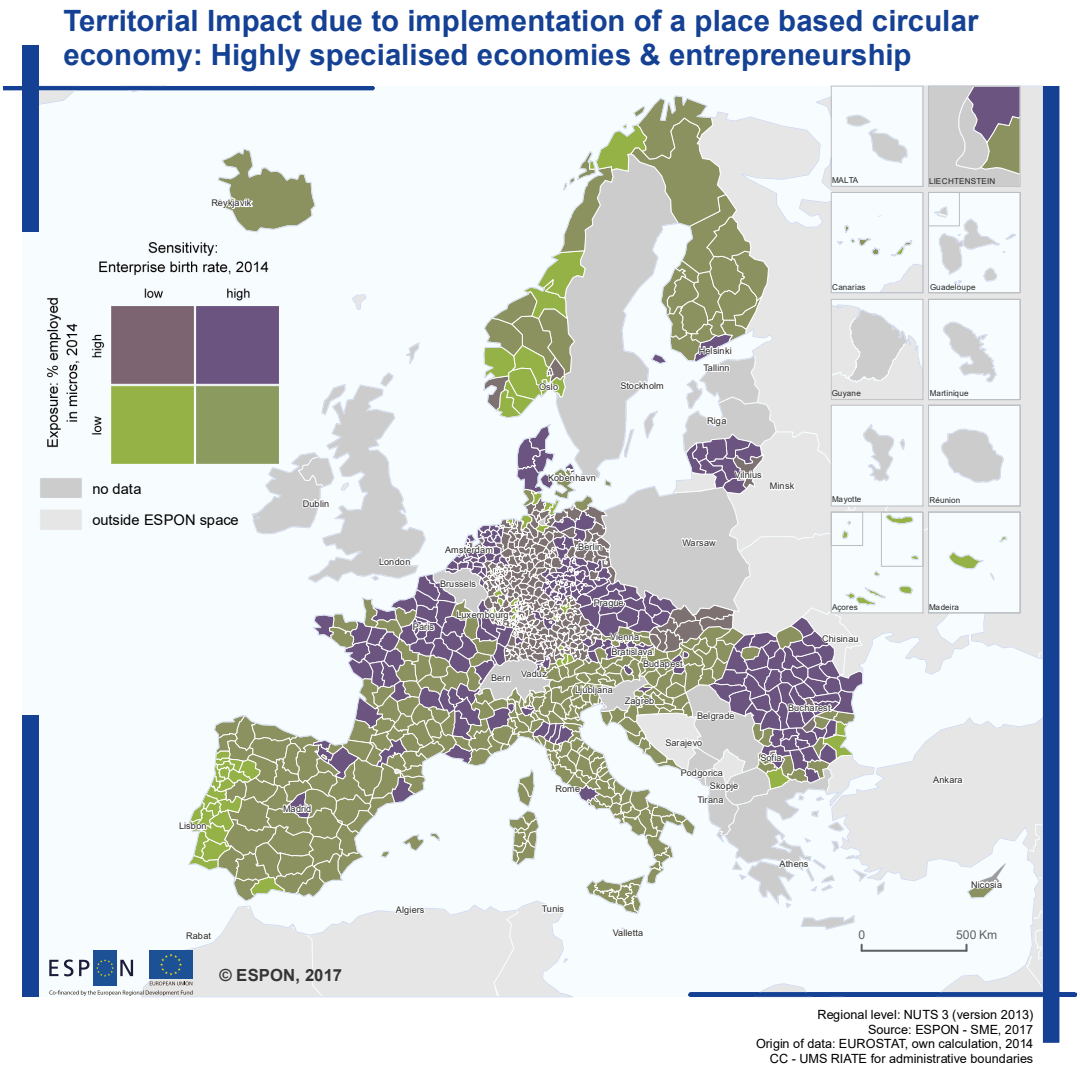
The share of people employed in micro-enterprises is used as an exposure indicator. This is negatively proportional, i.e. the higher the value, the lower the exposure, as areas with high shares of employment in small enterprises are less exposed than areas with concentrated employment in big firms. The sensitivity indicator that represents entrepreneurship is the enterprise birth rate, which is also negatively proportional, as the higher the enterprise birth rate, the lower the sensitivity to a lack of entrepreneurship.

- **Most challenged by transition** are areas with high exposure and high sensitivity. These include most regions of Romania, the Czech Republic, Lithuania, Denmark, the Netherlands and Luxembourg, as well as the capital city regions of Italy, Spain, Slovakia, Hungary, France and Austria, some regions of France and regions in Central Bulgaria and Eastern Germany.

- **Highly challenged by transition but with the potential to cope** are areas highly exposed to the transition but with low sensitivity due to higher levels of entrepreneurship. These are in Western Germany, Slovakia and Vilnius, Lithuania.
- **Least challenged by transition** are areas with low levels of exposure and low levels of sensitivity. These are mainly regions in Norway and Portugal, including the Azores and Madeira as well as some regions in Northern and Southern Germany, Southern Spain as well as regions in Bulgaria (on the Black Sea and Blagoevgrad).

The map below shows the territorial impact that a place based circular economy might have considering the changes related to specialised economies and entrepreneurship, focusing only on employment in micro enterprises (as exposure) and enterprise birth rates (as sensitivity).

Map 3.7 *Territorial impacts due to highly specialised economies and entrepreneurship*



3.5 Innovation linked to eco innovation and the green economy

The transition to a place based circular economy involves a variety of innovations in production processes in particular linked to a stronger focus on eco innovation and the green economy.

Example: Sidenor´s zero refractory waste strategy, Spain

The steel production plant in Basuari, Spain, developed integrated and systemic management of all refractory waste products generated in the plant. For this, waste is classified into three groups: Magnesium-Carbon, High Alumina and Other Grades. One of the most surprising conclusions was "the under-researched and under-exploited market" for this type of waste. This project develops innovations that are totally new and unique.

An action plan was drawn up that manages to recycle 94% of the waste (compared to 7% before the project). The absence of any need for investment facilitated the development of this project.

Environmental Benefits:

- Reduction of 81.5% in the amount of waste dumped in landfills.
- Increase of 66.1% in refractory material reused (directly or after recovery).
- Reduction of 7.9% in the use of critical materials and elimination of all associated impacts.

Financial Benefits:

- Savings of €479,750 from reduction in consumption of refractory material.
- Earnings of €36,018 from sales for recovery.
- Savings of €44,010 in the cost of dumping in a landfill (against €54,000 without management).
- Immediate profitability with the virtual absence of any need for investment.

Social Benefits:

- Promotion of a culture of reuse and recycling among staff at the facilities.
- Promotion of teamwork values.
- Nothing to prevent the replication of this project in other steelworks across Europe.

Source: http://www.circulary.eu/project/sidenor-waste/

3.5.1 Exposure

The transition to a place based circular economy requires substantial innovation, research and development allowing for production processes to change towards a 'zero waste' or 'circular economy' system. Regions with well institutionalised and connected R&D and education infrastructure can be at the forefront of this transition, i.e. regions with a lower innovation profile are particularly exposed to this change.

Striving towards technological change and staying ahead of the field mean that 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 converting innovations into new or improved goods and services.

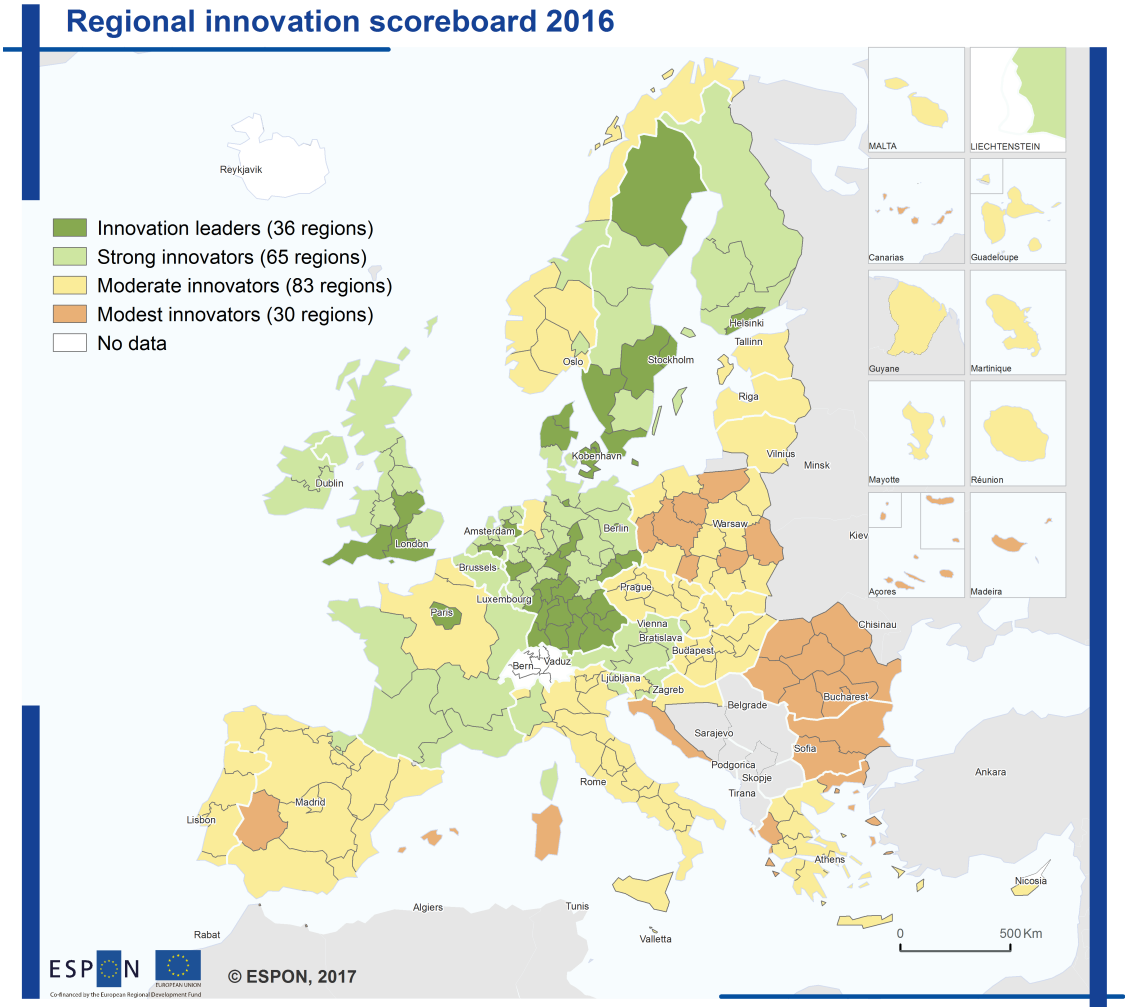
Regional innovation performance has increased over time, although in recent years overall performance has declined, especially for the least innovative regions. The European Commission frequently assesses region innovation performance based on a variety of indicators. Regional capacity to innovate may contribute to finding solutions to some of society's major 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 RDI with regional differences in innovation performance. The Regional Innovation Scoreboard differentiated four types of regions (see Map 3.8):

- Innovation leaders (mostly in southern England, southern Germany, Île de France, Sweden and Denmark)
- Strong innovators (the rest of the UK, Ireland, 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)

R&D is concentrated in capital city regions and regions with high technological activities. R&D expenditure is widely used as another indicator of the extent to which regional economies are prepared to stay ahead of forthcoming developments. Mostly regions in Nordic countries and Germany have high levels of R&D intensity, based on R&D expenditure relative to GDP in NUTS2 regions for 2013. R&D expenditure is often concentrated are around academic institutions or specific high technology industrial activities and knowledge-based services. These foster a favourable environment, attracting start-ups and qualified personnel so the competitive advantage of these regions is further intensified (Eurostat, 2016).

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. In these areas innovation plays an important role one way or the other (Capello et al., 2012).

Map 3.8 Regional Innovation scoreboard, 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
CC - UMS RIATE for administrative boundaries

3.5.2 Sensitivity

Among the regions with low levels of innovation, regions with a limited green economy and eco-innovation are particularly sensitive to the change.

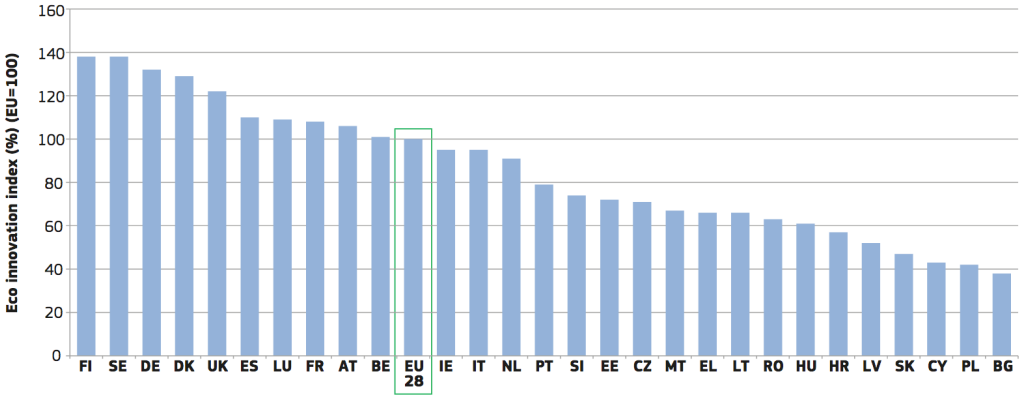
The eco innovations index[5] is topped by Finland and Sweden, followed by Germany, Denmark and the UK. Countries with the lowest ranks in this index are Bulgaria, Poland, Cyprus, Slovakia, Latvia and Croatia.

In terms of the green economy, a range of interesting maps covering green patents could be discussed in further detail. Green economic performance is highest in North and West Europe and lower in the South and East. This is measured using five spheres covering the green economy (territorial, economic, environmental, social and the econosphere). This combination of spheres shows that regions in Nordic Countries, Southern Germany, Austria and Switzerland perform best on green economic performance. Also regions in Ireland, Finland,

[5] See list on page 32:
http://ec.europa.eu/environment/resource_efficiency/targets_indicators/scoreboard/pdf/EU%20Resource%20Efficiency%20Scoreboard%202015.pdf

the Netherlands, the UK, France and Spain, including Paris and Madrid are performing well. On the other hand, most Eastern European regions often have low performance in several of the different spheres. Going into further detail, urban regions tend to be stronger than rural regions, although the differences are relatively small. A different picture becomes apparent when reviewing regional performance for each sphere. Nordic and Alpine regions have a high performance in the environmental sphere, resulting from high environmental and natural assets combined with low emissions. Their performance is similar in the territorial sphere, as a result of a high production of renewable energy and high land productivity. On the econosphere, they have high economic output per energy unit used. On the other hand, Southern European regions suffer from high exposure to air pollution and Eastern European regions from low life expectancy. This explains the low performance of these regions in the social sphere and in overall green economic performance.

Figure 3.1 Eco-innovation index 2013



Source: EUROSTAT, 2015: 29

3.5.3 Impact

Areas which are highly exposed due to low innovation levels and highly sensitive due to low levels of eco innovation and the green economy are:

- **Most challenged by transition.** Areas with high exposure and high sensitivity are in Bulgaria, Romania and Croatia as well as regions with modest innovation in Poland (mostly more rural regions) and Eastern Macedonia in Greece.
- **Highly challenged by transition but with the potential to cope.** An area highly exposed to the transition but with low sensitivity is Extremadura in Spain. Although this region will face major transformation steps, it be able to take them more easily.
- **Least challenged by transition.** Areas with low exposure and low sensitivity are Ile de France, the south coast in the UK, Switzerland, large parts of Southern Germany as well as most urban agglomerations in Germany, Northern Denmark, as well as the Øresundregion, metropolitan regions in Sweden, plus Northern Sweden and the capital region of Finland.

3.6 Conclusion on the territorial dimension of resource efficient production

A place based circular economy in Europe has an impact on territorial development with regard to changes affecting the resource efficient production of goods.

As discussed above, the exposure and sensitivity of regions varies. Some regions have a strong focus on place based and circular production in industry, with resource efficiency, high levels of entrepreneurship and the innovations needed for a place based circular economy.

Summarising the above sections, the map below shows territorial disparities and challenges that a place based circular economy may produce, due to changing production and economic systems. The map developed from sketches at the participatory workshop, enriched with the material presented above.

Map 3.9 *Territorial implications of changing production and economic systems in a place based circular economy*

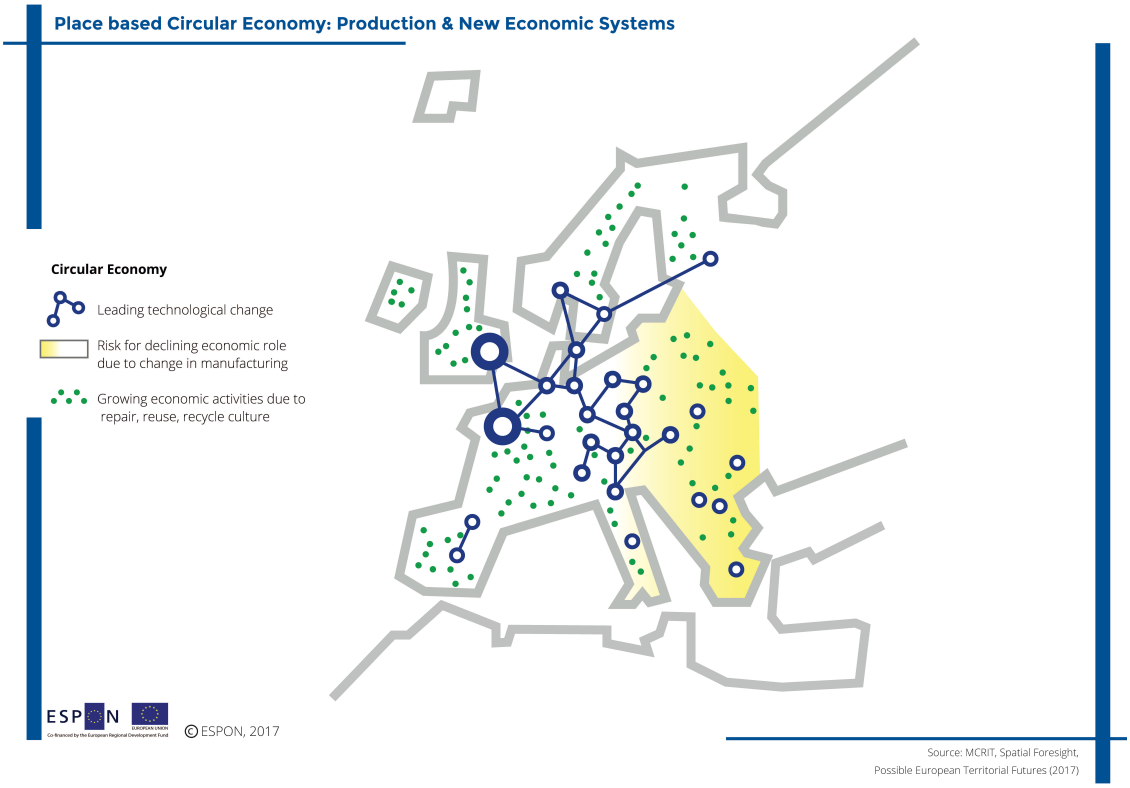


Table 3.1 *Exposure and sensitivity indicators – resource efficient production*

Hypothesis	Types of areas exposed	Sensitivity of the exposed areas
Circular economy requires substantial transitions for manufacturing in terms of resource efficiency, with the production of goods that last longer and can be repaired as well as in terms of industrial symbiosis.	Areas with high shares of manufacturing.	Areas with industries showing low resource efficiency and/or recycling may be more sensitive to changes caused by the transition.
Economic transitions and the set-up of industrial symbiosis processes will be easier in areas with a more	Highly specialised, single sector regions with corporate activity dominated by a few business groups rather than spread across many	Regions with a well-developed SME and entrepreneurial culture will have an advantage as they tend to be more flexible than large enterprises

diverse economic structure.	firms, will be in trouble. In the same sense regions with high levels of entrepreneurship will have an advantage.	in adjusting to changing framework conditions.
The transition to a place based circular economy will also need innovations in production processes and the green economy.	Regions with a well institutionalised and connected R&D and education infrastructure will have an advantage in this transition.	Regions with high levels of green economy as well as regions with a high level of econ-innovations may be less sensitive to the change.

As shown in the above sections, these exposures and sensitivities translate into areas which are particularly affected and those hardly affected. The main points are shown in the table below.

Table 3.2 Territorial impacts – resource efficient production

	Areas highly exposed and highly sensitive	**Areas highly exposed but not so sensitive**	**Areas least exposed and not so sensitive**
Manufacturing and resource efficiency	Most regions of the Czech Republic, most rural regions in Eastern Romania, regions with high levels of manufacturing in Bulgaria and rural Poland and partly also in rural Estonia	The Basque country in Spain, large parts of Northern Italy and Marche in Italy, as well as large parts of Southern and metropolitan Germany.	Regions with low levels of manufacturing in Switzerland, the UK, Ireland, large parts of the Benelux, and single regions in Norway, Sweden, Germany and Italy.
Highly specialised industries and entrepreneurship	Most regions of Portugal, some regions in Norway, and single regions in Bulgaria and Germany.	Widely spread around Europe. Indeed most regions fall into this category.	Capital regions and larger urban agglomerations. Most of these are in France, Germany, the Czech Republic, Denmark, Lithuania, Romania and Bulgaria.
Innovation linked to eco-innovation and green economy	Regions in Bulgaria, Romania, Croatia as well as regions with modest innovation in Poland (largely more rural regions) and Eastern Macedonia in Greece.	Extremadura in Spain. Although this region will face major transformation steps it may be more easily able to take them.	Ile de France, the south coast in the UK, Switzerland, large parts of Southern Germany as well as most urban agglomerations in Germany, Northern Denmark, as well as the Øresundregion, metropolitan regions of Sweden, plus Northern Sweden and the capital region of Finland.

4 Component – Resource efficient use – changing societal and behavioural patterns

This section addresses the territorial dimension of societal behaviour and consumption in the circular economy, identifying crucial characteristics of this component.

4.1 Why this component is important

In short, a place based circular economy implies a more resource efficient use of goods. A large body of literature not only focuses on production and industrial processes but also on the consumption and behavioural dimension of a circular economy (Aachener Stiftung Kathy Beys et al., 2017; Lüer et al., 2015). In short, a place based circular economy implies a lot of change. Resource efficient use of products will be a key feature which heavily depends on behaviour, including reuse and sharing.

Focusing on the sharing economy, a recent Swedish Government Official Report provides more in-depth insights (SOU 2017:26, 2017) including reflections on what needs to be done to support meaningful further development of the sharing economy.

4.2 Territories exposed and their sensitivities

A more resource efficient use of goods includes the responsible handling of goods to ensure they can be used for as long as possible (including development towards a reduced end-of-pipe or throw away attitude and a decreasing need for constant replacement of products with the latest fashion. This goes hand in hand with recent developments moving from the traditional view of a product to considering its use as a service (something used for a limited period of time), especially sharing and collaborative economies. Most prominent in this respect are large car manufacturers developing strategies towards selling 'mobility' instead of cars, through advanced car-sharing[6] concepts and experiments with driverless cars.

In this context, new services and behavioural patterns are needed. Innovation potential is an important asset in a place based circular economy.

While this applies to all cities and regions in Europe, for some it implies a greater transition to a place based circular economy than for others. Of the areas exposed to major adjustment needs, not all are equally sensitive. For some areas the need for adjustment may affect substantial parts of their society, others may be better prepared.

- Areas with low shares of recycling of household waste may need more adjustment than areas where households do not generate considerable amounts of waste (as recycling will be a strong aspect of the circular economy behaviour) (see section 4.3).
    - Areas with high levels of recycling or composting of household waste are less challenged by the transition than those with low levels.

[6] Car sharing or car clubs is a model of car rental where 'club members' rent cars for short periods of time, often by the hour.

- Areas with a limited sharing and collaborative economy may need more adjustment than areas where households are more used to a post-material economy (see section 4.4).
    - Among the areas with a limited sharing and collaborative economy, areas with high population density may find it easier to adjust as they can quickly establish critical mass for new lifestyles and services.
- The transition process will also require a different attitude towards prosperity, moving away from GDP to something closer to well-being or social progress indicators. Areas performing well in such measurements should find it easier to follow such a change (see section 4.5).
    - Among regions with low levels of well-being or social progress, regions with high administrative capacity may have an advantage in performing the transition.

The above provides the rationale why certain local or regional characteristics imply different levels of potential or challenges during the transition to a more efficient use of resources in a place based circular economy.

4.3 Household waste and recycling

In a place based circular economy, societal behaviour changes to reduced material consumption. This implies reducing household waste to a minimum and significant re-use, repair and recycling of products.

Example: Zero Waste Communities

Making the abstract matter of a place based circular economy more concrete, the Japanese municipality Kamikatsu is globally considered as an example of good practice for moving towards a 'zero waste' society (Aachener Stiftung Kathy Beys et al., 2017). In 2003, Kamikatsu declared its zero-waste ambition after the town gave up the practice of dumping trash into an open fire for fear of endangering both the environment and the population. By 2020 it wants to become Japans first 'zero waste' community, mainly through intensive and very detailed recycling systems.

Another example is Act Group in Croatia (http://act-grupa.hr/en/). Founded in a small town in a border region in Northern Croatia, Act Group is the leading example of social entrepreneurship in Croatia, supporting and developing social entrepreneurship in the green economy and for social services in the community. Their newest project is a national network of regional reuse centres that will collect, repair and resell products that would probably end up as waste. In the first phase centres start by reselling textile, furniture and consumer goods. The first centre has just been opened in a small rural community.

Other European examples can be found under Zerowasteeurope.eu

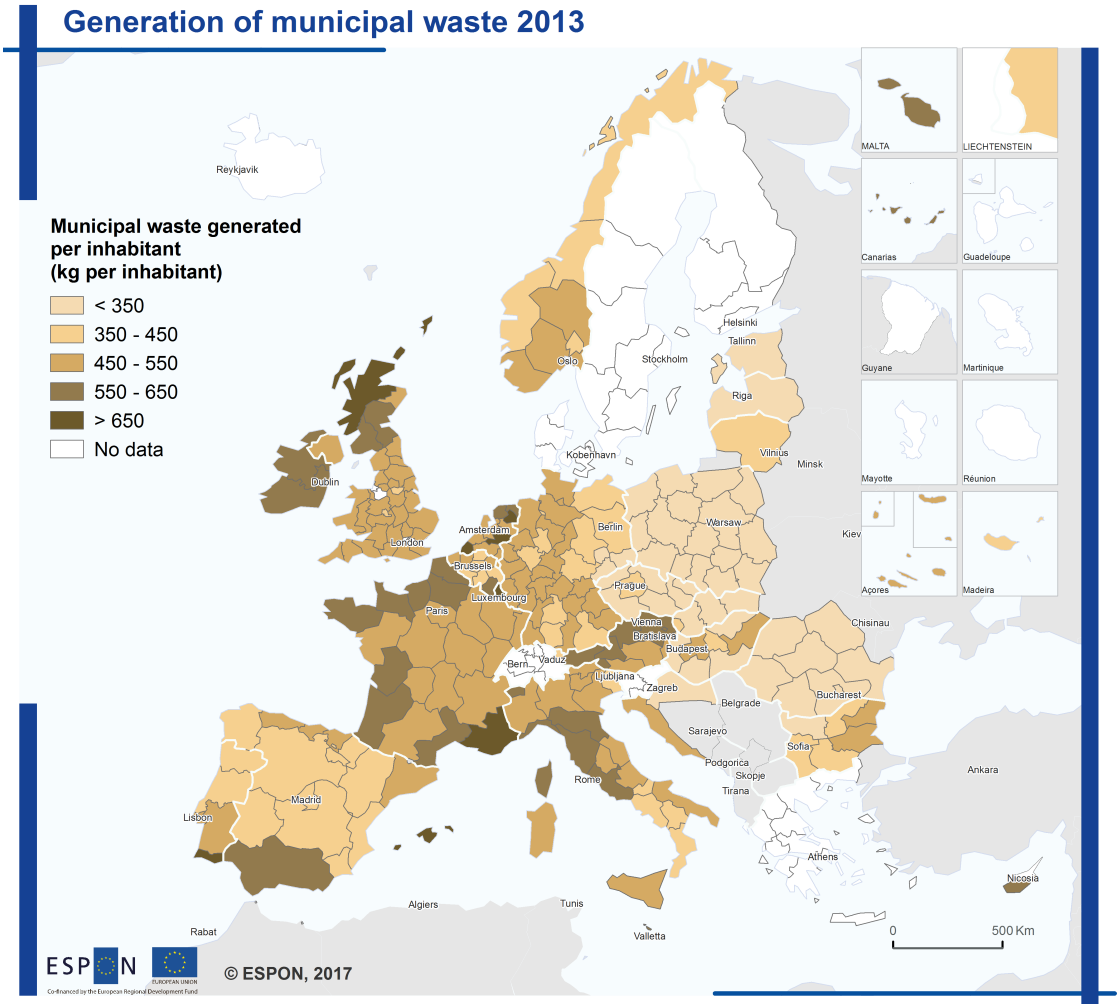
4.3.1 Exposure

Moving away from a culture of consuming & 'throwing away' to a societal behaviour of a place based circular economy is particularly hard for areas with high shares of household waste per inhabitant.

In the EU, the amount of municipal waste per person in 2014 was 475 kg, down by 10% compared with its peak of 527 kg per person in 2002. Since 2007, the municipal waste per person has consistently decreased in the EU to below its mid-1990s level.

The highest levels of kg municipal waste per inhabitant are in Scotland, Ireland, French coastal regions, the Algarve in Portugal, Tuscany, Emilia-Romagna, and Lazio in Italy, as well as in most Austrian regions, some Dutch regions, Cyprus, Malta and Luxembourg. To a large degree these are regions with high shares of tourism, suggesting that waste produced by tourists increases the waste per inhabitant.

Map 4.1 Generation of municipal waste, 2013



Definition of time varies between countries: IE=2010; FR&UK=2011; ES&RO&TR=2012; rest=2013
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: env_wwcon_r2), 2010-2013
CC - UMS RIATE for administrative boundaries

A first conclusion is that tourist areas may be affected by the need to improve resource efficiency through reducing waste. In addition, there seems to be also a correlation with

economic performance of regions, i.e. lagging regions in Eastern Europe produce the lowest waste per capita (but do not recycle).

4.3.2 Sensitivity

Among the areas which need to adjust most to reduce their household waste levels, areas with limited recycling and compositing are particularly sensitive to the change.

Treatment methods differ substantially between Member States. In 2014, recycling and composting together accounted for nearly two-thirds (64%) of waste treatment in Germany, followed by Slovenia (61%), Austria (58%), Belgium (55%) and the Netherlands (51%).

At least half of municipal waste in 2014 was incinerated in Estonia (56%), Denmark (54%), Finland and Sweden (both 50%), while the highest share of municipal waste landfill were recorded in Latvia (92%), Malta (88%), Croatia (83%), Romania (82% in 2013), Greece (81% in 2013), Slovakia (76%), Cyprus (75%) and Bulgaria (74%).

Eurostat data for 2013 shows that areas with high levels of municipal waste tend to have medium levels of recycling waste (20-30%). In particular Malta and Cyprus face significant transition as both the amount of waste produced and the share of recycling are less favourable for a circular economy.

4.3.3 Impact

In other words, areas which are highly exposed due to their level of municipal waste per inhabitant and highly sensitive due to limited recycling and composting are:

- **Most challenged by transition.** These areas are Malta and Cyprus, tourist areas in Scotland, along the coasts of France and large parts of the Mediterranean coastal regions in Spain and Italy as well as Algarve in Portugal (and probably also Greece).
- **Highly challenged by transition but with the potential to cope.** Areas with high levels of recycling are mainly tourist areas in the Alps and the Netherlands.
- **Least challenged by transition.** Areas with low levels of waste production and high levels of recycling are on the winning side. Examples are regions in Eastern Germany and single regions in Southern Germany.

4.4 Sharing and repairing attitude

A place based circular economy is not only about reducing waste and increasing recycling and repairing rates, it is also about increasing levels of product sharing. The sharing economy and its various facets should play a major role in a successful place based circular economy.

4.4.1 Exposure

In terms of increasing the role of the sharing economy, the transition process towards a place based circular economy is most troublesome in areas with a limited sharing and collaborative economy. These areas are more exposed than areas where households are more used to post-material economies.

According to PwC, the UK and France have led this start-up creation, with over 50 sharing economy organisations founded in each of these countries. Germany, Spain and the Netherlands have each contributed over 25 sharing economy organisations, while less than 25 have been established in Sweden, Italy, Poland and Belgium.

Following Eurobarometer (European Commission DG COMM, 2016) the use of collaborative economy platforms are one segment of the sharing economy. The usage of such platforms is lowest in Cyprus, Malta, the Czech Republic, Portugal, Finland, the UK, Belgium, Greece and Lithuania. While they are most used in France, Ireland, Latvia, Croatia, Germany, Estonia, Romania, Spain and Italy.

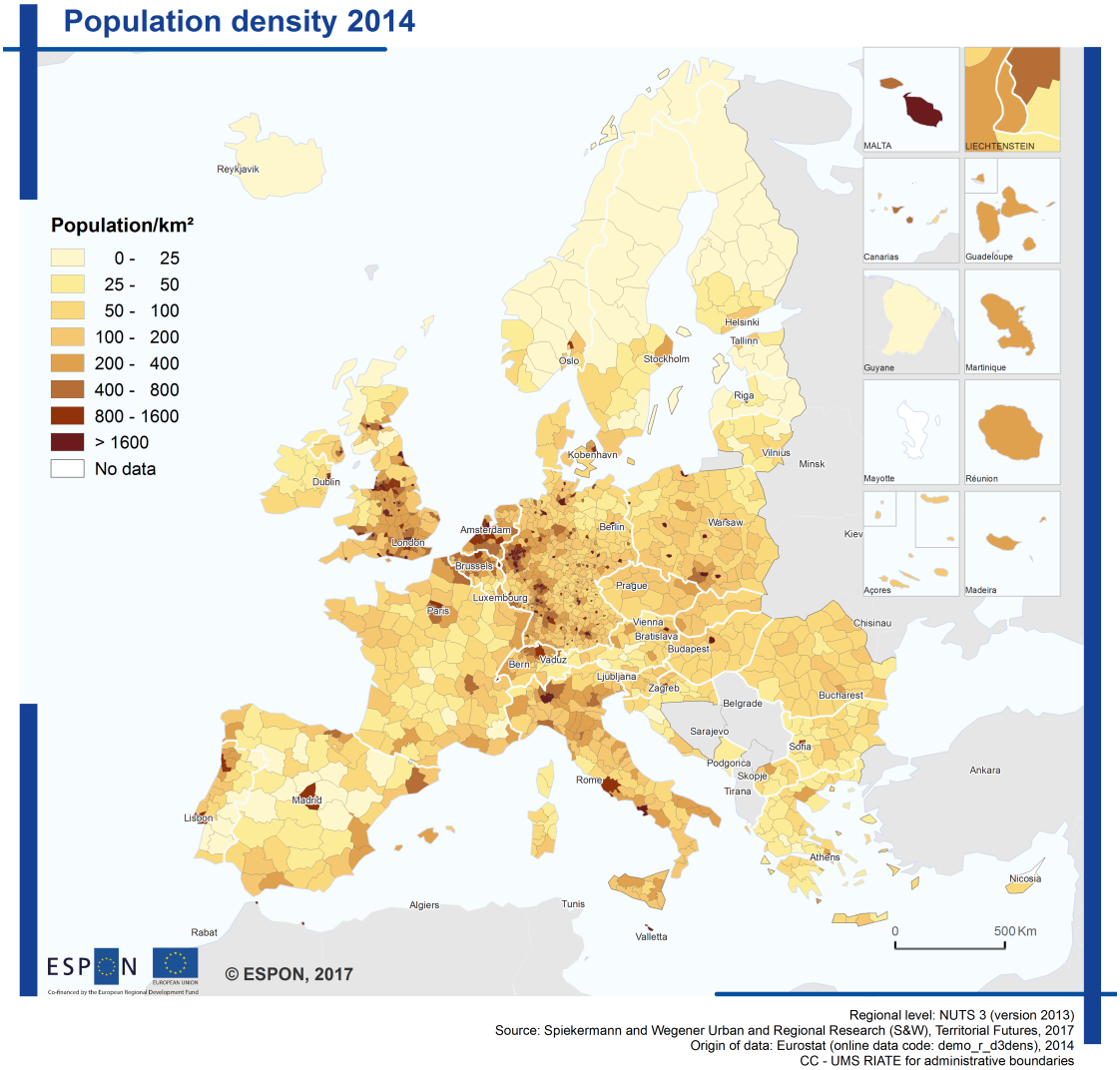
4.4.2 Sensitivity

Among the areas affected through low shares of sharing and collaborative economy, areas with high population density find it easier to adjust as it is easier to establish critical mass for new types of lifestyles and services. In other words, areas with low population density were more sensitive to the change as it is more difficult to establish critical mass for sharing economy services.

Literature dealing with the sharing economy mostly provides cases from large urban agglomerations (Martin, 2016; Morgan and Kuch, 2015; Schor, 2014). More generally, it can be argued that higher density favours collaborative and sharing economy approaches concerning the use of goods. In other words, in areas with low density it is more difficult to establish critical mass for a sharing economy. So, such areas are more sensitive to the change.

Typical sharing economy models based on maximising profits for online platform owners, act more as a traditional economy of scale (which means favouring certain types of territory based on demographic size or their economic resources – e.g. tourism attractiveness). Collaborative economies can also be less affected by the type of territory. Examples of collaborative economy in Croatia, found outside of urban areas, are usually connected with more dynamic and economically diversified rural areas rather than with a rural periphery where lack of both human and social capital clearly limits innovative, collaborative approaches. In those cases, sometimes, external factors such as animators coming from urban centres might influence a developing and spreading collaborative economy.

Map 4.2 Population density



Regional level: NUTS 3 (version 2013)
Source: Spiekermann and Wegener Urban and Regional Research (S&W), Territorial Futures, 2017
Origin of data: Eurostat (online data code: demo_r_d3dens), 2014
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For a more nuanced picture, in addition to population density, other factors can be taken into consideration for a more differentiated territorial view:

- demographics (more young people become consumers);
- economic regulation (deregulation and liberal approach are more conducive to a sharing economy);
- cultural determinants (e.g. greater orientation toward traditional private ownership in East-Central Europe, with a lack of private property before 1989).

Over the next 20-30 years the following processes may spreading the sharing economy in Europe:

- from metropolises and large cities toward multifunctional medium-sized urban centres, with a diffusion of innovative cultural behaviour;
- toward peripheral and depopulation areas, as a response to the necessity of ensuring the access to basic public utility services;
- from North-West Europe toward southern and eastern countries (more attached to traditional private property);

- within the countries that have more liberal legislative-economic regulation (e.g. Great Britain, Ireland) from metropolises toward extra-metropolitan and rural areas.

4.4.3 Impact

In other words, areas which are highly exposed due to a limited shared and collaborative economy and highly sensitive due to low population density are:

- **Most challenged by transition.** Areas with low population density in countries with few people using the sharing economy are highly affected with high exposure and high sensitivity. These are mainly rural areas of Cyprus, Malta, the Czech Republic, Portugal, Finland, and Lithuania.
- **Highly challenged by transition but with the potential to cope.** Areas highly exposed to due to a limited sharing economy but with low sensitivity are urban areas of Cyprus, Malta, the Czech Republic, Portugal, Finland, Greece and Lithuania.
- **Least challenged by transition.** Areas with significant social progress and high quality of government are the urban agglomerations of France, Ireland, Latvia, Croatia, Germany, Estonia, Romania, Spain and Italy.
- **Repairing activities create local jobs.** The increasing focus on repair, reuse and recycle implies new jobs in labour intensive sectors. In a place based circular economy new jobs will be created throughout Europe.

4.5 Changing understanding of prosperity

In a place based circular economy the perception of wealth and prosperity moves beyond GDP and the accumulation of material goods.

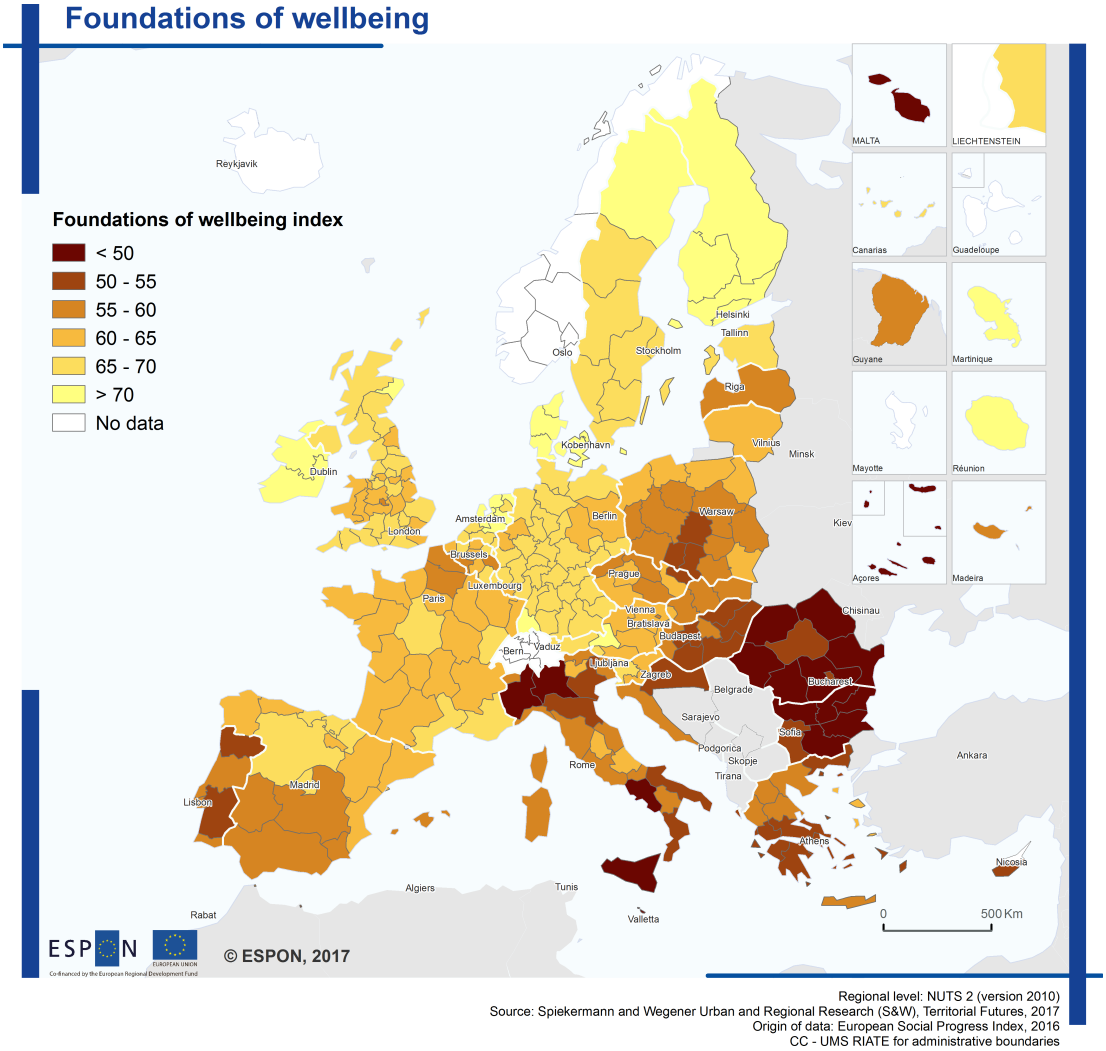
4.5.1 Exposure

The transition process required a changing attitude towards prosperity moving away from GDP as only indicator to something closer to well-being or social progress indicators. Areas performing well in terms of well-being and social progress were generally less exposed to the need of changing societal values.

The European Social Progress Index (European Commission, 2016) aims to measure social progress for each region as a complement to traditional measures of economic progress. As it is intended to complement measures based on GDP, income or employment, it purposely leaves such indicators out of the index. One of its building blocks is the foundations of wellbeing which covers access to basic knowledge, access to information and communication, health and wellness and environmental quality (see Map 4.3). A second building block on opportunities, covers personal rights, personal freedom and choice, tolerance and inclusion and access to advanced education.

With regard to this indicator, regions with particularly low levels can be found in Bulgaria, Croatia, Eastern Romania, Southern Italy, and Eastern Hungary. This is followed by other regions in Italy, Greece, Slovakia, Czech Republic, Poland, Latvia, Cyprus and Portugal.

Map 4.3 Foundation of wellbeing

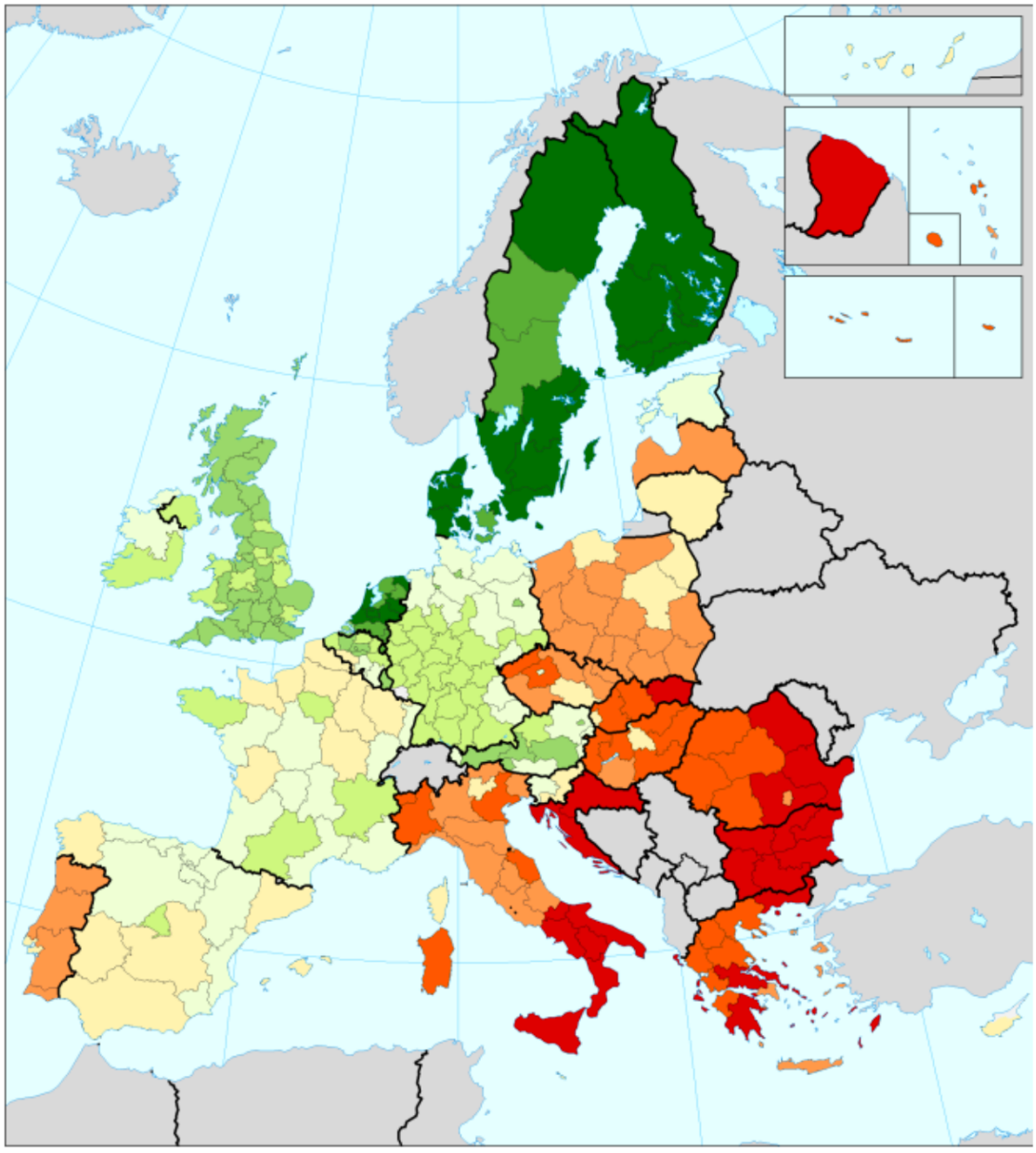


4.5.2 Sensitivity

Among regions with low levels of well-being or social progress, regions with high administrative capacity have an advantage during the transition. In other words, regions with low administrative capacity and limited personal opportunities (see Map 4.4*) are more sensitive to the changes.*

The European quality of sub-national government index (European Commission, 2014: 171) provides insights into the governance capacity that could cope with and support societal transition and promote a place based circular economy. Regions with low levels of government quality may find the transition particularly challenging. These are in Bulgaria, Romania, Croatia, southern central and southern Italy, Greece and the Northwest of the Czech Republic and Central Hungary.

Map 4.4 *Personal opportunity index*



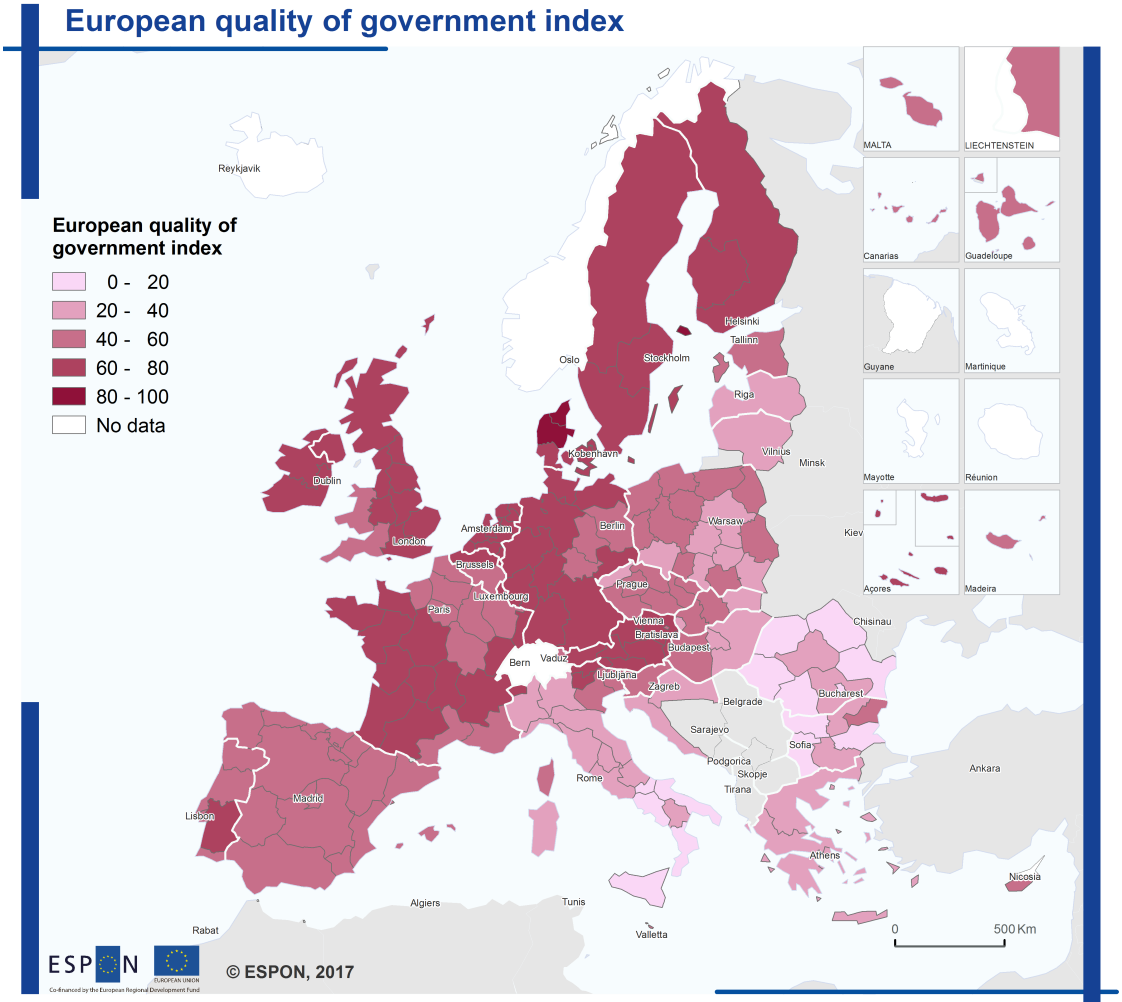
Opportunity sub-index

Index

< 45	65 - 70
45 - 50	70 - 75
50 - 55	75 - 80
55 - 60	>= 80
60 - 65	

Source: DG REGIO

Map 4.5 European quality of government index



Regional level: NUTS 2/BE,DE,EL,HU,SE=NUTS 1/CY,EE,FI1B-D,ITI3+ITH5,LU,LT,LV,SI=NUTS 0 (version 2010)
Source: Spiekermann and Wegener Urban and Regional Research (S&W), Territorial Futures, 2017
Origin of data: Quality of Government Institute, 2013
CC - UMS RIATE for administrative boundaries

4.5.3 Impact

In other words, areas which are highly exposed due to limited well-being and personal opportunities and highly sensitive due to low levels of government quality economy are:

- **Most challenged by transition.** Areas with high exposure and high sensitivity, are in South-East Romania, Eastern Bulgaria, and Southern Italy.
- **Highly challenged by transition but with the potential to cope.** An area highly exposed due to limited well-being and personal opportunities but with low sensitivity due to good government quality is North-Eastern Bulgaria.
- **Least challenged by transition.** Areas with social progress and good government are mainly the Nordic Countries, and large parts of the Netherlands.

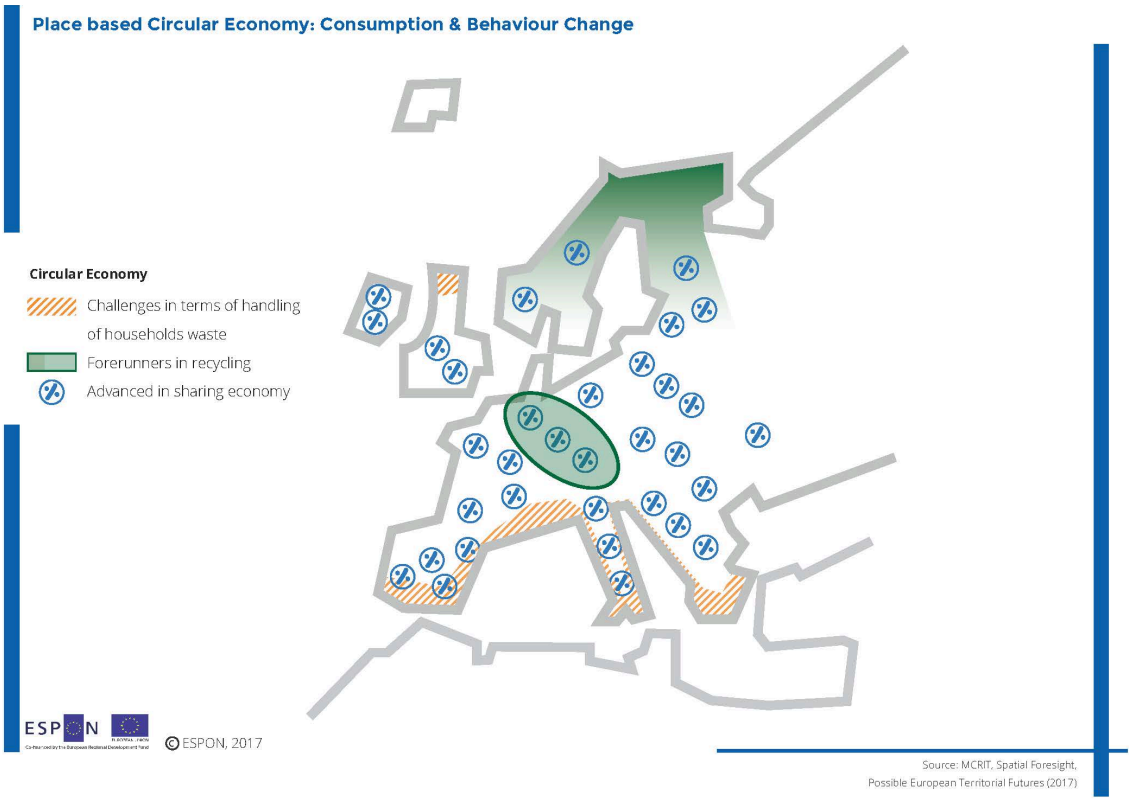
4.6 Conclusion on the territorial dimension of societal behaviour and consumption

A place based circular economy in Europe has an impact on territorial development with changes in societal behaviour and consumption.

As discussed above, the exposure and sensitivity of regions varies, with a strong focus on existing place based and circular consumption, including the share of household waste, recycling, sharing and repairing as well as an understanding of wealth going beyond GDP.

Summarising the sections above, the map below shows territorial disparities and challenges a place based circular economy might bring about due to changing consumer behaviour. The map is developed from the sketches at the participatory workshop, enriched with the material presented above.

Map 4.6 Territorial implications of changing consumer behaviour in a place based circular economy



The table below summarises the exposure and sensitivity indicators discussed.

Table 4.1 Exposure and sensitivity indicators – societal behaviour and consumption patterns

Exposure and sensitivity indicators – societal behaviour and consumption patterns

Hypothesis	Types of areas exposed	Sensitivity of the exposed areas
Overall a place based circular economy implies a lot of behavioural changes.	Areas with high levels of well-being and/or good performance on social progress indices will have an advantage in the behavioural shift, with less transition expected.	Regions with low administrative capacity and low levels of trust in the government and societal bodies may be more sensitive to the transition and find it more difficult. Areas with a high share of young and flexible people may be less sensitive to the transitions.
Resource efficient use of products is key to a place based circular economy.	Regions with low levels of household waste might find the transition easier, being less exposed to transition challenges.	Areas with substantial recycling (as an indication of resource efficiency) may be less sensitive as they have the first preconditions in place.
A place based circular economy is also about a paradigm shift from owning goods to using them for a	Areas with relatively high levels of sharing and collaboration may find the transition easier and be less	Areas with high population density have a critical mass to establish sharing economy initiatives and thus

limited period.	exposed to transition challenges.	are less sensitive to these changes compared to sparsely populated areas.

As shown in above, these exposures and sensitivities translate into areas which are particularly affected and those hardly affected. The main points are highlighted in the table below.

Table 4.2 Territorial impacts – societal behaviour and consumption patterns

Territorial impacts – societal behaviour and consumption patterns

	Areas highly exposed and highly sensitive	**Areas highly exposed but not so sensitive**	**Areas less exposed and not so sensitive)**
Household waste and recycling attitude	Malta and Cyprus, and tourist areas in Scotland, along the costs of France Mediterranean coastal regions in Spain and Italy, as well as Algarve in Portugal (probably also Greece).	Areas with high levels of waste but with low sensitivity due to significant recycling are mainly tourist areas in the Alps and the Netherlands.	Areas with low levels of waste and high levels of recycling are on the winning side. These include regions in Eastern Germany and single regions in Southern Germany. (NB data is very patchy, so these are limited examples)
Sharing and repairing attitude	Areas with low population density in countries with few people using the sharing economy are highly affected. These are rural areas of Cyprus, Malta, the Czech Republic, Portugal, Finland, and Lithuania.	Areas with low levels of sharing economy but with low sensitivity are mainly the urban areas of Cyprus, Malta, the Czech Republic, Portugal, Finland, Greece and Lithuania.	Areas with a high level of social progress and good quality government are the urban agglomerations of France, Ireland, Latvia, Croatia, Germany, Estonia, Romania, Spain and Italy.
Changing understanding of prosperity	Areas in South-East Romania, Eastern Bulgaria, and Southern Italy.	A highly exposed area but with low sensitivity due to good quality government is mainly North-Eastern Bulgaria.	Areas with significant social progress and good government are the Nordic Countries, and large parts of the Netherlands.

5 Component – Place based – balancing local and global interaction

This section addresses the territorial dimension of the transport and flow of goods, identifying crucial characteristics for territorial exposures and sensitivities.

5.1 Why this component is important

In short, a place based circular economy implies changing transport patterns. To illustrate this, we focus on the transport and flow of goods in production processes. As outlined above, industrial production processes will change with more networked production and more reuse of resources. Though global trade relations and production chains will continue, their pattern and intensity is expected to change.

In a place based circular economy, the amount of goods and raw materials transported over long distance is expected to decline considerably, as less material goods will be produced and these will be used, shared, reused and repaired and thus have a considerably longer life than products today.

5.2 Territories exposed and their sensitivities

A place based circular economy implies a decrease in international freight.

- Areas with industries heavily dependent on international export or import of goods may be more exposed to transition (see section 5.3).
- Areas with International freight transport hubs (ports & freight airports) may be more exposed to transition (see section 5.4).

5.3 Export-import regions

A place based circular economy implies reduced consumption of new products, as re-use, repair and sharing means that products are used more efficiently and over a longer period. Although goods are still produced in international value chains, the amount of materials transported, exported and imported declines.

Example: Optimising freight transport

In the context of increasing efficiency and reducing the carbonisation of freight transport, a range of initiatives focus on asset sharing. This include long distance as well as short distance transport e.g. from collection points to the city centre.

Sharing assets can have three main approaches: (a) vehicle sharing via 'matching' of coincident light and heavy loads for selected long journeys; (b) depot sharing with joint use of consolidation centres; and (c) combined vehicle and depot sharing with joint optimisation of shared vehicles and depots.

In all these cases transport will decline.

5.3.1 Exposure

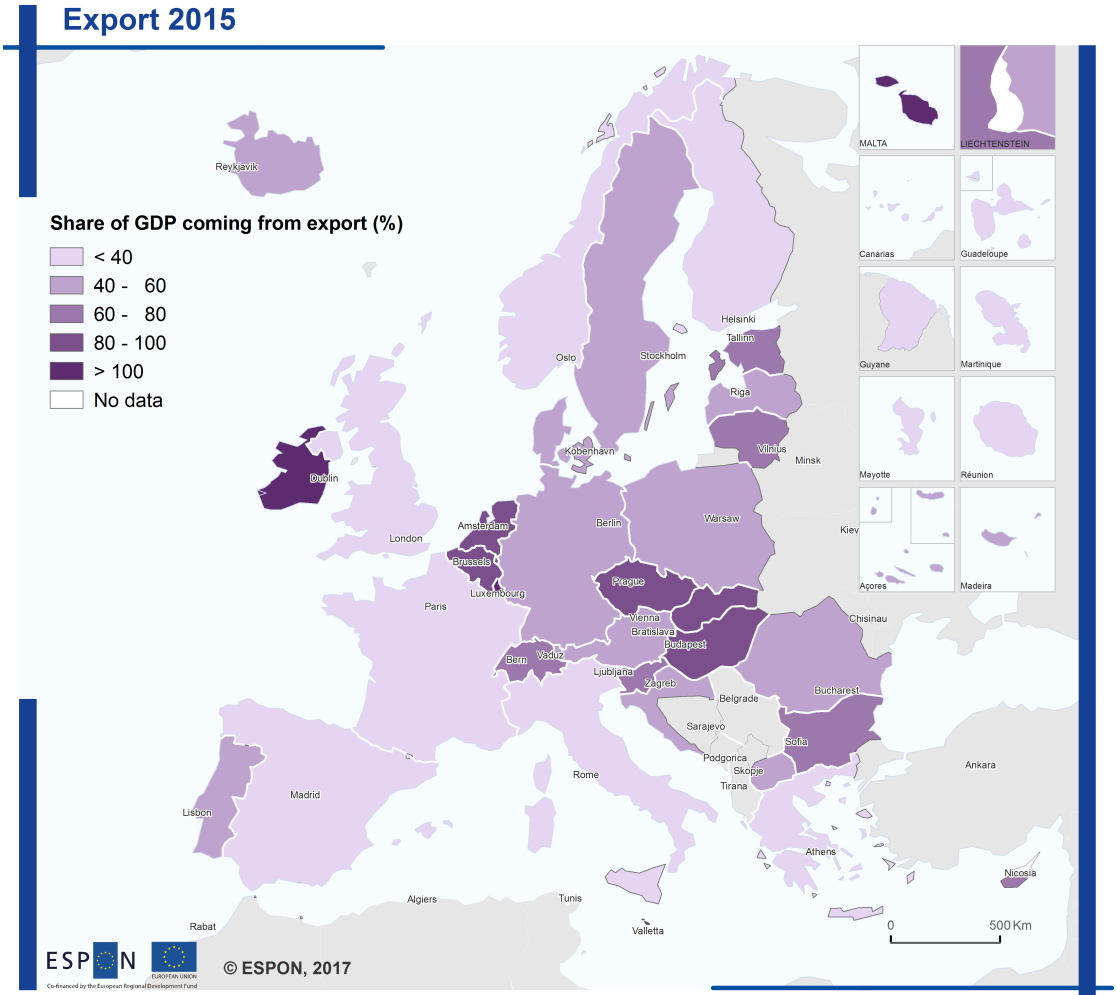
With declining transport, export and import, regions with high shares of their economy dependent on international trade are exposed to industrial transition.

Areas with high volumes of export are particularly exposed to this kind of change coming with a fully place based circular economy. Germany features as the country with the highest levels of intra- and extra- European trade. This is followed the UK, Italy and France as concerns extra EU trade respectively the Netherlands (due to Rotterdam), France the UK for intra-EU trade.

5.3.2 Sensitivity

Among highly exposed areas due to the importance of exports and imports in their local economies, areas with high exports are particularly sensitive.

Map 5.1 Exports, 2015



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: nama_10_gdp), 2015
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Looking at the depends of the countries on the export of trade, more recent information on exports as share of GDP shows particularly high levels for Ireland, the Benelux, the Czech Republic, Slovakia and Hungary.

5.3.3 Impact

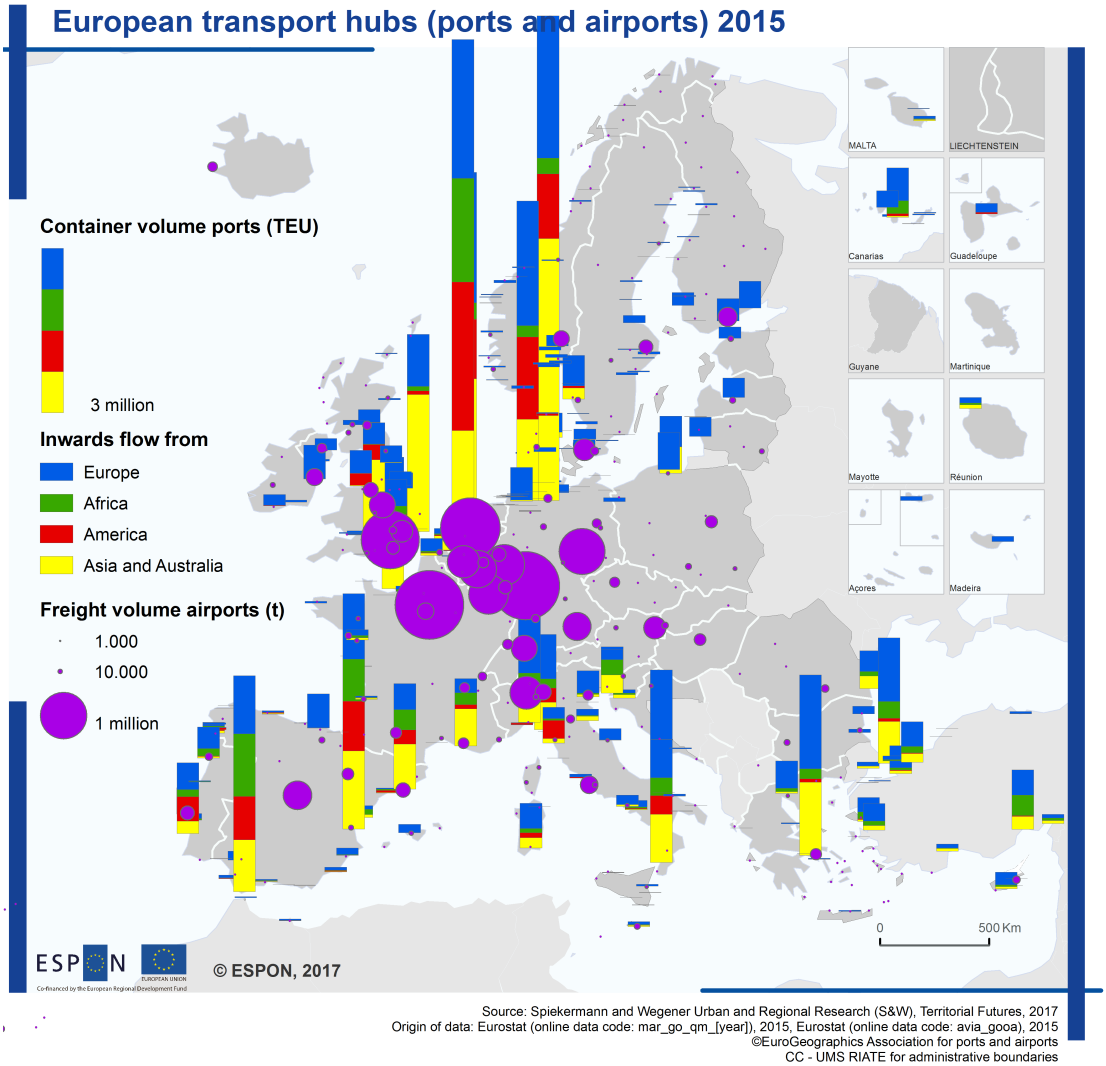
In other words, areas which are highly exposed due to high levels of openness to international trade and highly sensitive due to high shares of GDP deriving from exports are:

- **Most challenged by transition.** In particular manufacturing areas in the Benelux and Ireland.
- **Highly challenged by transition but with potential to cope.** Areas highly exposed but with low sensitivity are Upper Normandy and Midi-Pyrénées (Toulouse / Airbus), as well as Finland.
- **Least challenged by transition.** Areas with low exposure and low sensitivity are Spanish inland regions, Greece and parts of Southern Italy.

5.4 Transport hubs

Declining material production in a place based circular economy also implies declining transport of resources and goods.

Map 5.2 European transport hubs (ports and airports), 2015



Source: Spiekermann and Wegener Urban and Regional Research (S&W), Territorial Futures, 2017
Origin of data: Eurostat (online data code: mar_go_qm_[year]), 2015, Eurostat (online data code: avia_gooa), 2015
©EuroGeographics Association for ports and airports
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5.4.1 Exposure

Areas hosting international freight transport hubs (ports & freight airports) are exposed to economic transition following declining levels of goods transport.

The most exposed are the main transport hubs in Europe. For ports, these are Rotterdam, Antwerp, Hamburg, Amsterdam, Algeciras, Marseille, Le Havre, Immingham, Valencia, Bremerhaven, Trieste, London, Bergen, Genoa, Sines, Riga and Athens.

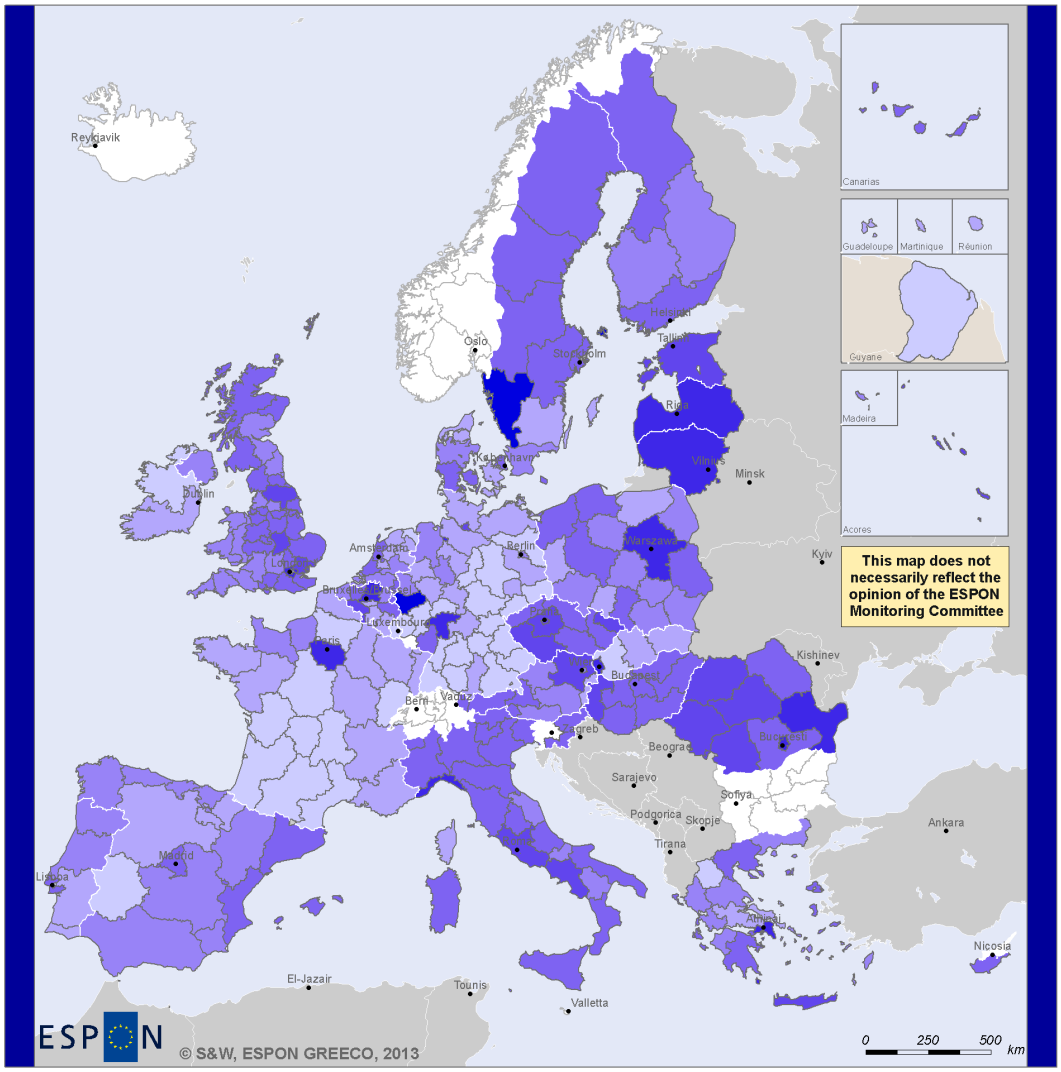
When it comes to airports, the main ones for freight and mail are, Paris, Frankfurt, Amsterdam, London, Leipzig, Köln/Bonn, Luxembourg, Liege, Milan, Brussels, Madrid, East Midlands, Vienna, Copenhagen, Helsinki, Rome and Dublin.

5.4.2 Sensitivity

Among freight transport hubs, areas where much of the regional economy depends on hub functions are particularly sensitive to the changes.

The relative importance of transportation and storage services can be analysed by comparing employment in this sector with the non-financial business economy workforce. Among the 193 NUTS level 2 regions for which data are available from 2013, the median share of the transport and storage services sector in the non-financial business economy workforce was 7.3%. Employment within the transport and storage services sector was widespread, with very few regions being particularly unspecialised in this activity. By contrast, a small number of regions were strongly specialised, notably the capital city regions of Slovakia (Bratislavský kraj), United Kingdom (Outer London), France (Île de France), as well as Italy (Liguria), Latvia and Lithuania. In each of these regions, transport and storage services accounted for 12% or more of non-financial business economy employment. Several other capital city regions recorded relatively high employment shares for transportation and storage services, including Dytiki Makedonia in Greece, Helsinki in Finland and Estonia**.** The transport and storage services sector accounted for less than 4.0% of non-financial business economy employment in the Portuguese region of Norte. The lowest share for any capital city region (for which data are available) was 3.1% for Inner London in the United Kingdom.

Map 5.3 *Gross Added Value of the transport sector, 2009*



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Origin of data: Eurostat, 2013
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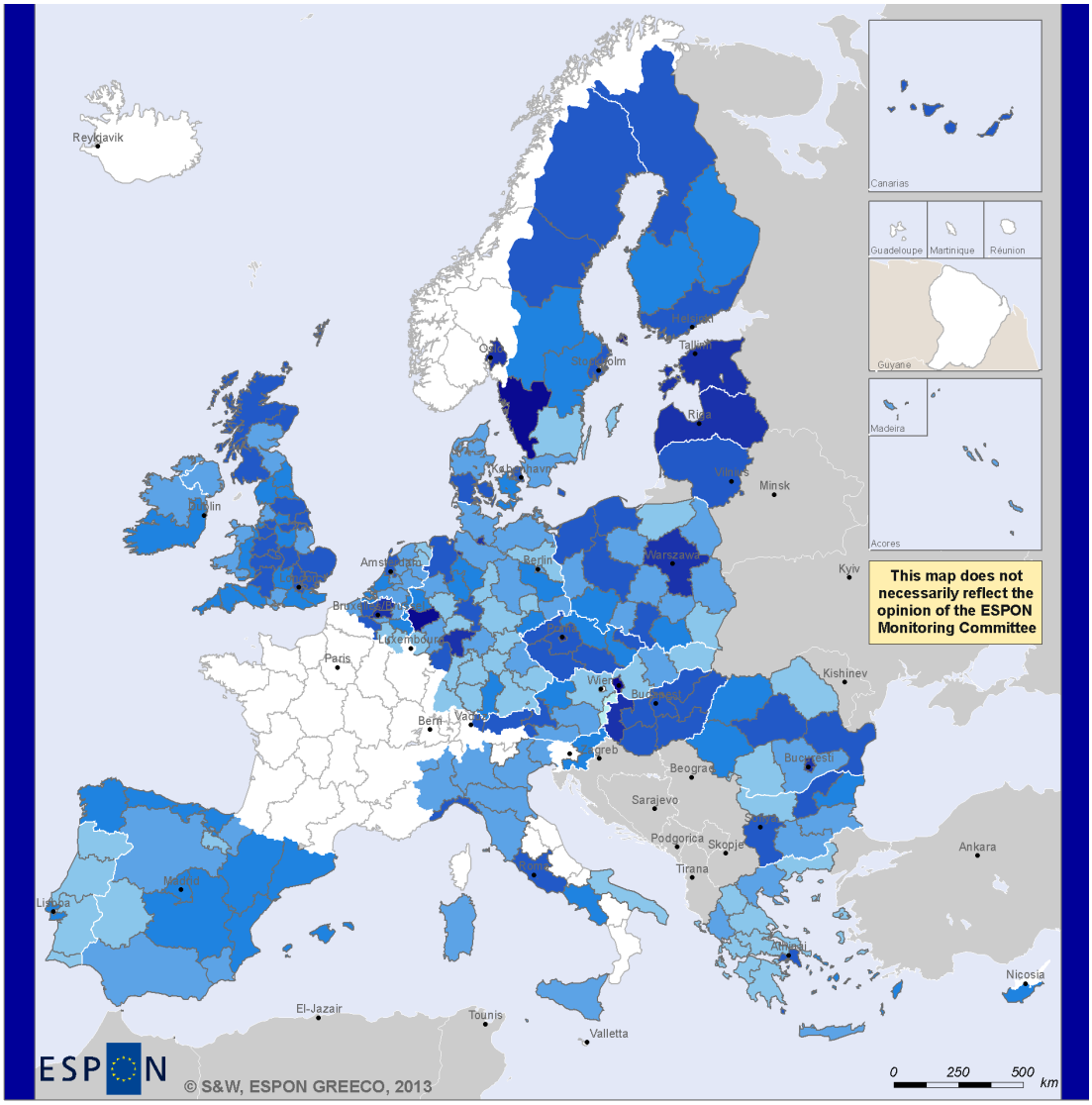
GVA of transport sector H (2009)
Transportation and storage

Share of total GVA (in percent)

- < 2.5
- 2.5 - 3.5
- 3.5 - 4.5
- 4.5 - 6.5
- 6.5 - 8.5
- 8.5 - 15.0
- > 15.0
- no data

Map 5.4 *Employment in the transport sector, 2009*



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Source: ESPON GREECO Database, 2013
Origin of data: Eurostat, 2013
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Employment in transport sector H (2009)
Transportation and storage

Share of total employment (in percent)

- < 2.0
- 2.0 - 3.5
- 3.5 - 4.5
- 4.5 - 5.5
- 5.5 - 7.5
- 7.5 - 14.0
- > 14.0
- no data

5.4.3 Impact

Areas with a major freight transport hub which are highly exposed and highly sensitive due to a high share of jobs in the transport sector:

- **Most challenged by transition.** Areas in Outer-London, Paris, Genoa, Helsinki, Riga and Athens, but also Rotterdam, Antwerp and Bremerhaven are to be mentioned.
- **Highly challenged by transition but with the potential to cope.** Highly exposed areas but with lower sensitivity are the other transport hubs listed above.
- **Least challenged by transition.** Areas with low exposure and low sensitivity are regions those not close to any of the listed transport hubs.

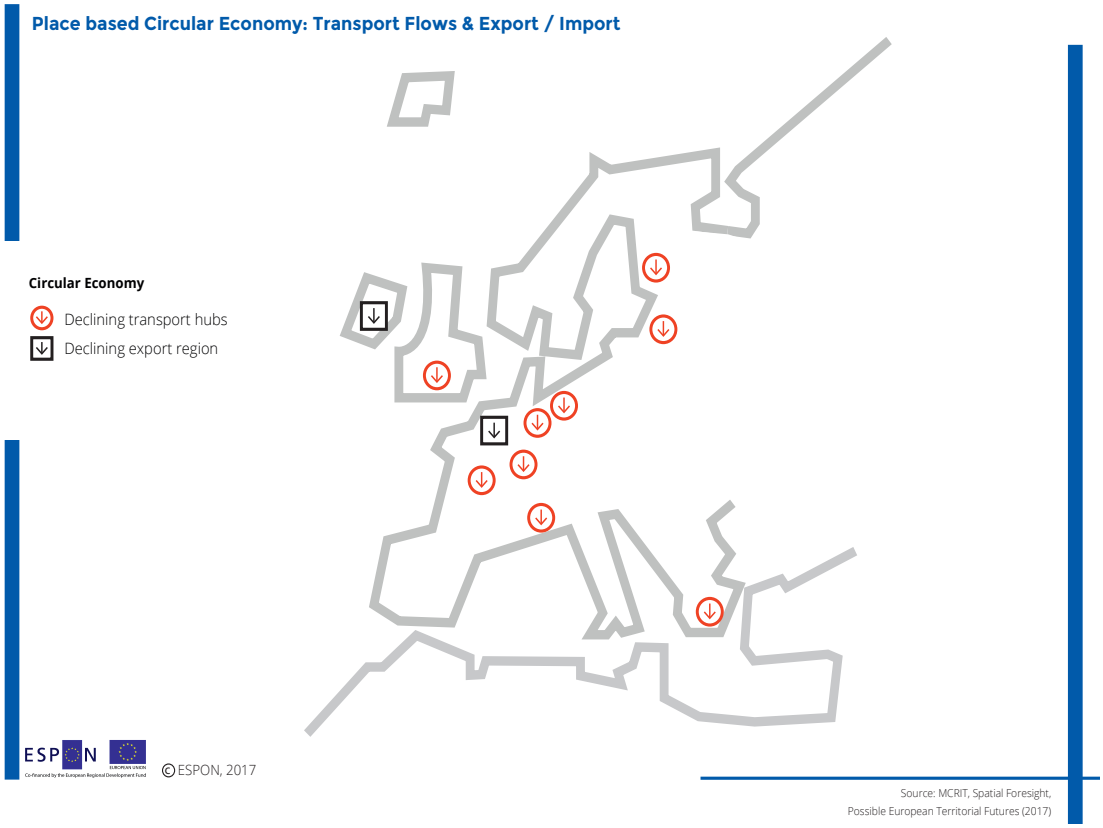
5.5 Conclusion on the territorial dimension brought about by the declining transport and flow of goods

A place based circular economy in Europe has an impact on territorial development with regard to changes in the flow of transport and goods.

As discussed above, the exposure and sensitivity of regions varies with a strong focus on the export and import of material resources and goods, as well as transport hubs.

Summarising the work in the above sections, the map below shows key territorial disparities and challenges due to changing transport flows. The map is developed from sketches at the participatory workshop, enriched with the results of material presented above.

Map 5.5 Territorial implications of transport flows in a place based circular economy



The below table summarises exposure and sensitivity indicators.

Table 5.1 Exposure and sensitivity indicators - transport and flows of goods

Hypothesis	Types of areas exposed	Sensitivity of the exposed areas
A place based circular economy implies a decrease in goods produced as they last longer, are shared, reused and repaired. Additive manufacturing will change production processes which implies a decline in goods exported and imported.	Areas with industries with high volumes of products for export may be more exposed to transition and need to adjust to the new industrial paradigms.	Areas where a lot of the regional economy depends on industries focusing on international trade are the most challenged.
The decline of goods produced, exported and imported also implies a decline in freight transport.	International freight transport hubs (ports & freight airports) are more exposed to transition.	Areas where a lot of the regional economy depends on hub functions are most challenged.

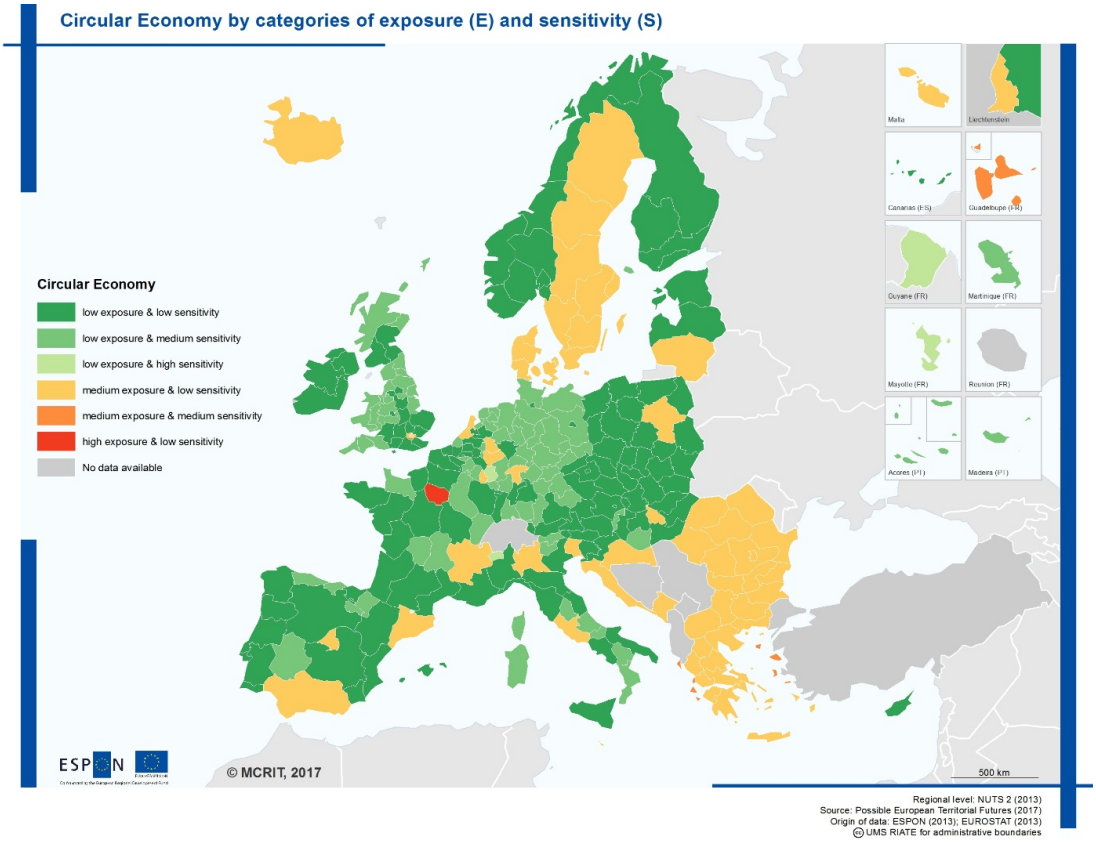
As shown above, these exposures and sensitivities translate into areas which are particularly affected and those hardly affected. The main points are shown in the table below.

Table 5.2 Territorial impacts – transport and flows of goods

	Areas highly exposed and highly sensitive	Areas highly exposed but not so sensitive	Areas less exposed and not so sensitive
Export-import regions	Manufacturing areas in the Benelux and Ireland.	Upper Normandy and Midi-Pyrénées (Toulouse / Airbus), Finland.	Spanish inland regions, Greece and parts of Southern Italy.
Transport hubs	Outer-London, Paris, Genoa, Helsinki, Riga and Piraeus.	The other transport hubs listed above.	Regions which are not close to any of the listed transport hubs.

An attempt to metamodel specific aspects of the territorial dimension of a place based circular economy with regard to changing transport flows is shown in the map. The focus is on employment in the transport and storage sector (as exposure) and the share of GDP from exports (as sensitivity). It highlights the metropolitan areas of Paris, Madrid, Barcelona, London, Rome, Frankfurt, Rotterdam, Warsaw and Luxembourg, but also most of Iceland, Denmark, Sweden, Greece, Croatia, Bulgaria, Romania and Lithuania.

Map 5.6 Territorial impact of a place based circular economy due to reduced freight transport



6 Scenarios for extreme cases

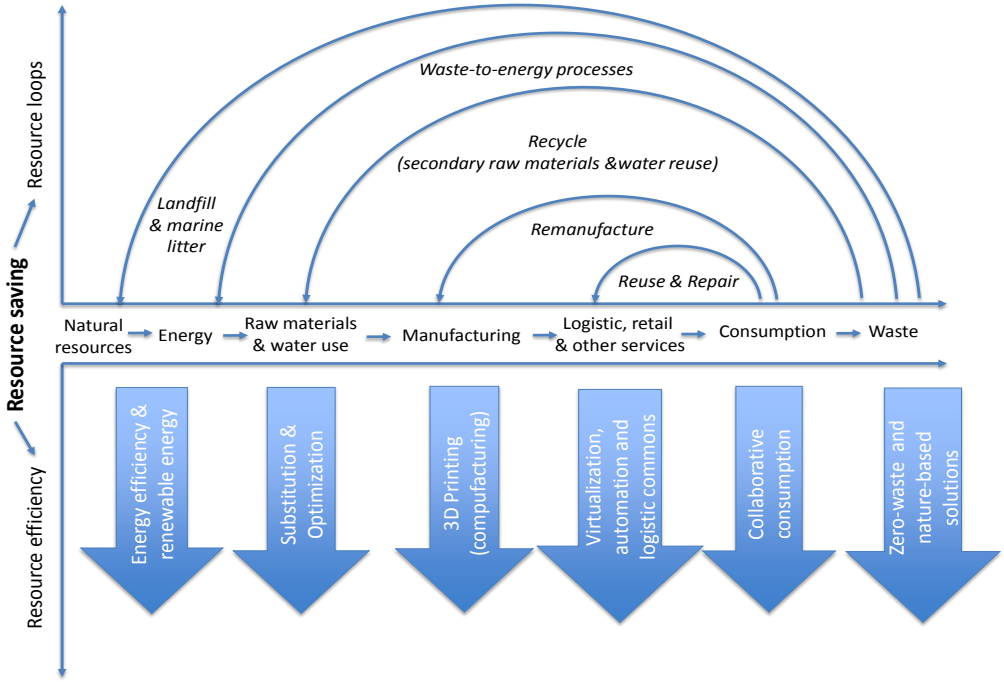
A place based circular economy could also take a different turn than what has been discussed above. It could e.g. focus exclusively on industrial waste management or driving behavioural changes. This section presents further food for thought.

To illustrate resource circularity and efficiency in two extreme scenarios of a circular economy we use a working definition of resource saving as the combination of:

1. any improvement in efficiency for a single production or consumption process in the value chain (resource efficiency);
2. the reuse or recycling of a resource for more than one production process in a consumption cycle (resource loops).

The diagram below shows how this working definition can distinguish the two scenarios.

Figure 6.1 Between resource efficiency and resource loops



In theory, we may have a scenario in which focus and innovation is concentrated on closing resource loops in production and consumption systems (top area in the diagram) or radically improving resource efficiency in individual steps of the production and consumption chain (bottom area of the diagram). In practice a mixed scenario, where advances are made in both loops, is more realistic.

The resource vs. efficiency concept in the next diagram represents the complexity of the production and consumption system and its possible evolution short-term from now to 2020 and medium-long term to 2030.

For any system – e.g. the whole EU, a Member State or a region - we use the height of the feedback loops to represent current volumes of reuse/recycling and targets established for

2020. If a detailed data breakdown is available, the shares of total resource mass or the value of each reuse or recycling option can be shown for the single feedback loops and waste (the last loop). The depth and length of the arrows on the bottom represent estimates of current penetration as well as short-term forecasts to 2020 for resource efficiency gains. The latter are delivered through key mechanisms (the arrows) that – individually or combined – promise to radically change resource efficiency in the production and consumption system: 1) greater reliance on energy efficiency improvements and renewable energy; 2) substitution of old with new materials and optimisation of resource use; 3) 3D printing (also named additive manufacturing, 'infofacturing' or 'compufacturing'; 4) virtualisation as a consequence of the increasing digitalisation of products and automation of processes (Artificial Intelligence); 5) collaborative consumption; 6) new zero-waste (bio-)production processes and nature-based solutions.

For some aspects, such as energy efficiency and renewables, estimates and forecasts are based on robust statistics and models, while for other aspects, such as the penetration of additive manufacturing and collaborative consumption, evidence is usually more anecdotal, so current and short-term penetration can only be guessed.

6.1 Scenario: Global industrial waste management

In this extreme scenario, multiple players across business and research communities, supported by policy makers and investors, come together to reconceive key manufacturing processes and flows of materials and products, establishing standards for recycling components and materials.

A paradigm shift from disposability to restoration started with global producers in different sectors, such as Renault in the automotive sector and Ricoh with office machines, moving away from the «take, make, and dispose» system by designing and optimising products for multiple cycles of disassembly and reuse. Material started to be viewed as a valuable stock to be used again, not as elements to flow through the economy once.

Companies succeeded in closing materials loops on a global level, achieving tipping points that brought major streams of materials back into the system, with high volume and quality, through established markets. Circular value chains are created at regional (e.g. within Europe) or interregional level (e.g. across the Mediterranean, between South Europe and Africa) with peripheral (South) low labour cost countries specialising in recycling materials and products that return for the next cycle of re-utilisation in high value production in central and northern countries.

In the year 2030, the new circular industry paradigm has almost eradicated waste – not just from manufacturing processes, but systematically, throughout the life cycles and uses of products and their components. Indeed, tight component and product use and reuse, aided by product design, helped define the concept of a circular economy and distinguish it from recycling, which loses large amounts of embedded energy and labour.

In almost all industrial sectors, the eco-design has made products more durable and easier to repair, upgrade or remanufacture. A circular system has introduced a strict differentiation between a product's consumable and durable components. Products returning from leasing contracts are inspected, dismantled, and taken through an extensive refurbishing process that includes replacing components and updating software before re-entering the market. For products that can't be remanufactured, refurbished, or upgraded, companies harvest the components and recycle them at local facilities. A closely related way companies benefit from the circular economy is to maximise the number of consecutive product cycles (cycles of reuse, repair, or remanufacture) and the time products spend in each. If designed appropriately, each additional cycle eliminates some of the material, energy, and labour costs of creating a new product or component. Another source of value creation is to take a product or component and diversify its reuse more widely across the value chain, redistributing materials so they can substitute for inflows of new materials somewhere else.

Since restoration is the default assumption in the new circular economy, the role of consumer is replaced by that of user. For companies, this change required a different way of thinking about their implicit contract with customers. For example, in a buy-and-consume economy, the goal is to sell the product. In a circular economy, the aspiration is to rent it and ensure that it is returned for reuse. When products must be sold, companies create incentives to guarantee their return and reuse.

A key catalyser for this scenario was establishing standards for materials to be circulated in the economy, starting from four categories of materials at different stages of maturity: 1) "golden oldies", including well established recyclables (e.g. glass, metals, paper, PET); 2) "high potentials" such as PP, PR and other polymers, that were not systematically reused; 3) "rough diamonds", including by-products of manufacturing processes (e.g. carbon dioxide, concrete, food waste); 4) "new blockbusters", including innovative materials that support fully restorative usage cycles (e.g. bio-based material and 3D printing material). The result was to close material loops through regional value chains, achieving tipping points that brought major streams of materials back into the system, at high volume and quality, through established markets within regional areas (e.g. Europe) or together with neighbourhood areas.

To conclude, the main feature of the extreme scenario presented here is the restructuring and closing of global value chains, with their transformation mostly into regional value chains, not their decline or demise. In other words, this is a global circular economy scenario, not place based.

6.2 Scenario: Driving local behavioural changes

Transition to a low-carbon economy could involve radical energy efficiency improvements across every sector of the economy. This could include the wide diffusion of smart electricity grids, decentralised production and trade of energy from renewable sources, the wide diffusion of electric cars and Grid To Vehicles (G2V) storage capabilities, renewable energy

from biomasses, waste heat and combined heat and power technologies (CHP) in district heating networks (DHN).

Pervasive use of advanced (nano- and bio-) materials in production and consumption processes and IoT based optimisation. The guiding principle for substitution is to consider every resource a company uses in its core products and every resource customers use or consume and then to look for higher-performing and less expensive, less risky, or less scarce materials that might work as substitutes. But new resources are not simply replacements for current materials. Substitution should also deliver superior performance (qualitative improvement). A much richer understanding of materials science at the nano scale, combined with advanced computer-processing power, catalyses a broad revolution in absorption characteristics, as well as surface, optical and electrical properties. Substitution is extended even to food production, such as animal-free milk and eggs. Another way for companies to boost the productivity of existing resources will be to optimise their use by integrating software into traditional industrial equipment or providing heavy equipment as a service. Companies increasingly consider opportunities with the most potential by asking: What expensive assets could be integrated with software and sensors? Which pieces of equipment are used only for a small portion of the time? What energy-intensive equipment is active without performing a function? The answers integrate with IoT solutions that optimise routing, timing, loading, or sharing.

Diffusion of additive manufacturing as the dominant production mode. This differs from conventional centralised manufacturing in several important ways (Rifkin, 2014): a) software does all the work, leading to the idea of “infofacture” rather than “manufacture”; b) the software is open source, and the elimination of intellectual property protection also significantly reduces the cost of printing products; c) subtractive processes are substituted by additive infofacturing, which greatly increases resource efficiency; d) production is less capital-intensive and more flexible, meaning tailored instead of mass production; e) production can be more easily supported by decentralised IoT and energy infrastructure, allowing infofacturers to be anywhere and quickly move to where they can connect with IoT infrastructure. In this new production context, more and more prosumers make and use simple products at home, with local 3D printers powered by green electricity harvested from renewable energy onsite or generated by local producer cooperatives. Small and medium-sized 3D business, infofacturing more sophisticated products, clustering in local technology parks to establish an optimum lateral scale. Homes and workplaces are no longer separated by lengthily commutes. To make 3D printing a truly local, self-sufficient process requires feedstock used in the filament to be abundant and locally available. Some experimental 3D printers use cheap paper as feedstock, this paper costs a mere 5% of previous material. Other feedstock such as melted sand or plastics, are even cheaper, reducing the cost of materials to near zero. In the building sector 3D printing is in a very early stage of development, but growing exponentially. It uses the cheapest building materials on Earth, sand and rock, as well as virtually any kind of discarded waste material, all from locally

available sources. This avoids the high costs of traditional building materials and the equally high logistic costs of delivering them. The additive process of building infrastructure layer by layer provides further savings on the materials used in construction. In the automotive sector 3D printing will radically change the production logic. Automobiles can be made from nearly free feedstock available locally, eliminating the high cost of rare materials, of shipping them to the factory and storing them on-site. Most car parts can be made with 3D-printed plastic, except for the base chassis and engine. The rest of the car is produced in layers, in a continuous flow rather than being assembled from individual parts, meaning less material, less time, and less labour are used. Because a 3D printing automotive factory can be located anywhere that it can plug into IoT infrastructure, it can deliver vehicles locally or regionally for less expense than shipping vehicles across countries from centralised factories.

Virtualisation and automation. Virtualisation means moving activities out of the physical world or simply not doing things, because they've been automated. Both challenge existing business models. To understand the idea think of physical objects or products that you no longer own or use, even though they were part of your everyday life just five or ten years ago. That could include traditional calculators, paper calendars, cameras, alarm clocks, or photo albums. All of these have been rendered virtual by smartphone technology. Companies struggle to embrace virtualisation because they don't want people to stop doing things that generate revenue, which seems to drop more than costs whenever activities move into the virtual realm. For instance, car companies don't want people to drive less, but that is what is happening in developed countries. Miles driven per capita peaked in 2004 in the United States and have declined steadily since. The reasons are not entirely clear yet. The decline started before the recent recession and has continued even as the economy rebounded (higher gas prices are surely a factor, but probably more important is the fact that many people are doing things virtually that they used to do by hopping into cars). Even teenagers have shown a declining interest in driving, according to statistics on the age when Americans (and Europeans) get their first license - the ability to connect via social media being a possible reason. Skype and other video-chat applications further reduce the need to drive somewhere to see someone. Work, too, is becoming more virtual as people increasingly use online media and virtual private networks to connect productively without needing an office.

Logistic commons. Another key development in this extreme scenario is the transformation of logistics (Rifkin, J. 2014). In an IoT based global logistic system traded physical products need to be embedded in standardised modular containers that are transported across logistic networks, at continental, regional and local levels. The containers are equipped with smart tags and sensors for identification and sorting. The entire system, from warehousing to transport, to end users, uses the same standard technical protocols to assure easy passage from one point to another. In the new open logistic commons system, conventional private point-to-point and hub-and-spoke transport gives way to distributed, multisegment, intermodal transport. Instead of one driver handling the entire load from the production centre to the drop off and then heading to the nearest location to pick up a shipment designated for delivery on

the way back home, the delivery is distributed. The first driver might deliver the shipment to a hub close by and then pick up another shipment and head back home. A second driver would pick up the shipment and deliver it to the next hub down the line, whether it be a truck port, rail yard, or airport, until the entire shipment arrives at its destination. The technology to build this new logistic commons system is already available. What is needed is the acceptance of universal standards and protocols and a business model to manage a regional, continental and global logistic system.

Collaborative consumption. The notion of a «collaborative economy» (also named «sharing economy» or «peer-to-peer» economy) is evolving. Currently this refers to a variety of rapidly emerging business models where activities are facilitated by online platforms that create an open marketplace for the temporary use of goods or services, often provided by private individuals. The collaborative economy involves three categories of actors: (i) service providers who share assets, resources, time and skills — these can be private individuals offering services on an occasional basis ('peers') or professional service providers; (ii) users of these services; (iii) collaborative economy platforms that connect providers with users and facilitate transactions between them, also ensuring the quality of these transactions e.g. through after-sale services (handling complaints), insurance services, etc. Collaborative economy transactions frequently do not involve a change of ownership and can be for profit or not for profit. Collaborative platforms have already penetrated several sectors of the economy, particularly services, and continue to do so in this extreme scenario, becoming the dominant form of consumption for: 1) tourism and peer-to-peer accommodation; 2) peer-to-peer transportation (shared mobility); 3) online skills, with the exchange of household and professional services; 4) collaborative finance (crowdfunding). The main drivers for the diffusion of a collaborative economy are internet technology, which provides the basis for developing online platforms and linking them with service providers and purchasers, and societal drivers such as population density. Increased population density within cities provides the basis for a critical mass of resources and suppliers to support online markets for localised services. In this scenario, shared mobility is the dominant passenger transport mode both within cities and for interurban trips. At the same time, commuting with rigid time schedules will be greatly reduced as an effect of new work and life arrangements following the spread of infofacturing, virtualisation and service automation.

Diffusion of zero waste and nature-based solutions. Zero waste refers to waste management and planning approaches which emphasise waste prevention as opposed to end-of-pipe waste management. Zero waste encompasses more than eliminating waste through recycling and reuse, it focuses on restructuring production and distribution systems to reduce waste. In this respect, zero waste is more of a goal or ideal rather than a hard target. It provides guiding principles for continually working towards eliminating waste. The most promising zero-waste processes come from imitating natural processes and ecosystems. "Nature-based solutions" are actions which are inspired by, supported by or copied from nature. They have tremendous potential to be energy and resource-efficient and resilient to change, but to be successful they

must be adapted to local conditions. In this extreme scenario solutions are widespread across Europe. This will be based on the successful deployment of the EU Research and Innovation agenda on nature based solutions and renaturing cities, which has enabled Europe to become a world leader both in R&I and in the growing market for nature-based solutions.

7 Towards territorial cohesion?

In this final chapter the focus is on pointers for policies focusing on how to strengthen territorial cohesion in a European place based circular economy.

For this we summarise the differences in territorial cohesion between a place based circular Europe and a business as usual Europe. We identify drivers for these differences and subsequently develop policy pointers to support territorial cohesion and counteract challenges.

7.1 Territorial cohesion today and tomorrow

As shown in volume B on the future of the European territory, a business as usual scenario for the territorial future of Europe points to considerable challenges for territorial cohesion, including:

- increasing polarisation of settlements;
- increasing concentration of economic activities;
- growing climate change and environmental concerns; but also
- technology and innovation that can make new regional stars.

Compared to this, the place based circular economy holds more potential for territorial cohesion in Europe, as aspects such as additive manufacturing have a stronger focus on 'reuse, repair & recycle' as well as that reduced importance of transport hubs creating opportunities for smaller, more peripheral and lagging areas to grow while some dominant urban agglomerations lose importance. Examples are:

- **Changing manufacturing processes (chapter 3.3):** Labour intensive repair, reuse and recycle activities will create new jobs throughout Europe and benefit polycentric development with new jobs emerging in smaller and lagging areas. This development will also be supported by manufacturing moving from large scale production to additive manufacturing. However, areas with low population density in the European peripheries and inner peripheries will not benefit from this.
- **Increased sharing and repairing attitude (chapter 4.4):** Boosting the sharing economy will be easier in some place than in others. However, overall this should increase territorial cohesion. Still. it will be particularly challenging for areas with a limited sharing economy, societal trust or population density. Among the potential frontrunners are urban agglomerations in France, Ireland, Latvia, Croatia, Germany, Estonia, Romania, Spain and Italy.
- **Changing understanding of prosperity (chapter 4.5):** A place based circular economy implies an understanding of prosperity and wealth which goes beyond GDP and focuses more on well-being. Trust and governance are key aspects in this. The areas with the

most dramatic transition processes are South-Eastern Romania, Eastern Bulgaria and Southern Italy.

- **Changing role of transport hubs (chapter 5.4):** International transport volumes will drop substantially. This implies that major transport hubs for freight (ports and airports) will decline in importance. The biggest declines are expected in London, Paris, Genoa, Helsinki, Riga and Piraeus as well as Rotterdam, Bremerhaven, Hamburg, which for some reason do not feature in the statistics.
- **Changing role of goods exports and imports (chapter 5.3):** International export and import for goods will decline dramatically. This challenges industrial regions in Belgium, the Netherlands and Ireland.

At the same time, a place based circular economy might also further emphasise some territorial disparities in Europe. Some regions heavily dependent on large scale manufacturing may fall behind, regions leading in green technology solutions may become even more dominant, and some behavioural changes may affect convergence regions more than leading regions. Examples for this are:

- **Changing manufacturing processes (chapter 3.3):** In a place based circular economy places with high levels of manufacturing and low resource efficiency risk falling behind (large parts of manufacturing may even disappear). Among the areas facing particular transition challenges are regions on the Czech Republic, most rural regions in eastern Rumania, regions with high levels of manufacturing in Bulgaria and rural Poland and also rural areas in Estonia.
- **Driving role of green innovations (chapter 3.5):** Regions with significant innovation and in particular eco innovation could become champions producing new solutions that spread throughout Europe. This includes Northwest Europe; Ile de France, the south coast in the UK, Switzerland, large parts of Southern Germany as well as most urban agglomerations in Germany, Northern Denmark, the Øresundregion, metropolitan regions of Sweden, plus Northern Sweden and the capital region of Finland.
- **Behavioural change needed to reduce household waste (chapter 4.3):** Household waste volumes and recycling are particular challenges for tourist areas with low recycling cultures. Among these are Malta, Cyprus, tourist areas in Scotland, along the French coast and large parts of regions along the Mediterranean coast in Greece, Italy and Spain and the Algarve in Portugal, as well as tourist urban nodes, such as Venice, and winter sport destinations.

Taking all these points together, a place based circular economy will imply dramatic changes for all parts of Europe and will also affect the European urban system and territorial balance. At a European level, the differences between socio-economic strong points and lagging regions may become less pronounced. A place based circular economy holds potential for

increasing territorial cohesion and polycentric development in Europe, while at the same also posing new challenges to cohesion.

7.2 Drivers on the way from today to tomorrow

Developing a place based circular economy which contributes as much as possible to territorial cohesion, requires some key drivers that are already in place.

A place based circular economy implies a paradigm shift in production processes and in consumption patterns. Key drivers are:

- **Political and social will.** Most important for this paradigm shift is the political will to go through industrial and societal transition. Approaching the circular economy purely as a resource management and waste reduction strategy will not suffice. A change of thinking and attitudes will be needed otherwise there is a risk that resource reduction will be counteracted by increased consumption.
- **Technological solutions.** For increasing reductions of waste in industrial production processes, including industrial symbiosis and additive manufacturing, a wide range of solutions already exist. While these need to be more widely applied, new innovations are needed to speed up the transition to a place based circular economy.
- **Behavioural change.** While the technological solutions will support the production side of a circular economy, behavioural change is needed to support the consumption side. This especially regards the shift to sharing (with a focus on usage instead of owning), using products for a longer period (instead of regularly replacing them with the latest fashion), as well as repairing, reusing and recycling products.

7.3 Pointers to policies for territorial cohesion tomorrow

To ensure better territorial cohesion in a place based circular economy, negative aspects need to be counteracted and positive aspects supported. Some pointers for policies are:

- **Polycentric structures for additive manufacturing.** This could help economic development also in smaller and lagging areas. Supporting this through increasing investment capacity, funding and knowledge in smaller centres and lagging regions can further strengthen territorial cohesion.
- **Local and regional industrial symbiosis processes** are an important part of the place based circular economy which may evolve faster in areas with higher awareness and a good mix of different production processes. Supporting these processes in smaller locations through increasing investment capacity, funding and knowledge can further strengthen territorial cohesion.
- **Declining manufacturing and transport hubs** may contribute to more balanced development in Europe if it reduces the socio-economic dominance of major urban agglomerations. However, it may also affect manufacturing in other areas and thus

contribute to further disadvantages for these areas. In any case, policy interventions might be needed to facilitate and cushion the decline of production and transport hubs.

- **Changing transport and distribution patterns** hold the potential to develop more polycentric freight transport systems which are better suited to declining transport volumes. Supporting the development of a polycentric system of smaller transport hubs may further strengthen territorial cohesion.
- **New technological solutions for resource efficient production** are needed. While many examples show that a wide range of such solutions already exist, there is also a need to develop further solutions. For both existing and new solutions, it is important that ideas and solutions are quickly shared and adapted throughout the territory. Policies supporting the sharing and dissemination of circular economy solutions can support these processes. This may also contribute to reducing disparities between areas which are driving innovations in the field and those merely adapting new solutions.
- **Sharing economy solutions supporting the behavioural shift** in our consumption of goods are an important part of a place based circular economy. These can generally be supported through adequate legal frameworks and online platforms. A particular emphasis will be needed for smaller, sparsely populated areas and inner-peripheries where there is no critical mass for self-sustaining local sharing platforms. Supporting innovative solutions for these areas will be important to avoid them falling behind in the paradigm shift.
- **Changing behaviour concerning household waste** is a challenge in all parts of society. In areas with many tourists this may be a significant challenge as tourist behaviour strongly impacts on the volumes of local household waste. Particular policy action might be needed for these tourist areas.
- **Sparsely populated areas and inner-peripheries** will be additionally disadvantaged in a place based circular economy. Therefore, it is important to develop policy actions which ensure that their potential is developed and innovation solutions are supported to ensure their access to goods and services.

References

Aachener Stiftung Kathy Beys, Effizienz-Agentur NRW and Wuppertal Institut für Klima, Umwelt, Energie GmbH (2017) *factory - Circular Economy*. Magazing für nachhaltiges Wirtschaften 1. Bochum.

Barca F (2009) *An Agenda for a reformed Cohesion Policy. A place-based approach to meeting European Union challenges and expectations.* Available at: ec.europa.eu/regional_policy/archive/policy/future/pdf/report_barca_v0306.pdf (accessed 25 January 2012).

Capello R, Camagini R, Lenzi C, et al. (2012) *ESPON KIT. Knowledge, Innovation, Territory. Final Report.* Luxembourg: ESPON.

EASAC (2016) *Indicators for a circular economy*. 30, EASAC policy report. Halle: European Academies' Science Advisory Council.

Ellen MacArthur Foundation, McKinsey Centre for Business and Environment and Stiftungsfonds für Umweltökonomie und Nachhaltigkeit (2015) *Growth within: a circular economy vision for a competitive Europe*. June. Available at: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=0ahUKEwiAztbmk73KAhWBCxoKHXAoDKUQFgglMAE&url=http%3A%2F%2Fwww.ellenmacarthurfoundation.org%2Fassets%2Fdownloads%2Fpublications%2FEllenMacArthurFoundation_Growth-Within_July15.pdf&usg=AFQjCNGV12AIasdtYgU-Y9FmC-pl9bZCcw&sig2=3Jo6s1nOLrFonH0iVUKDvA (accessed 22 January 2016).

European Commission (2011) *White Paper on transport. Roadmap to a Single European Transport Area - Towards a competitive and resource-efficient transport system.*

European Commission (2014) *Investment for jobs and growth - Promoting development and good governance in EU regions and cities - Sixth report on economic, social and territorial Cohesion*. July. European Commission.

European Commission (2015a) Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and to the Committee of the Regions. Closing the loop - An EU action plan for the Circular Economy. Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1453384154337&uri=CELEX:52015DC0614 (accessed 22 January 2016).

European Commission (2015b) *Territorial Agenda 2020 put in practice. Enhancing the efficiency and effectiveness of Cohesion Policy by a place-based approach*. Brussels.

European Commission (2016) Moving Beyond GDP: New Regional Social Progress Index. Available at: http://ec.europa.eu/regional_policy/en/newsroom/news/2016/02/16-02-2016-moving-beyond-gdp-new-regional-social-progress-index.

European Commission DG COMM (2016) *The use of collaborative platforms*. Flash Eurobarometer 438–March 2016. Brussels.

European Commission DG Environment (2016) *EU Resource Efficiency Scoreboard 2015*. Belgium. Available at: http://ec.europa.eu/environment/resource_efficiency/targets_indicators/scoreboard/pdf/EU%20Resource%20Efficiency%20Scoreboard%202015.pdf.

European Environment Agency (2016) *Circular economy in Europe. Developing the knowledge base*. 2/2016, EEA Report. Luxembourg: European Environment Agency.

EUROSTAT (2015) *EU Resource Efficiency Scoreboard 2014*. Luxembourg: Eurostat.

Eurostat (2016) Eurostat regional yearbook - 2016 edition. Available at: http://ec.europa.eu/eurostat/documents/3217494/7604195/KS-HA-16-001-EN-N.pdf/76c007e9-6c1d-435a-97f8-e5ea700aa149.

Lüer C, Böhme K, Jæger S, et al. (2015) *Report on territorial impact projections. Final deliverable (D7.2) of work package 7 on Territorial Governance. FLAGSHIP project, 7th Framework Programme (FP7)*. Available at: http://flagship-project.eu/wp-content/uploads/2016/03/FLAGSHIP_D7.2_final.pdf (accessed 20 May 2016).

Martin CJ (2016) The sharing economy: A pathway to sustainability or a nightmarish form of neoliberal capitalism? *Ecological Economics* 121(2016): 149–159.

Morgan B and Kuch D (2015) Radical transactionalism: legal consciousness, diverse economies and the sharing economy. *Journal of law and Society* 42(4): 556–87.

Pauli G (2010) *The Blue Economy: 10 Years, 100 Innovations, 100 Million Jobs. Report to the Club of Rome.* Taos, New Mexico, USA: Paradigm Publications.

Schor J (2014) Debating the Sharing Economy. *http://www.greattransition.org/publication/debating-the-sharing-economy*.

SOU 2017:26 (2017) *Delningsekonomi: På användarnas vilkor. Betänkande av Utredningen om användarna i delningsekonomin*. Stockholm. Available at: http://www.regeringen.se/495f62/contentassets/82aabf7f731c4e18aaee3b8dc3621063/delningsekonomi--pa-anvandarnas-villkor-sou-201726.

World Economic Forum (2014) *Towards the Circular Economy: Accelerating the scale-up across global supply chains*. Geneva: World Economic Forum. Available at: http://www3.weforum.org/docs/WEF_ENV_TowardsCircularEconomy_Report_2014.pdf (accessed 15 June 2016).

World Economic Forum (2015) *Intelligent Assets. Unlocking the Circular Economoy Potential*. Geneva: World Economic Forum. Available at: https://www.weforum.org/reports/intelligent-assets-unlocking-the-circular-economy-potential (accessed 15 June 2016).

Zaucha J, Świątek D and Stanczuk-Olejnik K (2013) Place-based. Territorially sensitive and integrated approach. Polish Ministry of Regional Development.

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