NWE Territorial Analysis and Programme Draft
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TASK 1: The Territorial Analysis of the NWE Cooperation Area

THEMATIC ANALYSIS

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1 PO 1 – A smarter Europe

The territorial analysis for PO1 focuses on four themes, namely socio-economic developments, competitiveness, innovation capacities and the transition to a digital economy and society.

1.1 Socio-economic developments[1]

The cooperation area of North West Europe (NWE) contributed to 46% of Europe's gross domestic product (GDP) in 2018, making the cooperation area one of Europe's most productive and wealthy areas. On average the NUTS 2 regions of the cooperation area have a GDP at purchasing power standard (PPS) per inhabitant of 34,820 EUR against 30,800 EUR on average in the EU.

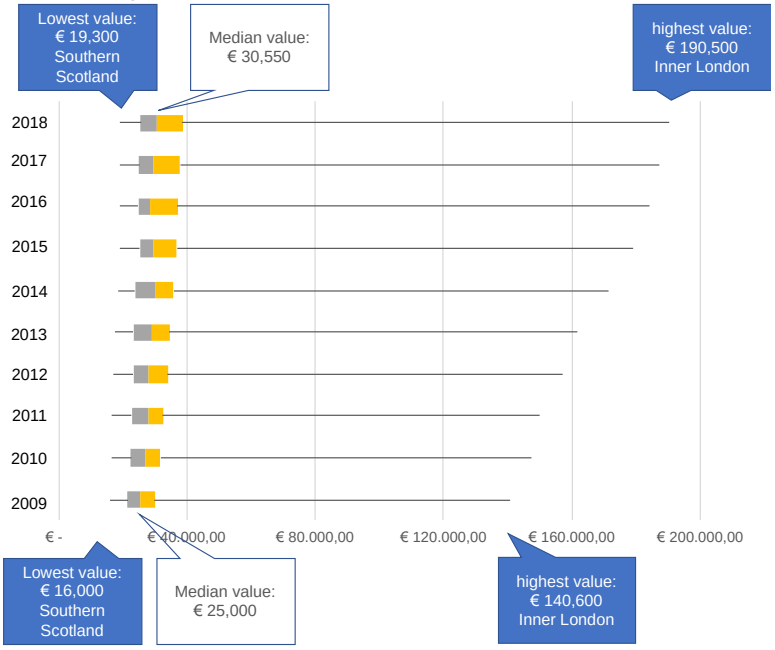
The wealth is, however, not equally distributed across the cooperation area. In 2018, the GDP per capita in PPS was highest in Inner London (190,500 EUR), followed by Luxembourg (80,900 EUR). This is considerably higher than in Southern Scotland (19,300 EUR) and West Wales and the Valleys (20,500 EUR) that reported the lowest values in the cooperation area in 2018. Half of the regions in the cooperation area had a GDP per capita in PPS between 25,625 and 38,650 EUR as represented by the coloured box in Figure 1-1). The further apart are the two ends of the bloxplot, the higher the variance or the standard deviation among the regional performance in GDP per capita in PPS. The distribution of regions illustrates thus a large variety between the 25% most wealthy regions and less variety among the other regions in the cooperation area.

The territorial differences by GDP per capita in PPS have increased. The difference in GDP per capita in PPS between the least wealthy and most wealthy regions was considerably less in 2009 and has been growing ever since (Figure 1-2). Moreover, the spread of GDP per capita in PPS to mark 50% of the NUTS2 region in the cooperation area increased from 8,300 EUR in 2009 (between 21,700 and 30,000 EUR) to 13,025 EUR, suggesting that some regions experienced more growth than others.

GDP has been gradually increasing in the cooperation area, but clear differences can be observed related to the financial crises and BREXIT (Figure 1-2). NUTS 2 regions of the cooperation area had an average yearly GDP growth of 3% between 2009 and 2018. Until the financial crisis Dutch and Irish regions experienced lower growth rates than other NUTS 2 regions in the cooperation area. After the financial crisis, especially Irish and British regions saw an increase in GDP, whereas Luxembourg and Belgian regions had still lower growth rates, indicating longer recovery times from the financial crisis. The growth in GDP has slowed down and turned into a decrease of GDP in United Kingdom regions, since the announcement of a BREXIT referendum. Irish regions experience a similar development as United Kingdom regions. Northern and Western Ireland experiences a decrease in GDP since 2015 (Map 1-1).

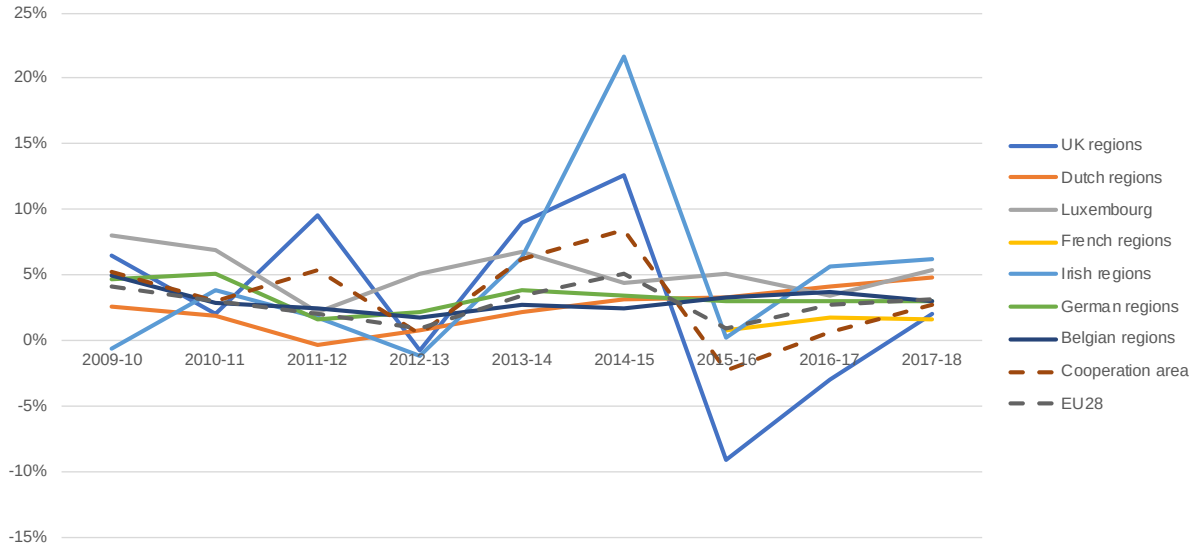
[1] Any territorial pattern observed in this section may alter in the next years following diverse impacts of the COVID-19 pandemic across the cooperation area. It may be assumed that overall the GDP and household incomes decrease. The extent of the decrease and the timespan of the decrease may differ largely between territories, depending on the level of COVID-19 cases and government responses to contain the outbreak. The Alsace, province of Liège, North Brabant, Paris and London are among the territories most hit by the virus. France, Belgium and Luxembourg are among the north west European countries with strictest measures to contain further spreading of the virus that may have a severe impact on any economic activity.

Figure 1-1 Distribution of NUTS 2 regions in the NWE cooperation area by their GDP per capita in PPS[2], 2018



Source: own elaboration based on Eurostat 2020 data (nama_10r_2gdp)

Figure 1-2 Average GDP growth rates of NUTS 2 regions per country 2009-2018



Source: own elaboration based on Eurostat 2020 data (nama_10r_2gdp)

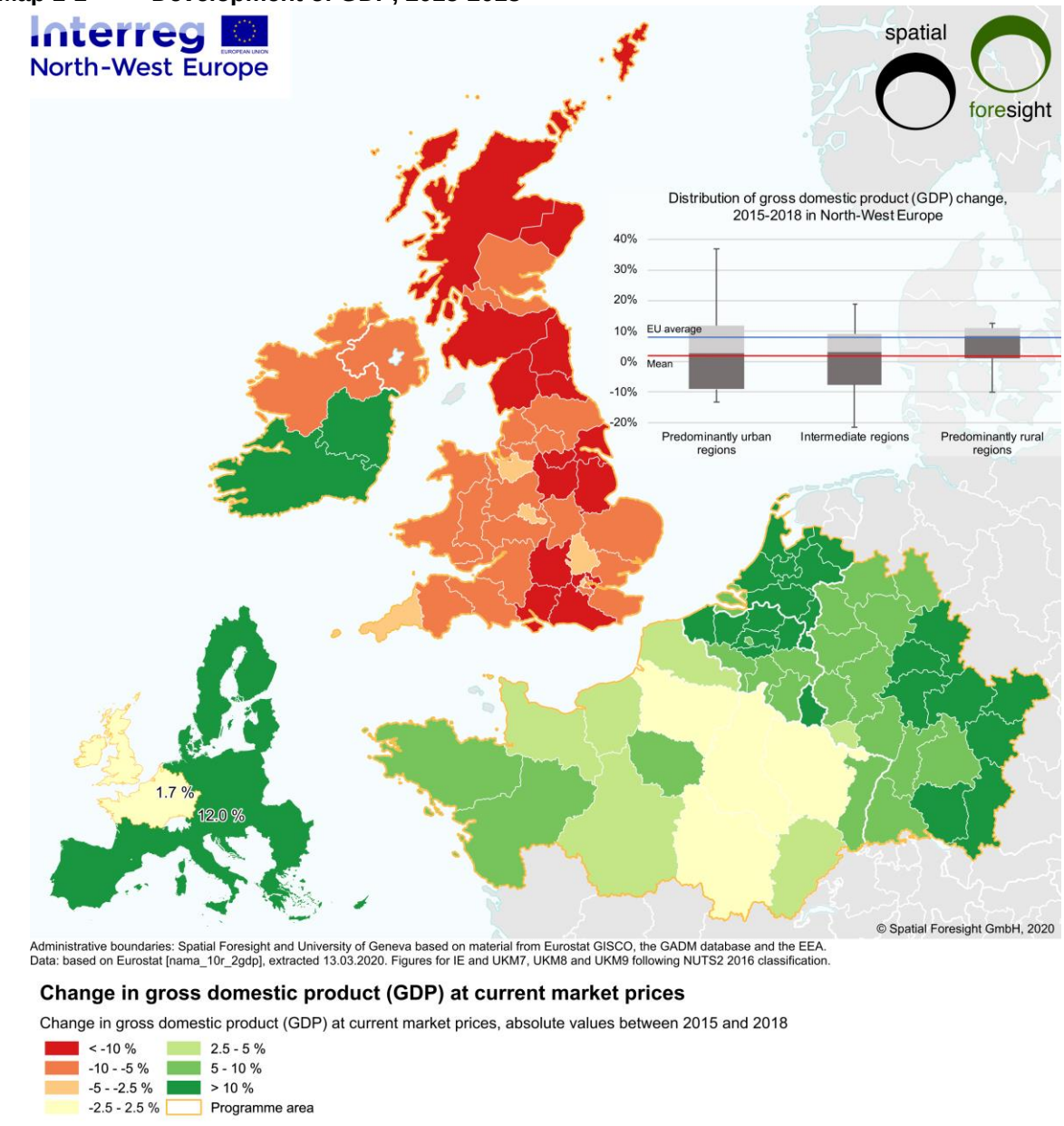
In recent years, GDP increased mostly in urban and intermediate regions and has been moderate in rural regions[3]. In particular, the GDP of Dutch, Flemish, German and Irish regions of the NWE

[2] Every individual part of the boxplot (line on the left side of the box, grey and yellow parts of the box, line on the right side of the box account for a quartile or 25% of the observations. The further apart the two ends of the boxplots are, the higher the variance or the standard deviation in GDP per capita in PPS between the regions.

[3] Not considering UK regions, due to their exceptional decrease in GDP after the announcement of the BREXIT referendum.

cooperation area grew between 2015 and 2018 (Map 1-1). However, compared to the rest of Europe, GDP growth has been moderate in the NWE cooperation area. The GDP growth rate of the NUTS 2 regions of the NWE cooperation area were lower than the rest of Europe, even when United Kingdom regions are not considered. Excluding the GDP development in the United Kingdom, the average GDP growth was 9,0% for NWE NUTS 2 regions, against an average growth rate of 12,0% in the rest of Europe.

Map 1-1 Development of GDP, 2015-2018



Source: own presentation, 2020

The development of household income in the cooperation complements GDP information by providing more detailed information on the economic the well-being of households. The NWE cooperation area is characterised by regional differences in disposable household income. The difference between the

NUTS 2 regions with highest and lowest disposable household incomes is particularly high in the United Kingdom. In 2017, income levels have been highest in Inner London-West, namely EUR 63,400 whereas income levels where on average EUR 14,800 in West Wales and the Valleys (Table 1-1), a difference of more than EUR 8,000. Regional differences were considerably smaller in the other countries in the cooperation area.

Table 1-1 Key statistics on disposable household income per inhabitant in NWE 2009 and 2017

		2009	2017
Top-5 regions with highest disposable household income per inhabitant		Inner London-West, Luxembourg, Vlaams Brabant, Outer London West and North, Berkshire, Buckinghamshire and Oxfordshire	Inner London-West, Stuttgart, Outer London - West and North West, Darmstadt, Luxembourg
Average disposable household income NUTS 2 regions in the cooperation area		20,025	22,527
Average (and standard deviation[4]) of NUTS 2 regions in the cooperation area in:	Belgium	20,418 (3,013)	22,727 (3,359)
	Germany	21,505 (1,719)	27,095 (2,328)
	Ireland	15,633 (2,315)	17,600 (2,821)
	France	n.a.	19,508 (2,886)
	Luxembourg	26,600	30,200
	The Netherlands	21,156 (1,983)	24,100 (2,050)
	United Kingdom	19,110 (6,293)	21,095 (8,029)
Top-5 regions with lowest disposable household income per inhabitant		Northern and Western Ireland, West Wales and The Valleys, West Midlands, Tees Valley and Durham	West Wales and The Valleys, Northern and Western Ireland, South Yorkshire, West Midlands, Cornwall and Isles of Scilly

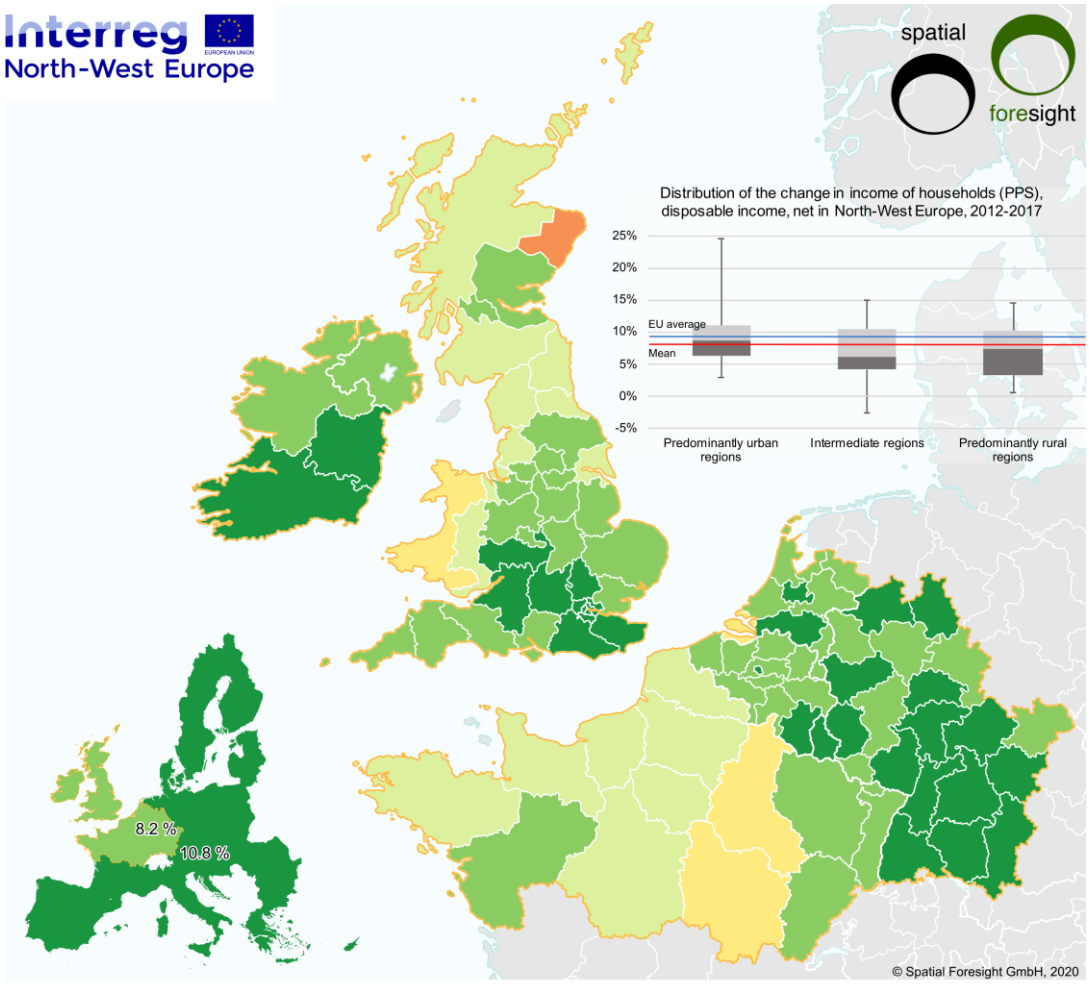
Source: Based on Eurostat 2020 data (nama_10r_2hhinc)

Between 2009 and 2017, regional differences in disposable household income increased particularly in Germany and the United Kingdom whereas the change between Dutch NUTS 2 regions is only minor. Increasing regional differences in Germany can also be observed when ranking the regions with highest and lowest disposable household incomes. The disposable household incomes in Stuttgart and Darmstadt surpassed, among others, Luxembourg (Table 1-1).

In general, disposable household incomes increased more in regions with already high values in their national context (Map 1-2). Household incomes increased mostly in predominantly urban areas and less in intermediate and predominantly rural regions, although considerable regional differences can be observed between regions of these types. Disposable household incomes have for example increased considerably in the region of Luxembourg in Belgium, which is a predominantly rural region. The increasing number of residents from this province working in the Grand Duchy of Luxembourg can be a possible explanation for this increase, given the considerably higher household income levels in the Grand Duchy.

[4] Difference between the NUTS 2 region with the highest and lowest value

Map 1-2 Change in disposable household incomes, 2012-2017



Source: own presentation, 2020

1.2 Competitiveness

This section looks at different elements that form the competitiveness of the NWE cooperation are, i.e. the regional competitiveness index, the sectoral focus of the regions and the SMEs in the NWE cooperation area.

1.2.1 Regional competitiveness index

DG Regio uses the regional competitiveness index to measure a region's ability to offer an attractive and sustainable environment for firms and residents to live and work by comparing 11 competitiveness dimensions and 74 indicators. The index compares the competitiveness levels among all European

NUTS 2 regions and defines z-scores to them, meaning that regions with a score of 0 equal the European median score (Annoni and Dijkstra, 2019).

Regional competitiveness levels in the cooperation area generally better than elsewhere in Europe (Map 1-3 - Map 1-6). Comparing regional competitiveness scores over time is complicated due to different indicators used per edition. Nevertheless, the relative place in the ranking illustrates how individual regions have developed compared to other European regions between 2010, 2013, 2016 and 2019 (Map 1-3 - Map 1-6).

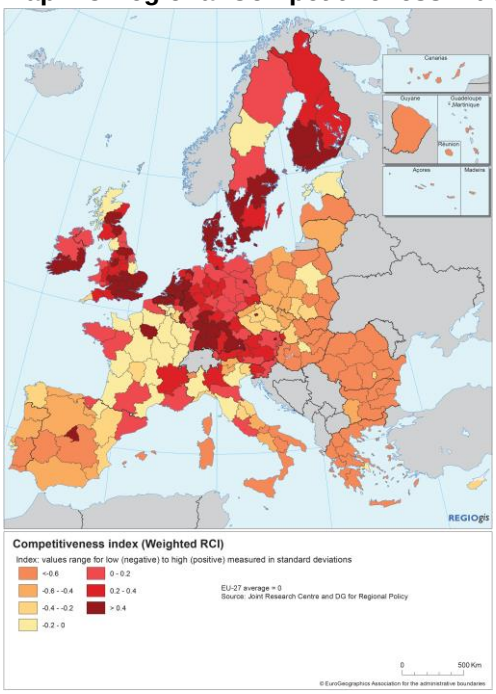
- About one-third of the NUTS 2 regions in the cooperation area kept a stable place in the ranking of European regions. This includes well performing regions like London, Paris, Luxembourg, Karlsruhe, Stuttgart and Cologne, average performing regions, mostly in the United Kingdom but also Alsace in France and the regions with lowest competitive levels in the cooperation area.
- About one-six of the NUTS regions in the cooperation area improved their scores between 2010 and 2019, mostly Dutch and Flemish regions, but also some British regions.
- Another third of the NUTS 2 regions have been ranked lower throughout the years. These include various German regions which most saw a lower ranking between 2010 and 2013, rural English regions and regions in the centre of France.
- Finally, the remaining regions have been ranked variably throughout the different years without any clear development trend. Among other Brussels Capital Region, Darmstadt (Germany) and Scottish regions have been ranked higher and lower for different years.

In 2019, only 8 NUTS 2 regions in the NWE cooperation area have a lower score than the European median, namely the province of Hainaut in Belgium, the region Northern and Western in Ireland, the Highlands and Islands region in the United Kingdom, and the regions of Picardie, France-Comté, Bourgogne, Basse-Normandie and Champagne-Ardenne in France (Map 1-6). On the contrary 7 out of Europe's 10 most competitive places can be found in the NWE cooperation area of which 3 regions forming the greater London region, Utrecht and Flevoland and North Holland in the Netherlands, and the Grand Dutchy of Luxembourg.

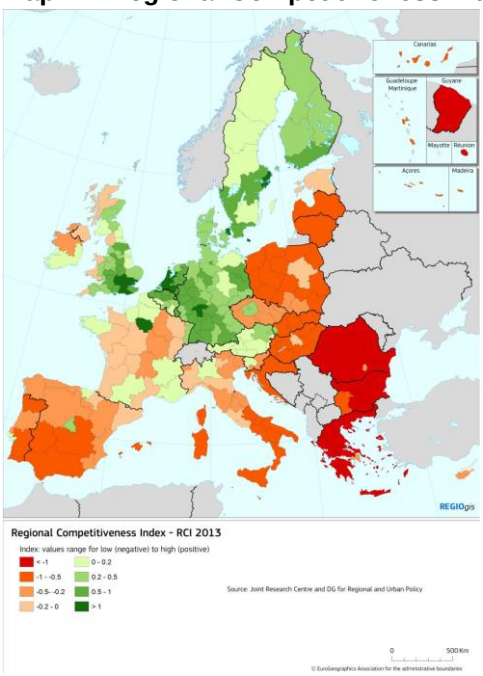
In general, urban and capital regions perform better than rural regions. Population density and the availability of infrastructures explain partly these differences, e.g. high population density illustrating a market for enterprises, the availability of universities illustrated the supply of high skilled labour, and proximity to airports and railway stations illustrates good connectivity to other places. Each of these factors increases the competitiveness levels of urban areas.

Also national differences can be observed. German, Luxembourgish and Dutch regions score general better on macro-economic stability due to high GDP levels and little fluctuation of GDP in the last years. Institutions are generally better ranked in the Netherlands, followed by the United Kingdom and Germany than in Belgium and France, partly due to different perceptions of the population on the role of the government.

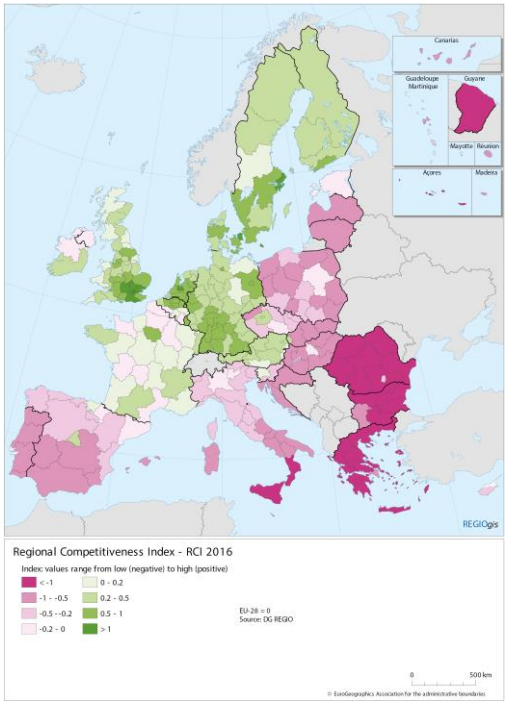
Map 1-3 Regional Competitiveness Index, 2010*



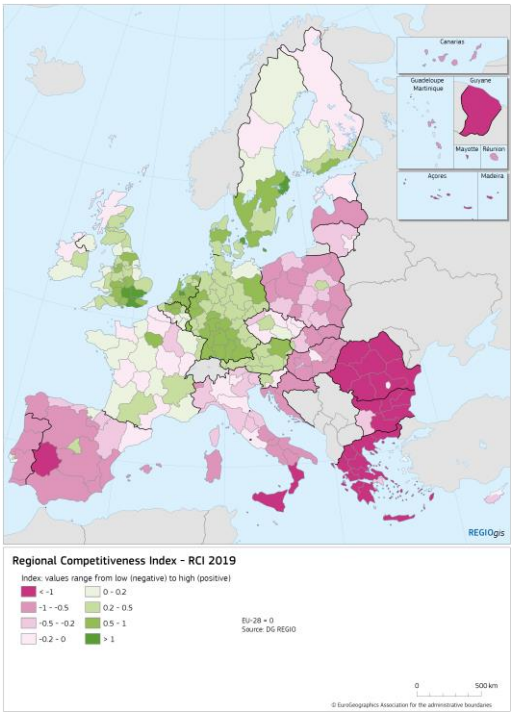
Map 1-4 Regional Competitiveness Index, 2013*



Map 1-5 Regional Competitiveness Index, 2016*



Map 1-6 Regional Competitiveness Index, 2019*



* RCI scores as z-scores for EU-28 = 0 for the respective years

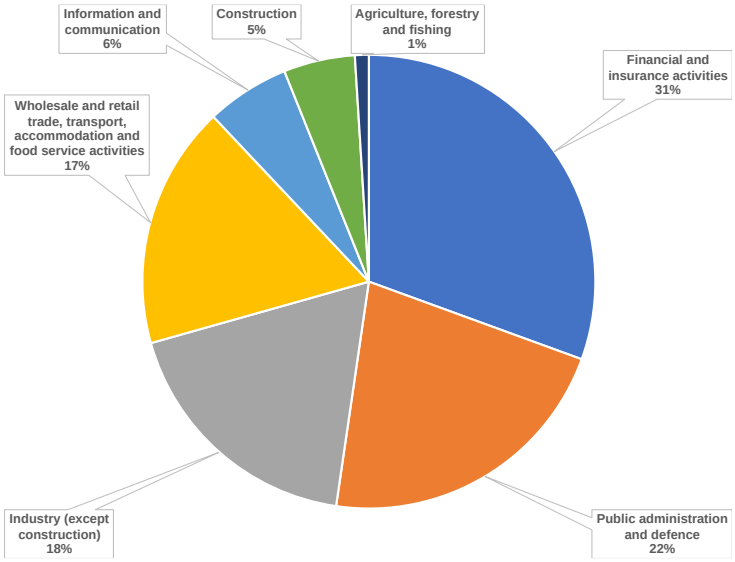
Source: Annoni et al. (2011), Annoni and Dijkstra (2019, 2013), Dijkstra et al. (2017)

1.2.2 Sectoral focus of regions

Regional economic profiles provide further explanations on the regional competitiveness levels. The NWE cooperation area is characterised by diverse regional profiles.

Looking at the sectoral focus in the NWE cooperation area, Figure 1-3 shows the gross value added (GVA) per sector in the whole NWE cooperation area in 2017. More specifically, financial and insurance activities[5] contribute most to the economy in the NWE cooperation area with a GVA of 31% (Figure 1-3).

Figure 1-3 Gross value added per sector in the NWE cooperation area, 2017[6]



Source: Based on Eurostat 2020 data (nama_10r_3gva)

Public administration and defence activities[7] is the second largest sector in the cooperation area, with a GVA of 22% (Figure 1-3). This is slightly more than the European average, where 27,7% of all GVA comes from this sector. Industrial activities[8] are on average slightly less present in the cooperation area than on average in Europe, having a GVA of 18%, followed by wholesale, retail and trade activities[9] representing 17% of the total GVA. Information and communication activities[10] represent 6% of the GVA, followed by the sector of construction activities[11] with 5% of GVA in the NWE cooperation area. Last but not least comes the agriculture, forestry and fishing activities[12] sector which contributes the least to the GVA of the NWE cooperation area (1% of GVA).

[5] NACE codes K-N
[6] Based on the average data of NWE NUTS 2 regions, data for France from 2016
[7] NACE codes O-U
[8] NACE codes B-E excluding C - construction
[9] NACE codes G-I
[10] NACE code J
[11] NACE code C
[12] NACE code A

Although the overall picture is quite diverse, each sector may have a different contribution at single regions of the NWE cooperation area. Table 1-2 shows which of these seven sectors contribute most (the top-5) and least (the bottom-5) to the regional economies.

Table 1-2 Sectors most and least contributing to regional economies in NWE, 2017[13]

	% GVA in agriculture, forestry and fisheries	% GVA in industry (except construction	% GVA in Construction	% GVA in Wholesale and retail trade, transport, accommodation and food service activities	% GVA in Information and communication	% GVA in Financial and insurance activities	% GVA in Public administration and defence
Top-5	Champagne-Ardenne, Cornwall and Isles of Scilly, Lincolnshire, Zeeland, Flevoland	Southern Ireland, Stuttgart, Tübingen, Schwaben, Rheinhessen-Pfalz	Essex, Outer-London East and North East, Kent, Cornwall and Isles of Scilly, Bedfordshire and Hertfordshire	Vlaams-Brabant, Flevoland, Outer London East and North West, Zeeland, Zuid-Holland	Eastern and Midland, Greater London, Paris, Cologne, Utrecht	Inner London, Luxembourg, Outer London South, Brussels Capital Region, Paris	Namur, Luxembourg (Belgium), Hainaut, Nord-Pas-de-Calais, Lorraine
Bottom-5	Greater London, Brussels Capital Region, West Midlands, Greater Manchester, Paris	Greater London, Brussels Capital Region, Luxembourg, Utrecht, Noord-Holland	Inner London - West, Souther Ireland, Brussels Capital Region, Eastern and Midland, Noord-Holland	Southern Ireland, Inner London, Tübingen, Stuttgart, Rheinhessen-Pfalz	Zeeland, Trier, Luxembourg (Belgium), Champagne-Ardenne, Picardie	Southern Ireland, Highlands and Islands, Champagne-Ardenne, Trier, Zeeland	Southern Ireland, Eastern and Midland, Inner London – West, Stuttgart, Cheshire

Source: Based on Eurostat 2020 data (nama_10r_3gva)

Taking each of the sectors sector separately, the following look explain to which regions the respective sector is most or least present.

The financial and insurance activities sector has the highest GVA in 47 NUTS 2 regions of the NWE cooperation area. The top-5 regions in which this sector is particularly present are London, Luxembourg, Paris and Brussels which host numerous global finance firms (Table 1-2). The public administration and defence activities sector contributes to more than one-third of the total GVA of regional economies in the French and Walloon rural regions and is the largest sector in 33 NUTS 2 regions of the NWE cooperation area (Table 1-2). Several industrial regions can be distinguished in the NWE cooperation area. Industrial activities contribute most to the overall GVA in 18 NUTS 2 regions, while they constitute the second largest GVA contributor in 15 regions of NWE cooperation area. The share of industrial activities is highest in Southern Ireland, where 95% of the GVA in this region comes from the manufacturing industry (Table 1-2). The share of industrial activities is also relatively high in many German regions. Industrial activities contribute less to the overall GVA in urban regions like London, Brussels, Luxembourg, Utrecht and Noord-Holland (Amsterdam). Wholesale, retail and trade activities

[13] Data for NWE NUTS 2 regions. In some cases, NUTS 2 regions in the greater London area have been grouped to describe more diversity. Data for France from 2016

seem to be relatively well spread across the territory. The sector is neither the largest nor the smallest sector in any region. Still the sector contributes considerably more to the overall GVA in some Dutch, British and Flemish regions, where the sector represent more than one-fifth of the total GVA than in some Irish or German regions where the sector represents less than 15% of the total GVA (Table 1-2). Information and communication activities are more present in urban areas than in rural areas. The sector is particularly large in Eastern and Midland in Ireland, among other due to the presence of large multinationals with offices in Dublin and surroundings, like Microsoft, Facebook and Google. At the same time, a concentration of information and communication activities in Paris contribute most to the gross value added in the cooperation area (Table 1-2).

Construction activities contribute relatively much to the total GVA in regions that are in close vicinity of growing urban areas, such as the regions around London or the province of Luxembourg close to Luxembourg city. On the contrary, this sector is less represented in urban and predominantly rural regions. Although the agriculture, forestry and fishing activities sector contributes the least to the GVA of the cooperation area, it contributes in some regions to relatively large shares of the total GVA. Such regions are, for example, the former regions of Champagne-Ardenne and Bourgogne due to the concentration of vineyards, in Cornwall, Lincolnshire, Zeeland and Flevoland due to crop production. Highest amounts of gross value added can however been found in Zuid-Holland due to horticulture, followed by Bretagne and Pays de la Loire due to dairy production.

Diverse regional profiles make the economy more resilient in the event of crises (Bristow et al., 2014). At the same time, trends and other developments may transform specific sectors, creating opportunities and challenges for the regions that have an over or underrepresentation of these sectors. Examples of such trends are the increasing automation of production, which would demand transformations in the manufacturing industry, the trend of increasing e-commerce activities, which would require also changes in the retail sector, or the growing tendency for shorter value chains and sustainable agriculture, trying at the same time to be globally competitive (ESPON, 2018a).

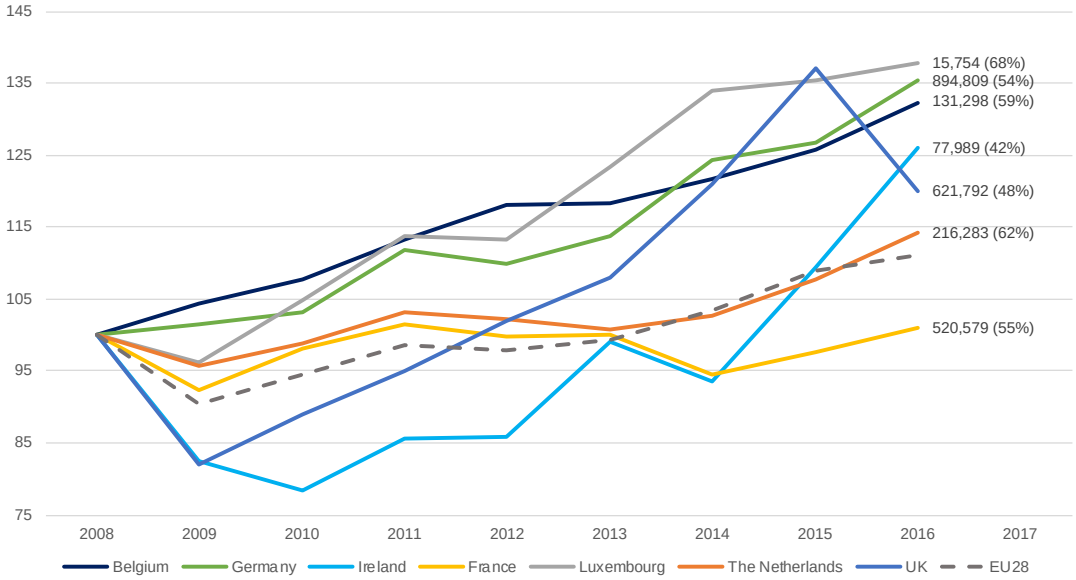
In the case of the NWE cooperation area, for example, some of the territories with a large share of industrial activities face specific challenges due to the industrial transition. Globalisation, the introduction of new technologies and the need to adopt environmental-friendly measures forces a transformation of coal, steel and other heavy industries. These transformations imply for example the need for new investments in innovative production processes or imply the need to lay off employees. Regions such as Northern France, Wallonia, Northern England, Wales, the Ruhr area or Saarland have relative a large share of such industries have thus will need to cope with the new challenges (European Commission, DG REGIO, 2019).

1.2.3 SMEs

Small and Medium sized Enterprises (SMEs) represent the majority of all business in the EU and in the NWE cooperation area. In particular, the value added of SMEs represents in Luxembourg, the Netherlands, Belgium, France and Germany more than half of the total value added by enterprises (total figures and percentages in Figure 1-4), making an important contribution to the economy. Moreover, SMEs are considered to have a particularly high potential for innovation and growth. The value added to the overall economy by SMEs has been increasing between 2008 and 2016, particularly in Germany,

Belgium and Luxembourg. The development in the Netherlands has been similar to the EU average, while the value added of French SMEs remains relatively stable (Figure 1-4).

Figure 1-4 Development of value added of SMEs in NWE countries (2008 = 100)



Source: SBA factsheets 2019[14]

Recent comparable and harmonised regional data on SMEs is scarce, especially timeseries. Nevertheless, some territorial differences can be observed in the cooperation area:

- The number of SMEs (10-249 employees) was high in German, British and Dutch regions as well as in rural Irish regions in 2014, ranging between 3-7 enterprises per 1,000 inhabitants. Between 0-3 enterprises were reported for most French and Belgium regions.
- The share of persons employed in these SMEs was generally higher in rural regions. About half of the population in Wallonia, North West Ireland, Trier, Koblenz and Freiburg in Germany and the former French regions of Champagne-Ardenne, Nord-Pas-de-Calais, and Pays de la Loire was working in enterprises with 10-249 employees in 2014.
- The share of people working in these SMEs has been decreasing in Dutch and French regions as well as Central and Southern Ireland between 2008 and 2014. In the other regions the shares of persons increased between 0 and 2.5%.
- The share of persons employed in micro-enterprises (1-9 employees) was higher in French regions then elsewhere in the cooperation area, particularly in pre-dominantly rural regions. The shares of persons employed in micro-enterprises reached up to 45% in these areas. In most Dutch and Flemish regions this share was below 15% in 2014.
- Between 2008 and 2014, the share of persons employed in micro-enterprises decreased in Dutch and German regions, but increased in Luxembourg and most Belgian regions (ESPON, 2018b).

The Small Business Act is in place to facilitate the SMEs development. It has defined nine key policy actions to support SMEs and DG Grow monitors yearly the available instruments in EU Members States

[14] Available at https://ec.europa.eu/growth/smes/business-friendly-environment/performance-review_en

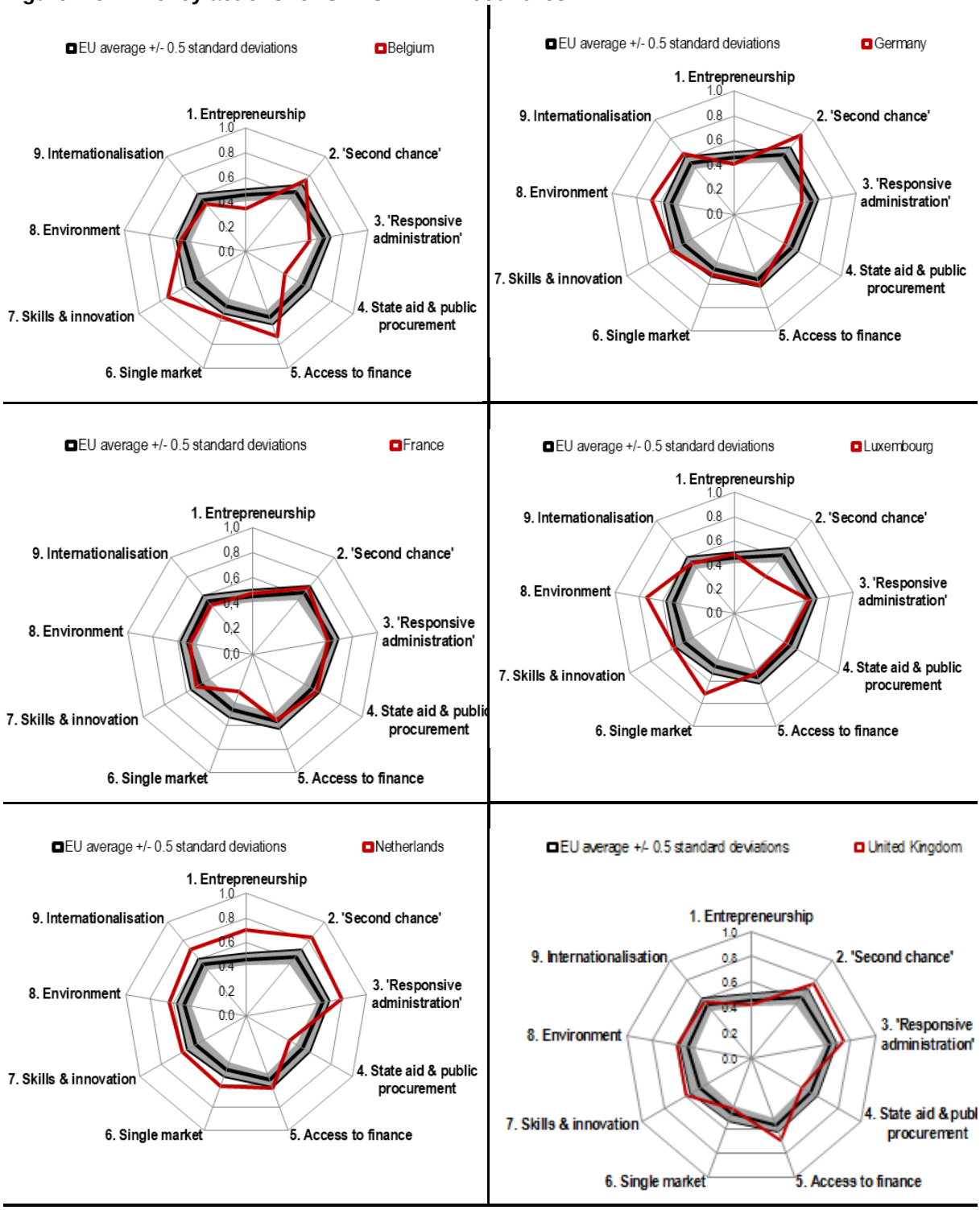
in relation to them. In 2018, the Netherlands had the most comprehensive set of policy instruments in the NWE cooperation area, more than EU average for eight out of the nine policy actions (Figure 1-5), while France was closer to the EU average for all policy actions.

For each country a focus on certain actions can be observed:

- Entrepreneurship seems not a key concern for national SME policies in the cooperation area. Only in the Netherlands more instruments have been observed than on average in the EU, fewer instruments were observed in Belgium and Germany.
- More instruments to providing honest entrepreneurs a second chance after bankruptcy have been observed in Belgium, Germany, the Netherlands, and the United Kingdom and less in Luxembourg.
- Actions to make public administrations responsive to SMEs' needs are more prominent in the Netherlands and in Luxembourg and less observed in the other NWE countries.
- Actions to facilitate SMEs' participation in public procurement and better use of State Aid possibilities for SMEs seems to be less relevant in the cooperation area than elsewhere in Europe.
- Actions to help SMEs to benefit from the opportunities offered by the Single Market seems to be more prominent in Luxembourg, Belgium, the Netherlands and less in France.
- Actions to promote the upgrading of skills in SMEs and all forms of innovation are more frequent observed in Belgium than in other countries.
- Actions providing information, expertise and financial incentives to the opportunities for new "green" markets and increased energy efficiency are more often observed in Germany and Luxembourg.
- Only in the Netherlands more actions to encourage internationalisation were observed than on average in the EU.

In addition to the above, there is an increasing number of SMEs that aim to make a societal impact rather than pursuing monetary gains. The number of the so-called social enterprises is also increasing in the NWE cooperation area, although their share in the total economy remains very small. Some countries in the NWE cooperation area introduced specific policy instruments to facilitate the development of social enterprises, inspired (or not) by the European Commission Social Business Initiative. Examples are the French law on social and solidarity economy, the Irish national social enterprise policy and the Luxembourg law on social enterprises. Other countries in the NWE cooperation area have a long history in social economy, such as Belgium and the United Kingdom. A comparison between countries remains however challenging due to different definitions of social enterprises and different levels of institutionalisation of the sector. Nevertheless, the NWE cooperation area is home to some of Europe's leading countries and regions to support social enterprises (Borzaga et al., 2020).

Figure 1-5 Policy actions for SMEs in NWE countries



Source: SBA country reports 2019[15]

[15] Available at https://ec.europa.eu/growth/smes/business-friendly-environment/performance-review_en

1.3 Innovation capacities

Territories in the NWE cooperation area have generally better innovation systems than elsewhere in Europe. 43 out of 56 regions in the cooperation area had an innovation score above European average (Map 1-7). DG GROW regularly publishes a regional innovation scoreboard as comparative assessment tool for regional innovation systems[16]. The NWE cooperation area is home to some of Europe's leading innovative regions and only four regions which are considered as moderate innovators, namely the regions of Koblenz, Normandie, Hauts-de-France and Zeeland.[17] These are regions with a score between 50% and 90% of the European average (European Commission, 2019a). Despite their overall lower innovation score, these regions provide specific conditions for innovation, too.

Between 2011 and 2019, 36 out of the 56 territories in the NWE cooperation area have lost ranks. Among these are innovation leaders, particularly German regions that lowered their rank against the European average regional innovation score, suggesting that territorial disparities decreased between 2011 and 2019[18]. At the same time, some British regions as well as Utrecht, Brussels Capital Region and the Dutch Province of Limburg increased their position against the European average. Utrecht, Brussels Capital Region and South East England, which includes Oxford, were innovation leaders that managed to keep their position compared to other European regions. Other regions in the Netherlands, Belgium as well as Pays de la Loire, Northern and Western Ireland, Southern Ireland and Bretagne kept their position against the European average.

Each territory provides specific conditions that favour innovation. The assessment of the individual indicators used for the regional innovation scoreboard, illustrates that territorial diversity is among the conditions for innovation. One region can for example excel in one indicator and perform worse than other European regions in other indicators (Table 1-3). Few territorial differences can be observed when assessing the individual indicators reflecting the main conditions for a well-performing region innovation system:

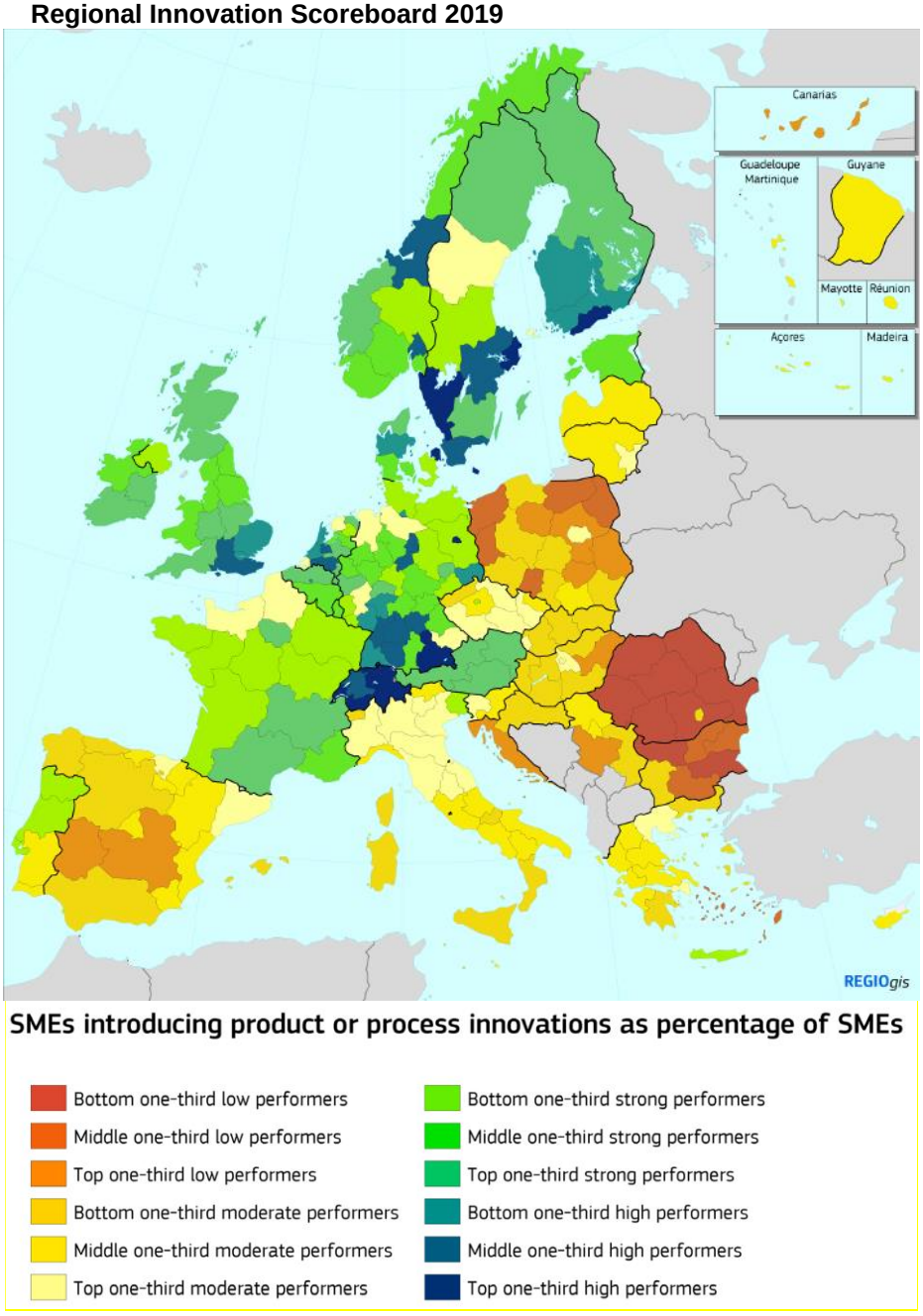
- German territories score worse than other territories in the cooperation area regarding educational aspects, the share of population with tertiary education and life-long learning. The focus on applied science and learning during professional life via the employer can partly explain these differences and may in practice not hamper the conditions for innovation in these territories.
- Regions hosting university towns score well with regards to number of scientific publications and cited publications. Territories in the NWE cooperation area with a low score lack universities, such as Flevoland or Zeeland in the Netherlands, or have relatively smaller or newer universities, such as the university of Koblenz which was established in 1990.

[16] The scoreboard combines 17 different indicators to measure the innovation score of each region to the European average. The scoreboard includes territories at different NTS levels. Information is for example published at NUTS 2 levels for the Netherlands and Germany and only at NUTS 1 level for France and the UK.

[17] The regional innovation scoreboard uses normalised and standardized values to allow comparisons between regions and over multiple years. In doing so it ranks the value of each region in comparison to the other European regions and ranks them. Absolute figures are only available for a few figures as the score board uses mostly composite indicators or information based on surveys, such as the Eurobarometer.

[18] Precise trends cannot be concluded from the data as the ranking of regions is in both cases against the European average. Even if innovation performance increased in a single region it may have been lower ranked in case the European average increased more.

Map 1-7 Regional Innovation Scoreboard 2019

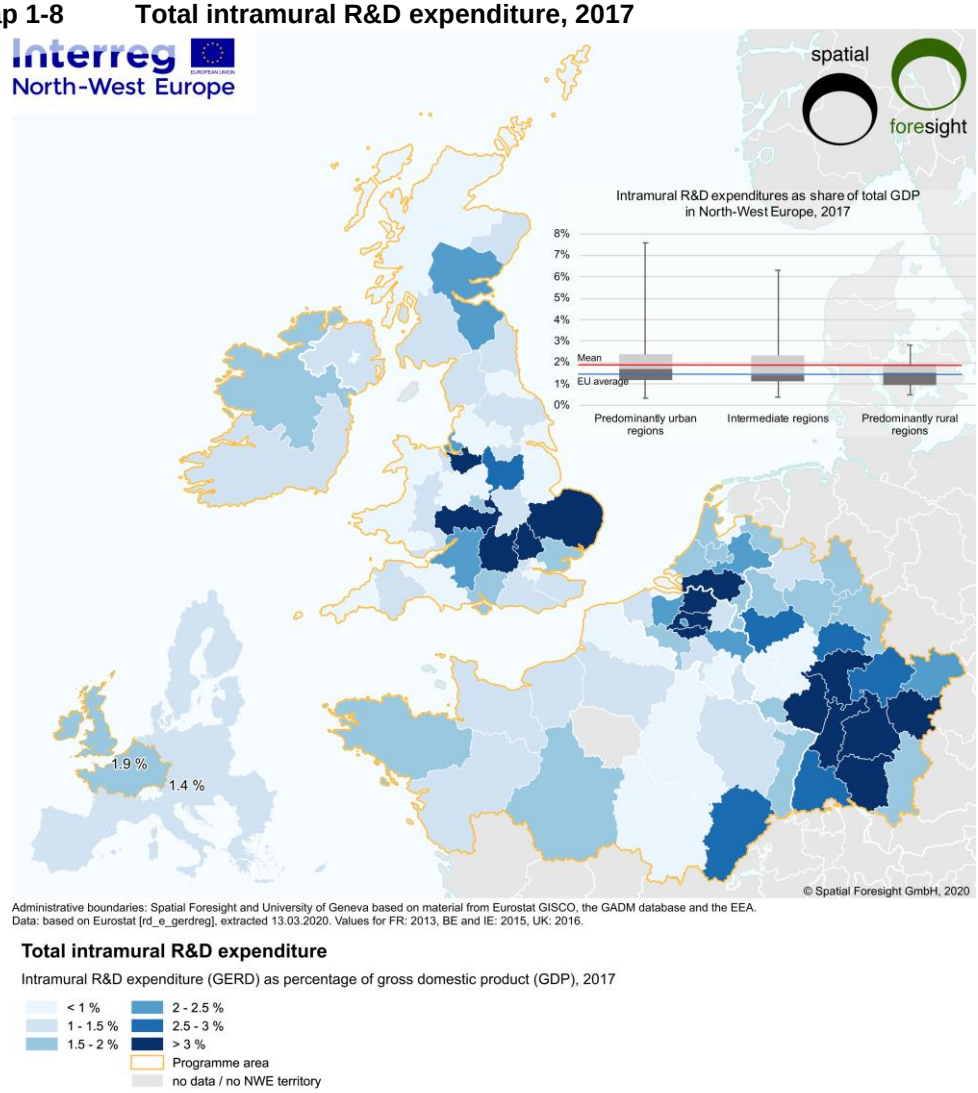


Source: (European Commission, 2019a)

- Public R&D expenditure concentrates in a few regions north of London, in the southern Netherlands, around Antwerp and Brussels in Belgium and in the German regions of Baden-Württemberg and Bavaria (Map 1-8). Only in these regions was the European 2020 target of 3% of GDP invested in R&D met 2014. At the same time private R&D investments are highest in regions with high share of manufacturing industry.
- Territories with high shares of manufacturing industry also score relatively higher on innovations in enterprises, such as in-house innovations and product and process innovations.

- Urban areas score relatively best regarding the number of patents and trademarks submitted. These territories host generally more head offices, which submit the trademarks or patents.

Map 1-8 Total intramural R&D expenditure, 2017



Source: own presentation, 2020

New products and processes for manufacturing activities reflect high levels of technological innovation activities within the Regional Innovation Scoreboard. In the NWE cooperation area these were the highest in SMEs in various Belgian and German regions. In particular, Brussels Capital Region and Tübingen score higher than other European regions, followed by Trier, Münster, Flanders, Karlsruhe, Detmold, Wallonia and Freiburg. Fewer SMEs that create, or diffuse state of the art technologies have been found in London, Bretagne, Nord-Pas-de-Calais and North East and North West England.

Territorial differences are getting smaller in the NWE cooperation area, when comparing the regions' rankings in 2011 with the 2019 rankings. Most of the regions ranked lowest in 2019 have improved their ranking compared to 2011, whereas the top-ranking region had lower rankings in 2019 compared to 2011. Only in Germany and in the United Kingdom the differences between regions increased.

United Kingdom and Belgium SMEs have relatively high turnover due to sales of 'new to the market' or 'new to the firm' innovations. The regional innovation scoreboard includes this indicator to capture both the creation of state-of-the-art technologies (new to market products) and the diffusion of these technologies (new to firm products)**.** The indicator measures the turnover of new or significantly improved products and includes both products which are only new to the firm and products which are also new to the market. The regions North East, East Midlands, West Midlands, South East, South West, and Wales have the best scores in Europe, followed by Scotland, Brussels Capital Region, North West and Flanders. Less turnover due to 'new to the market' or 'new to the firm' innovations have been reported in Paris, Nord-Pas-de-Calais, East of England, Pays de la Loire and Eastern and Midland.

Comparing the NWE cooperation area regions' rankings in 2011 with the 2019 rankings, the territorial differences increased. The rankings from the best ranked regions went up, whereas the worst performing regions rank lower in 2019 than in 2011. Also at national levels increasing territorial differences can be observed. The relative difference between rankings of regions in the United Kingdom, the Netherlands and Germany increased between 2011 and 2019. In France, the differences remained more or less the same. Only in Belgium territorial differences decreased.

Table 1-3 Territorial diversity among the key indicators that define regional innovation scores[19], 2019

Indicator	5 Best performing NWE territories	5 least performing NWE regions
Population with tertiary education	London, Utrecht, Île de France, Eastern and Midland, Scotland	Saarland, Detmold, Arnsberg, Münster, Koblenz
Lifelong learning	Utrecht, Pays de la Loire, Bretagne, Noord-Holland, Zuid-Holland	Schwabe, Wallonia, Mittelfranken, Düsseldorf, Koblenz
Scientific co-publications	Utrecht, Brussels Capital Region, Noord-Holland, London, Gelderland	Koblenz, Schwaben, Kassel, Trier, Flevoland
Most-cited publications	East of England, London, South East, Noord-Holland, Utrecht	Schwaben, Koblenz, Arnsberg, Saarland, Trier
R&D expenditure public sector	Trier, Cologne, Karlsruhe, Utrecht, Giessen	Zeeland, Schwaben, Koblenz, Eastern and Midland, Normandie
R&D expenditure business sector	Stuttgart, Tübingen, Karlsruhe, Rheinhessen-Pfalz, Mittelfranken	Koblenz, London, North East, Trier, Utrecht
Non-R&D innovation expenditures	Wales, Rheinhessen-Pfalz, Trier, Centre – Val de Loire, Freiburg	East of England, Dutch Province of Limburg, Zeeland, Overijssel, Noord-Brabant
Product or process innovators	Brussels Capital Region, Tübingen, Trier, Münster, Flanders	London, Bretagne, Hauts-de-France, North West, North East
Marketing or organisational innovators	Schwaben, Saarland, Karlsruhe, Southern, East and Midland	Dutch Province of Limburg, Zeeland, Overijssel, Noorrd-Brabant, Gelderland
SMEs innovating in-house	Tübingen, Münster, Brussels Capital Region, Detmold, Kassel	Dutch Province of Limburg, Zeeland, Overijssel, Noorrd-Brabant, Gelderland
Innovative SMEs collaborating with others	South East, East of England, West Midlands, South West, Yorkshire and the Humber	Trier, Düsseldorf, Detmold, Schwaben, Darmstadt

[19] Luxembourg does not appear in the regional innovation scoreboard database and only appears in the European Innovation Scoreboard at national level which uses different indicators. Hence Luxembourg is lacking as example in the table. The national report nevertheless provides some key areas for innovation for which Luxembourg scores better than the EU average, namely innovation-friendly environment, the number of innovators, intellectual assets and employment impacts. National report is available at https://ec.europa.eu/growth/industry/policy/innovation/scoreboards_en

Public-private co-publications	Utrecht, East of England, Rheinhessen-Pfalz, Noord-Brabant, Darmstadt	Trier, Koblenz, Detmold, Münster, Zeeland
PCT patent applications	Noord-Brabant, Stuttgart, Mittelfranken, Karlsruhe, Rheinhessen-Pfalz	Brussels Capital Region, Northern Ireland, Southern, Northern and Western, Eastern and Midland
Trademark applications	Noord-Holland, Flevoland, Noord-Brabant, London, Brussels Capital Region	North East, Normandie, Southern, Centre – Val de Loire, Pays de la Loire
Design applications	Arnsberg, Detmold, Stuttgart, Mittelfranken, Oberfranken	Southern, Zeeland, Scotland, North West, Northern Ireland
Employment MHT manufacturing & knowledge-intensive services	Stuttgart, Tübingen, Karlsruhe, London, Darmstadt	Centre – Val de Loire, Bretagne, Wales, Hauts-de-France, Grand-Est
Sales of new-to-market and new-to-firm innovations	Île de France, Hauts-de-France, East of England, Pays de la Loire, Eastern and Midland	Wales, North East, East Midlands, West Midlands, South West

Source: (European Commission, 2019a)

Public authorities in Europe encourage innovations mainly by overall support of business R&D and increasingly through support of science and industry cooperation. Fewer public authorities encourage innovation through public sector innovation initiatives, social innovation initiatives and support to participation in international R&DI programmes (Walenndowski et al., 2017). At local and regional levels, many public authorities were prompted to re-think their policies with the endorsement of the European level to adopt Regional Innovation Strategies for Smart Specialisation (RIS3). RIS3 are policy instruments to encourage innovation that define territorial specific policy objectives, scientific domains and economic domains following an entrepreneurial discovery process (see Box 1).

Box 1 Different approaches to the entrepreneurial discovery process in RIS

Entrepreneurial discovery process is an important element in RIS3 and shall lead to an adequate allocation of public sources to enhance innovation capacities in the territory. The process aims to prioritise areas for investments based on cooperation among representatives of the public and private sector and requires thus sufficient capacities of the involved players.

The majority of entrepreneurial discovery process in Europe aim to enhance specific technologies or sectors rather than on addressing societal challenges. Parts of the cooperation are among the European regions with the strongest focus on enhancing specific technologies or sectors, i.e. regions in BeNeLux, Germany and France, whereas southern, eastern and northern European regions seek more a balance between enhancing specific technologies or sectors and addressing societal challenges. United Kingdom and Irish regions rank in between.

Research organisation are considered as most relevant type of player to include in entrepreneurial discovery processes, followed by intermediate organisations such as network and cluster organisations. Research organisation and particularly universities are relatively frequenter considered as important players in the United Kingdom and Ireland whereas other territories prefer the inclusion of intermediate organisations.

Entrepreneurial discovery processes can benefit European territorial cooperation, as perceived by survey respondents. Only United Kingdom and Irish respondents perceived less added value of territorial cooperation

during the entrepreneurial discovery processes, partly due sufficient opportunities to discuss and compare with relevant players from neighbouring regions that are not necessarily in another country.

Source: (Kroll, 2016)

These strategies are a prerequisite to receive ERDF funding in relation to competitiveness and innovation[20]. Hence, all territories in the NWE cooperation area have a regional innovation strategy for smart specialisation (RIS3). Coordination among these strategies allows to further strengthen priorities, e.g. to strengthen a critical mass for research and development or by linking value chains. The European Joint Research Centre (JRC) classified RIS3 documents in Europe by their policy objectives, scientific domains and economic domains[21].

Sustainable innovations, digital transformations, key enabling technologies, and public health and security are among the key policy objectives in the RIS3 covering the NWE cooperation area (Figure 1-6). These objectives are mentioned in the RIS3 of about 75% of territories in the NWE cooperation area and relate to about 25% of the priorities in these strategies. The more specific policy objectives under these broad objectives are however diverse. Sustainable innovation covers eco-innovations, sustainable agriculture, sustainable land and water use, resource efficiency, or sustainable energy and renewables. Niches of policy objectives refer to blue growth, cultural and creative industries and space. RIS3 strategies refer less frequent to these types of policy objectives. Blue growth is for example only referred to in 8 regions and for 11 priorities in coastal regions in France, Ireland and the United Kingdom.

Furthermore, most RIS3 encourage a general advancement of knowledge and focus on increasing the knowledge on industrial production and technology. These scientific domains are referred to in the RIS3 of 90% of the territories and relate to more than 40% of the priorities. Likewise as for the policy objectives, a larger variety between the RIS3 becomes visible when assessing more detailed types of scientific domains. RIS3 in the NWE cooperation area focus mainly on manufacturing, professional scientific and technical activities and information and communication technologies in terms of economic domains. In particular the first two economic domains are referred to in the RIS3 in combination with other economic domains.

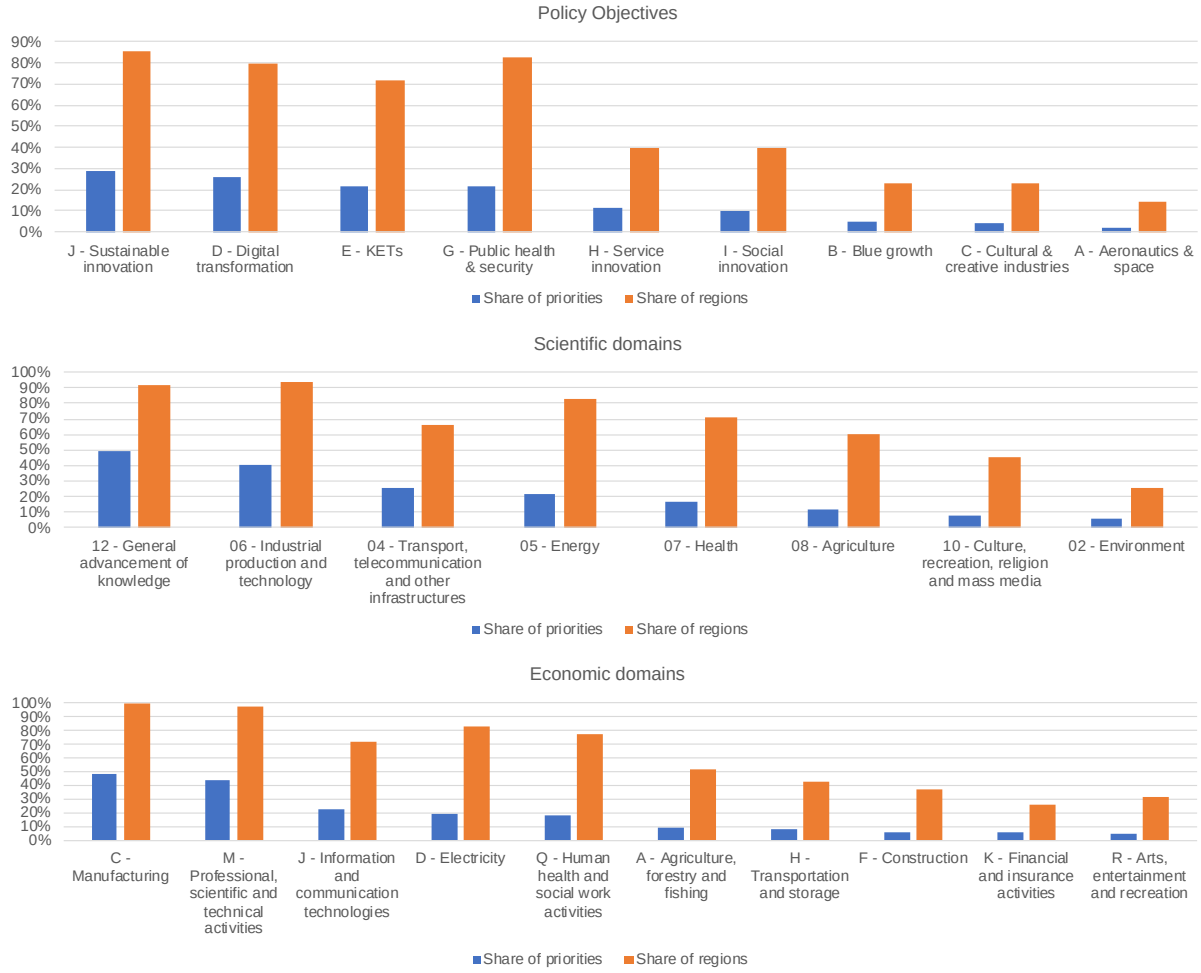
A few cross-links between the policy objectives, scientific domains and economic domains can be observed. For example, manufacturing, electricity and professional scientific and technical activities are relatively more frequently mentioned in relation to the scientific domain of environment; electricity is relatively more frequently mentioned as economic domain in relation to scientific domain energy; the economic domains information and communication technologies and arts, entertainment and recreation are frequenter referred to in relation to the scientific domain of culture, recreation, religion and mass media. Similarities among policy objectives, scientific domains and economic domains in RIS3 can be

[20] The JRC database includes only the RIS3 that functioned as ex-ante condition for 2014-2020 ERDF. More recent documents or current revisions of RIS are not considered. This implies that it includes RIS3 for the previous French regions and does not consider the new regional economic development schemes (SRDE) which have been adopted by each region. It also does not reflect any possible changes coming from the review of current strategies.

[21] The JRC Eye on RIS3 database include strategies for 35 territories covering the North West Europe cooperation area, including 7 from the UK. These strategies refer to national and regional geographies, either on NUTS1, 2, or 3 levels. In total these strategies include 225 priorities referring to a specific territorial competitive advantage, policy objective, economic domain, scientific domain or as horizontal priority encouraging coordination among multiple of these elements.

a starting point for dialogue among stakeholders in the cooperation area to further enhance this policy instrument [22].

Figure 1-6 Main areas covered by RIS3 in North-West European territories*



* The JRC database includes RIS3 that served as ex-ante condition for 2014-2020 ERDF. New updates of strategies are does not considered in this overview.

Source: Based on the JRC Eye on RIS database

The development of the RIS strategies contributed to the generation of more awareness of the issue of critical mass and a better focus on certain thematic areas. This implies a variety of regional measures to encourage innovation, also in the NWE cooperation area. The regional innovation monitor (Walenndowski et al., 2017) lists the following examples of different foci of regional innovation measures. A variety of innovation measures or similar experiences could serve as starting point for transnational cooperation.

- Belgium regions focused in recent years mainly on providing direct funding to business R&D and innovation, particularly Brussels Capital Region and Wallonia. In addition, Brussels Capital Region

[22] Further dialogue at transnational cooperation level shall deepen the comparison of RIS3, i.e. the classification of JRC only illustrates overall similarities and does not differentiate specific sectors or domains.

increasingly stressed measures that foster start-ups and gazelles. Fewer measures focusing human resources for science, technology and innovation have been observed in Belgian regions compared to other European regions.

- German regions focused also mainly on business R&D and innovation particularly by fostering start-ups and gazelles and by providing direct funding. Compared to the rest of Europe, fewer measures on science and industry cooperation, such as R&D cooperation projects between academy and industry and knowledge transfer structures between academia and industry have been observed in Germany regions among which North Rhine-Westphalia.
- French regions focused mainly on business R&D and innovation through direct funding. In particular, Île de France and Lorraine focused on such measures in recent years. In Bourgogne more attention was paid to science and industry cooperation, principally through R&D cooperation projects between academy and industry. Fewer measures on mobility between academia and business, knowledge-transfer structures between academia and industry and fostering start-ups and gazelles have been observed in French region, notably in Bourgogne and Lorraine.
- Dutch regions focused on business R&D innovation through direct funding to business R&D and funding of institutional R&D. This trend is observed especially in the provinces of Gelderland and Limburg. All provinces covered by the cooperation focused on support measures involving science and industry cooperation, more precisely, R&D cooperation projects between academy and industry, except for North Holland. As an example, several educational initiatives have been observed in Overijssel and North Brabant. Similarly, to other European regions there is a general lack of human resources for science, technology and innovation.
- Irish regions adopted rather comprehensive measures without a clear focus on certain measures. For example, the SFI funding programmes from 2016 which among others included measures for R&D cooperation projects between academy and industry are illustrated. Despite a comprehensive approach, still a lack of public support can be observed in some areas, such as measures on innovation climate and business eco-system and human resources for science, technology and innovation.
- Luxembourg focused mainly on strengthening public research as well as linkage between research institutes and other players (OECD, 2016).[23]
- British regions focused mainly on business R&D and innovation through direct funding. As an example, the Wales regional innovation report shows that the Welsh government has invested £63m in the SMART Cymru aimed at directly funding business R&D. Another focus area concerns knowledge-transfer structures between academia and industry and training and life-long learning of researchers and other personnel involved in innovation. For example, the Leeds City Region Local Enterprise Partnership launched two support measures concerning demonstration projects, prototypes and proofs of concepts in 2015, through the Energy Hub and the BioVale.

1.4 Transition to a digital economy and society

The European Commission made digital transformation one of its six priorities for the period 2019-24. As such, the Commission stimulates the development and use of new technologies in businesses and

[23] Examples for Luxembourg are not explicitly mentioned in the regional innovation monitor. Instead the OECD review of Luxembourg innovation policies in 2016 has been used to get a global overview of innovation policy measures in Luxembourg: https://www.oecd-ilibrary.org/docserver/9789264232297-en.pdf?expires=1588142922&id=id&accname=guest&checksum=036DA7F860D94333FAA52F257F055450

services, for example further automation and robotization of manufacturing processes or using digital solution for public service provision including e-health, e-learning and e-government.

The NWE cooperation area includes several territories that are frontrunners in the transition to a digital economy and society. Particularly regions in the Netherlands, United Kingdom and Ireland score high on the European Digital Economy and Society Index, a composite index summarising a countries digital performance. Germany and France score around the European average. Breaking down the Digital Economy and Society Index by its five main components illustrates however different strengths and weaknesses between the different countries (Figure 1-12).

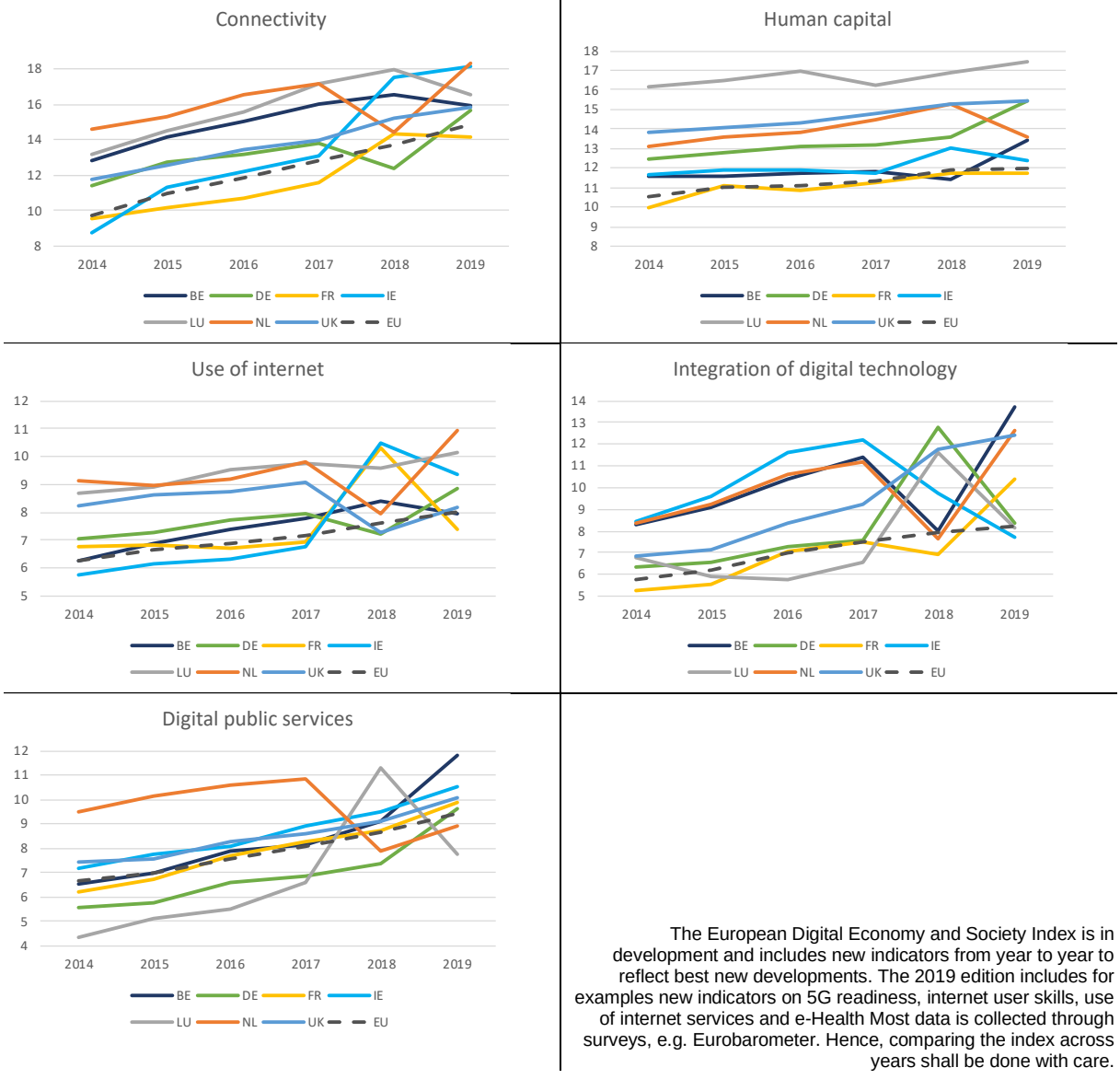
- Luxembourg, Ireland and the Netherlands are the best performing countries regarding **connectivity** in the cooperation area. This implies well coverage of fixed and mobile as well as fast and ultrafast broadband against relatively competitive prices.
- Luxembourg, Ireland and Germany the best performing countries regarding **human capital** in the cooperation are. In these countries relative more persons assess their digital skills as adequate or in these countries relative more persons are employed or trained as ICT specialist.
- The Netherlands, Ireland and Luxembourg are the best performing countries regarding the **use of internet** in the cooperation area. Persons in these countries use the internet for a variety of services such as shopping, banking, cloud storage, music and video streaming, news and social media.
- Belgium, the United Kingdom and the Netherlands are the best performing countries regarding the **integration of digital technology** in the cooperation area. This implies that business from these countries are most active online, i.e. for information sharing, social media or cloud services and that e-commerce has relative high turnovers in these countries, including cross-border sales.
- Belgium, Ireland, the United Kingdom and France perform better than the European average regarding **digital public services**. Relatively more people make use of pre-filled online forms and can share administrative with the government or businesses have the possibility to communicate with the government online. The component also reflects the use of e-health services, i.e. the percentage of people who use online health care services, the use of medical information systems and the use of electronic prescriptions by general practitioners.

Between 2014 and 2019, the digital performance of countries in the cooperation area has increased for all five components (Figure 1-7). Overall performance in relation to connectivity increased the most in Europe, +34% between 2014 and 2019. In the NWE cooperation area, only Ireland improved its connectivity better than Europe as a whole (+ 52%). The integration of digital technology in businesses and digital public services also improved considerably in Europe in both cases +29% between 2014 and 2019. Differences regarding the integration of digital technology increased in the NWE cooperation area as the performance of France, Belgium, the United Kingdom and the Netherlands increased more than average in the EU, countries that already had the best scores in the cooperation area. On the contrary, the difference regarding digital public services decreased. The development in relation to human capital were modest with only an increase of 12% of Europe's overall performance. In the NWE cooperation area, Belgium, Germany and France increased their performance more than the European average between 2014 and 2019.

Few comparable data are available in Europe to represent the transition to digital economy and society at regional levels. Nevertheless, some indicators can hint at potential for technological development and uptake in enterprises. The share of employment in technology and knowledge intensive sectors

illustrates a potential for the development of technological solutions, that in a second step can support the general economy or society. The use of technological solutions in SMEs illustrates current levels of up-take of technological solutions in private enterprises as proxy for the use and acceptance to transforming towards a digital economy and society.

Figure 1-7 Development of components of the Digital Economy and Society Index (DESI), 2014-2019



The European Digital Economy and Society Index is in development and includes new indicators from year to year to reflect best new developments. The 2019 edition includes for examples new indicators on 5G readiness, internet user skills, use of internet services and e-Health Most data is collected through surveys, e.g. Eurobarometer. Hence, comparing the index across years shall be done with care.

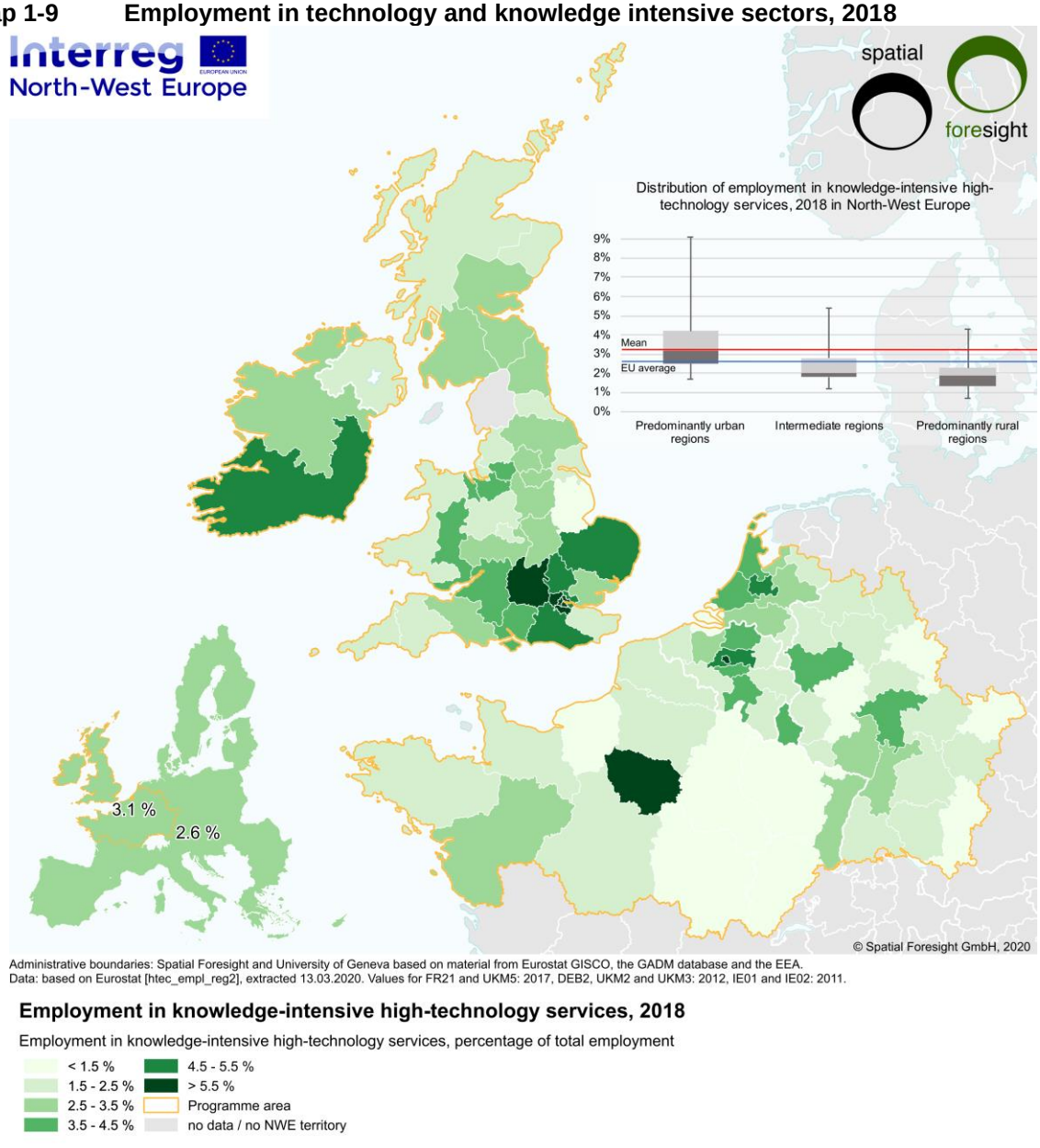
Source: Based on the EU DESI composite index[24]

Employment in technology and knowledge intensive sectors concentrates in capital regions (Map 1-9). The share of employment in technology and knowledge intensive sectors is particularly high in Paris

[24] DESI is a composite index that summarises relevant indicators on Europe's digital performance and tracks the evolution of EU Member States. The index is composed of 5 components and 13 indicators. The index can be assessed at https://digital-agenda-data.eu/datasets/desi

and London, followed by Brussels Capital Region, East Midlands and Southern Ireland. The share of employment is also relatively high in regions hosting secondary cities and university towns, for example Oxford, Cambridge, Utrecht, Cologne and Darmstadt. High population density and the availability of high skilled labour may attract technologic enterprises or provide fertile ground for start-ups in the sector. In addition, a concentration of technical expertise and knowhow with respect to industry 4.0 can be observed in some leading innovative regions, such as Baden-Württemberg or Pays de la Loire (Walenndowski et al., 2017) (see also section 1.3).

Map 1-9 Employment in technology and knowledge intensive sectors, 2018



Source: own presentation, 2020

2 PO 2 – A greener, carbon free Europe

The territorial analysis for PO 2 differentiates six themes, namely energy, climate change adaptation and environmental risks, greenhouse gas emissions and air quality, green infrastructure, water efficiency and circular economy. Some of these, particularly energy, consists of several sub-themes addressed in the territorial analysis.

2.1 Energy

The section on energy looks at renewable energy through investments in generation capacity, the NWE coal regions in transition, carbon storage, energy storage, smart energy systems and the promotion of energy efficiency measures.

2.1.1 Renewable energy through investments in generation capacity

Becoming the world's first climate-neutral continent by 2050 is the objective behind the European Green Deal (European Commission, 2019b), the most ambitious package of measures that should enable European citizens and businesses to benefit from sustainable green transition. The EU has committed itself to a clean energy transition, which will contribute to fulfilling the goals of the Paris Agreement on climate change and provide clean energy to all. To deliver on this commitment, the EU has set binding climate and energy targets for 2030 including increasing the share of renewable energy to at least 32% of EU energy use.

The use of renewable energy has many potential benefits, including a reduction in greenhouse gas emissions, the diversification of energy supplies and a reduced dependency on fossil fuel markets (in particular, oil and gas). The growth of renewable energy sources may also stimulate employment in the EU, through the creation of jobs in new 'green' technologies. In addition, the use of renewable energy could improve the security of the energy supply by reducing the dependence on fuel imports. The production of renewable energy may also contribute to rural economic development and provide new income and employment opportunities in rural areas. Deployment of renewable energy sources could also contribute to reducing the GHG emissions from fuel combustion.

In the draft National Energy Climate Plans (NECP), Belgium proposes an 18.3% share of energy from renewable sources in gross final consumption of energy in 2030 as contribution to the EU renewable energy target for 2030. This level of ambition is significantly below the share of 25% by 2030 that results from the formula in Annex II of the Governance Regulation (Article 4(a)(2), European Parliament and European Council, 2018), a situation which would also require in the final plan an indicative trajectory that reaches all reference points in accordance with the national contribution in the final plan (European Commission, 2020a).

Despite strong investments in 2017, there is a lack of certainty as regards the future investment opportunities for renewables in Germany. The relatively long timespan taken to issue permits, legal challenges and increased planning. Restrictions adversely affect the deployment of wind power, in particular[25]. Germany's proposed share of 30% of energy from renewable sources in gross final

[25] This is also reflected in the undersubscription of an auction held in October 2018, at which only just over 50% of the auctioned 670 MW were allocated. A lack of competition at auctions is also likely to push prices up.

consumption of energy in 2030 as national contribution to the EU 2030 target for renewable energy is in line with the results of the formula under the Governance Regulation on which the Commissions based its assessment of Member States' renewable energy contributions, as defined in the draft NECP. Moreover, Germany plans for the years 2022, 2025 and 2027 a more ambitious delivery of its national contribution for renewables than the required reference levels (European Commission, 2020a).

In France, the national contribution for renewable energy proposed in the draft NECP is 32% of gross final energy consumption in 2030 (European Commission, 2020a). This is slightly below the share of 33% that results from the formula in Annex II of the Governance Regulation (European Parliament and European Council, 2018a).

Different legal frameworks may create different barriers across the member states of the NWE cooperation are in deploying RES, as for example off-shore wind energy.

According to the French National Renewable Energy Action Plan[26], the anticipated national share of renewable energy in the transport sector is 10.5% by 2020. Since 2010, France is on track regarding its planned trajectory. If the current trend is maintained (8.9% in 2016), the country is projected to be almost in line in with its 2020 anticipation. Due to a very important diesel fuelled car market, France is by far the top European biodiesel consumer. The country owns a structured biodiesel industry with some of the main European producers.

In Ireland, the lack of a clearly identified contribution to the 2030 renewable energy target among the scenarios presented in the draft NECP makes it difficult to assess the level of ambition. The ambition levels range from 15.8% to 27.7%, and are below the share of 31% in 2030 that results from the formula contained in Annex II of the Governance Regulation (European Parliament and European Council, 2018a). 15.8% is also below Ireland's 2020 target of 16%.

Luxembourg's draft NECP presents a planned range of 23% to 25% of renewable energy by 2030 (European Commission, 2020a), which is above the share of at least 22% in 2030 that results from the formula in Annex II of the Governance Regulation (European Parliament and European Council, 2018a).

The Netherlands' draft NECP contains a bandwidth of a 27% to 35% share of energy from renewable sources as contribution to the EU renewable energy target for 2030 (European Commission, 2020a). This potential range is above the share of 26% in 2030 that results from the formula in Annex II of the Governance Regulation (European Parliament and European Council, 2018a) and is expected to be met mainly thanks to investment in off-shore wind farms, with most wind farms coming online between 2020 and 2023. As part of the new climate programme, the Dutch government has already agreed on a further build out of offshore wind parks to more than 10 gigawatts by 2030.

The United Kingdom has not provided a contribution to the EU's 2030 target for renewable energy in the draft NECP. The overall contribution expected by the formula contained in Annex II of the Governance Regulation is 27% (Article 4(a)(2), European Parliament and European Council, 2018). The renewable energy share in the United Kingdom was 10.2% in 2017, in line with the 2017-2018 indicative trajectory (10.2%). Still, reaching the interim 2020 target (15%) remains challenging, particularly as

[26] https://ec.europa.eu/energy/topics/renewable-energy/national-renewable-energy-action-plans-2020_en

progress in the transport sector is lagging behind, the planned trajectory under the national renewable energy action plan. The National Infrastructure Commission recommended that half of the United Kingdom's power should come from renewables by 2030 (Nationa Infrastructure Commission, n.d.).

The next sections provide recent statistics on the share of energy from renewable sources overall and in three consumption sectors (gross electricity consumption, heating and cooling, and transport) in the NWE area. Renewable energy sources include wind power, solar power (thermal, photovoltaic, and concentrated), hydro power, tidal power, geothermal energy, ambient heat captured by heat pumps, biofuels and the renewable part of waste.

The analysis is based on the aggregated indicator used for monitoring progress towards renewable energy targets of the Europe 2020 strategy implemented by Directive 2009/28/EC on the promotion of the use of energy from renewable sources (The Renewable Energy Directive, 2009, p. 28). This indicator is also a Sustainable Development Goal (SDG). It has been chosen for the assessment of the progress towards the objectives and targets of the EU Sustainable Development Strategy[27].

The indicator measures how extensive the use of renewable energy is and, by implication, the degree to which renewable fuels have substituted fossil and/or nuclear fuels. The share of energy from renewable sources is calculated for four indicators: Overall RES share (RES), Transport (RES-T), Heating and Cooling (RES-H&C), Electricity (RES-E).

2.1.1.1 Share of energy from renewable sources

Table 2-1 shows the overall share of energy from renewable sources for EU27, EU28 and the whole NWE cooperation area. More specifically, 18.9% of all energy consumed in the EU27 is from renewable sources, which is a bit lower than but still in range of the 2020 target of 20%28. From 2004 to 2018 the average increased by 9.3 points.

In the NWE cooperation area the overall lowest proportion of renewables was registered in the Netherlands (7.4%), Luxembourg (9.1%) and Belgium (9.4%). France was at 16.%, Germany at 16.5%, Ireland at 11.1% and the United Kingdom at 11%[29]. Compared with the most recent data available for 2018, the member states in the NWE cooperation area that are further from their respective 2020 targets are France, the Netherlands and Ireland that have to increase their share of renewable energy in final energy consumption by at least 6.4, 6.6 and 5.9 percentage points, respectively[30].

Figure 2-1 shows the share of the renewable energy sources per country in the NWE cooperation area in 2018. In short, wind energy accounts for the highest share (45%), followed by hydropower (18%), solar power (16%) and solid biofuels (9%), while all other renewables account for 12%.

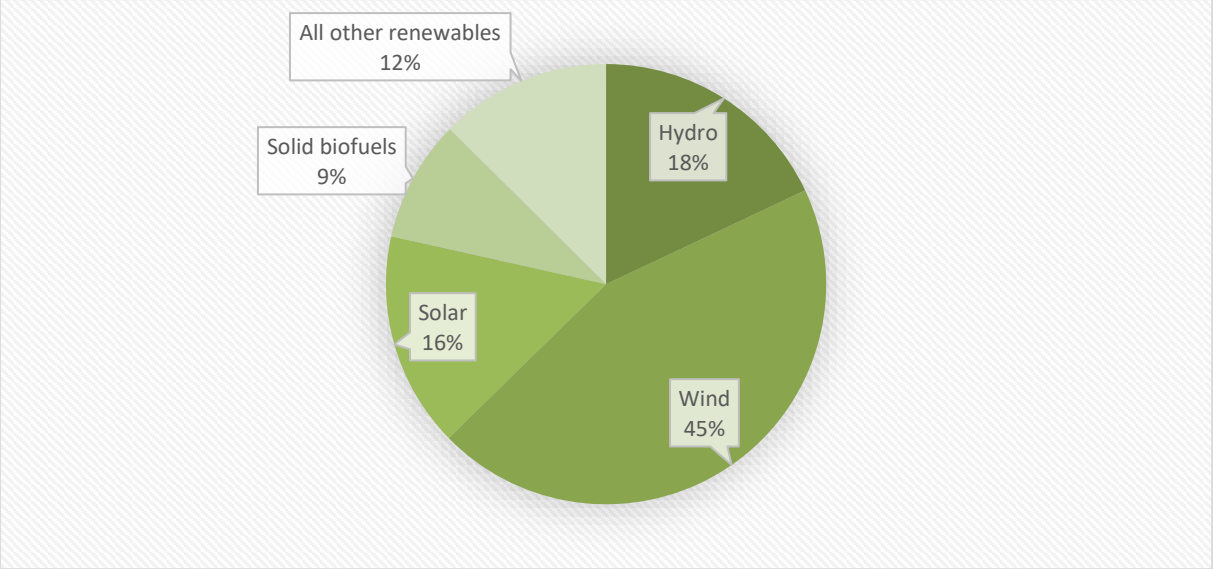
[27] The calculation is based on data collected in the framework of Regulation (EC) No 1099/2008 on energy statistics and complemented by specific supplementary data transmitted by national administrations to Eurostat.
[28] Eurostat (online data code: nrg_ind_ren)
[29] Eurostat (online data code: nrg_ind_ren)
[30] Eurostat (online data code: nrg_ind_ren)

Table 2-1 Overall share of energy from renewable sources in %, 2018

Country	2018
EU27_2020	18.9
EU_28	18.0
Belgium	9.4
Germany	16.5
Ireland	11.1
France	16.6
Luxembourg	9.0
the Netherlands	7.4
United Kingdom	11

Source: Eurostat (online data code: nrg_ind_ren), 2020

Figure 2-1 Share of RES source per NWE country, 2018



Source: Eurostat (nrg_ind_ren), 2020

2.1.1.2 Share of energy from renewable sources (Transport)

Table 2-2 shows the share of energy coming from renewable resources in the field of transport, looking at the EU27 average, the EU28 average and the member states of the whole NWE cooperation area. In the EU 8.3% of renewable energy used in transport activities in 2018. Moreover, the EU agreed to set a common target of 10% for the share of renewable energy (including liquid biofuels, hydrogen, biomethane, 'green' electricity, etc.) used in transport by 2020. As illustrated below, although no NWE country meets that target yet, they are all close to it, except for Belgium and Luxembourg[31]. The average share of energy from renewable sources in transport increased in the EU from 1.5% in 2004 to 8.3% in 2018. In some of the EU Member States there was a rapid take-up in the use of renewable energy as a transport fuel. Regarding specifically at the NWE countries, this was particularly the case in Ireland, Luxembourg, and in the Netherlands.

[31] Eurostat (online data code: nrg_ind_ren)

Table 2-2 Share of energy from renewable sources (Transport) in %, 2018

Country	2018
EU27_2020	8.3
EU_28	8.0
Belgium	6.6
Germany	8.0
Ireland	7.2
France	9.0
Luxembourg	6.5
the Netherlands	9.6
United Kingdom	6.5

Source: Eurostat (nrg_ind_ren), 2020

2.1.1.3 Share of energy from renewable sources in electricity

The growth in electricity generated from renewable energy sources during the period 2008 to 2018 largely reflects an expansion in three renewable energy sources across the EU, principally wind power, but also solar power and solid biofuels (including renewable wastes). In 2018 wind power is the single largest source for renewable electricity generation in the EU. Indeed, the amount of electricity generated from hydropower was relatively similar to the level recorded a decade earlier. By contrast, the amount of electricity generated in the EU from solar and from wind turbines was 15.5 times and 2.9 times as high in 2018 as it had been in 2008. The growth in electricity from solar power has been dramatic, rising from just 7.4 TWh in 2008 to 115.0 TWh in 2018.

Table 2-3 presents the share of energy from renewable sources in the field of electricity, looking at EU27 and EU28 average, as well as in the NWE cooperation area member states. Overall, there is a significant variation between EU Member States. The EU-27 average is 32%. The specific analysis of the NWE countries reveals that more than one-third of all electricity consumed was generated from renewable sources in Germany (38%), and about one-third in Ireland (33%), and in the United Kingdom (30%). A second group of countries shows a share of energy from renewable sources in electricity between 15% and 21%, this is the case in France (21%), Belgium (19%) and in the Netherlands (15%). Luxembourg closes the list with a share lower than one-tenth (9%). These shares are relatively low, compared to countries such as Austria (73.1%), Sweden (66.2%) and Denmark (62.4%) where at least three fifths of all the electricity consumed was generated from renewable energy sources – largely as a result of hydro and wind power.

Table 2-3 Share of energy from renewable sources in electricity in %, 2018

Country	2018
EU27_2020	32.2
EU_28	32.1
Belgium	19.0
Germany	38.0
Ireland	33.2
France	21.2
Luxembourg	9.1

the Netherlands	15.1
United Kingdom	30.9

Source: Eurostat (nrg_ind_ren), 2020

2.1.1.4 Share of energy from renewable sources in heating and cooling

In 2018, renewable energy accounted for 21.1% of total energy use for heating and cooling in the EU. This is a significant increase from 11.7% in 2004. Increases in industrial sectors, services and households (building sector) contributed to this growth. Aerothermal, geothermal and hydrothermal heat energy captured by heat pumps is considered, to the extent reported by countries. France is above the EU average with 21.8%. Germany follows at 13.6%, whereas the other countries are at much lower levels, notably Luxembourg (8.8%), Belgium (8.2%), the United Kingdom (7.5%), Ireland (6.5%), and the Netherlands (6.1%) (Table 2-4).

Table 2-4 Share of energy from renewable sources in heating and cooling in %, 2018

Country	2018
EU27_2020	21.1
EU_28	19.7
Belgium	8.2
Germany	13.6
Ireland	6.5
France	21.8
Luxembourg	8.8
the Netherlands	6.1
United Kingdom	7.5

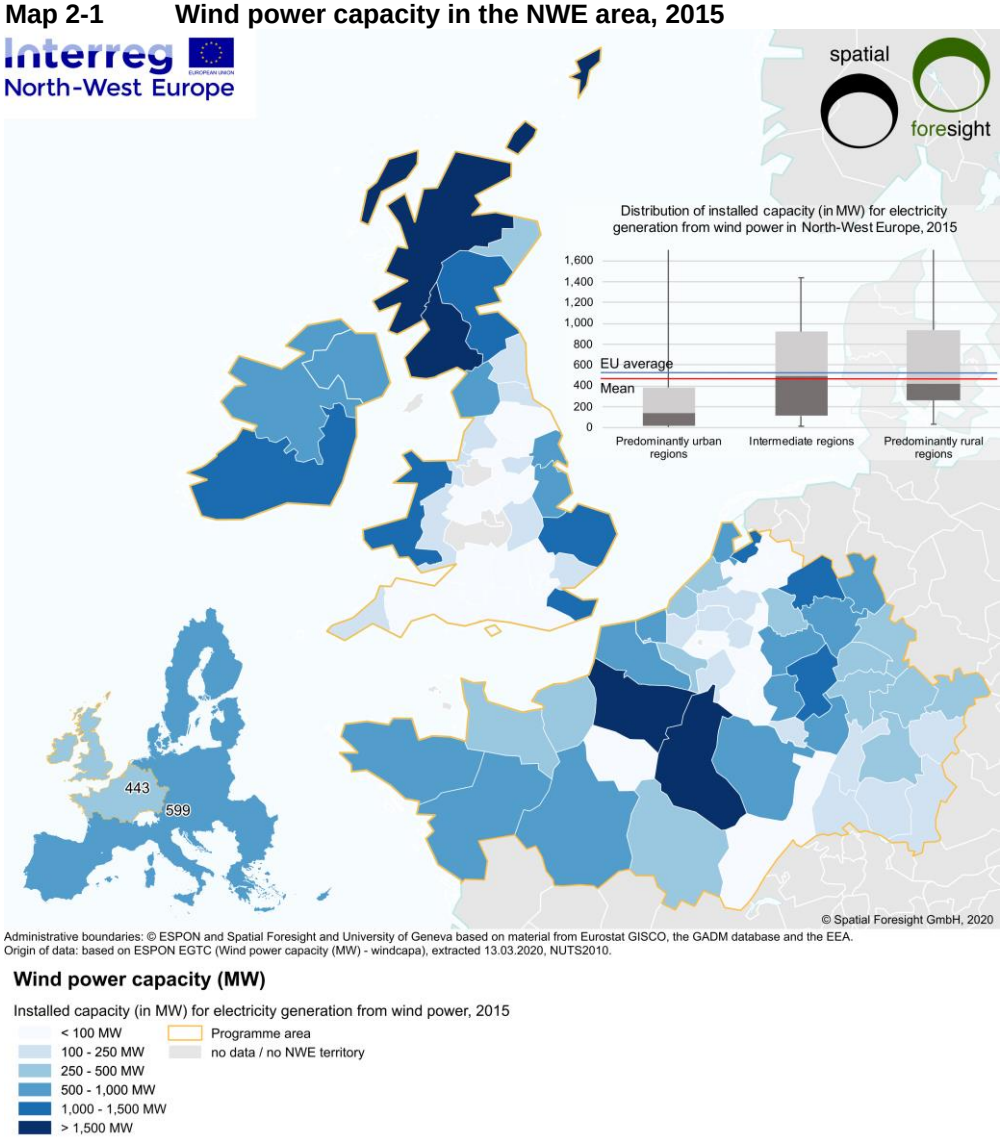
Source: Eurostat (nrg_ind_ren), 2020

2.1.1.5 Overall capacity and potential of different sources of RES in the NWE area

Regarding the different sources of renewable energy, **wind power** is the most important renewable source of electricity in the EU and in the NWE cooperation area countries. More specifically, France, Picardie and Champagne-Ardenne are the NUTS 2 regions with the highest wind power capacity (over 1 500 MW), together with the regions of Highlands and Islands, and South Western Scotland of the United Kingdom, followed closely by Southern and Eastern Ireland, the United Kingdom NUTS 2 regions of Eastern Scotland, West Wales and The Valleys, East Anglia and Kent, Flevoland in the Netherlands, Münster and Koblenz in Germany, all with a capacity between 1 000 and 1 500 MW[32]. Map 2-1 shows the specific distribution of installed capacity (in MW) for electricity generation from wind power in the NWE area.

[32] SHARES 2017 Summary Results, Eurostat, February 2019.

Map 2-1 Wind power capacity in the NWE area, 2015



Source: own presentation, 2020

Table 2-5 shows the share of electricity from renewable energy sources, per source and per NWE country and Table 2-6 the electricity from renewable energy sources, per source and per NWE country (in ktoe - thousand tonnes of oil equivalent). Wind power accounts for 45% of the total electricity from RES, mainly thanks to the on-shore and off-shore installations in Germany, France and in the United Kingdom. Solar power, including solar photovoltaics and solar thermal generation, follows wind power and accounts for with 16% of total electricity from renewable energy sources produced in the NWE countries. This is mainly the result of the installations located in Germany, in the United Kingdom and in France, with 59.5%, 16.7% and 13.7% respectively (Table 2-5). Hydro energy comes third with about 7.6 ktoe produced in 2018 (Table 2-6), corresponding to 18% of the total electricity from RES in the NWE countries. However, almost 70% of that amount is produced by France alone.

Table 2-5 Electricity from RES per source, per NWE country, 2018 (%)[33]

	BE	DE	FR	IE	LU	NL	UK	NWE	NWE/EU27	NWE/EU28
Hydro	0.4%	23.7%	69.2%	0.8%	0.1%	0.1%	5.7%	18%	25.4%	25.0%
Wind	3.5%	48.8%	13.2%	4.0%	0.1%	4.6%	25.8%	45%	67.9%	57.8%
Solar	5.1%	59.5%	13.7%	0.0%	0.2%	4.8%	16.7%	16%	66.9%	60.2%
Solid biofuels	8.0%	24.9%	8.7%	0.8%	0.2%	3.4%	54.1%	9%	57.3%	43.8%
All other renewables	3.3%	65.8%	8.5%	0.8%	0.2%	5.2%	16.1%	13%	70.3%	63.2%
Total (RES-E numerator)	**3.6%**	**46.0%**	**22.4%**	**2.1%**	**0.1%**	**3.8%**	**22.1%**	**100%**	**51.6%**	**46.3%**

Source: Eurostat, SHARES tool, 2018

Table 2-6 Electricity from RES per source, per country, 2018 (ktoe - thousand tonnes of oil equivalent) [34]

	BE	DE	FR	IE	LU	NL	UK	NWE	EU-27	EU-28
Hydro	26,8	1.787,4	5.205,7	62,2	9,0	8,1	427,6	7.526,8	29.640,2	30.067,8
Wind	653,0	9.123,9	2.466,9	746,1	17,8	862,7	4.821,9	18.692,3	27.529,0	32.350,9
Solar	335,5	3.936,7	908,7	1,4	10,3	317,5	1.105,5	6.615,8	9.886,7	10.992,2
Solid biofuels	299,6	931,0	323,9	28,4	8,2	128,6	2.023,3	3.743,0	6.531,2	8.554,6
All other renewables	170,8	3.458,3	449,2	44,2	10,6	275,1	845,7	5.253,9	7.473,8	8.319,4
Total (RES-E numerator)	**1.485,7**	**19.237,3**	**9.354,4**	**882,3**	**55,9**	**1.592,1**	**9.224,1**	**41.831,8**	**81.060,9**	**90.285,0**

Source: Eurostat, SHARES tool, 2018

Solid biofuels cover solid organic, non-fossil material of biological origin (biomass)[35] which may be used as fuel for heat production or electricity generation and contribute to 9% of the total electricity from RES. The production of RES from solid biofuels is concentrated in the United Kingdom (54.1%), and Germany (24.9%) (Table 2-5). Last but not least, all the other renewables include electricity generation from gaseous and liquid biofuels, renewable municipal waste, geothermal, and tide, wave & ocean energy and contribute to 13% of the total energy from RES produced in the NWE countries. More than 80% of the production of this type is localised in only two countries, Germany and the United Kingdom with 65.8% and 16.1% respectively (Table 2-5).

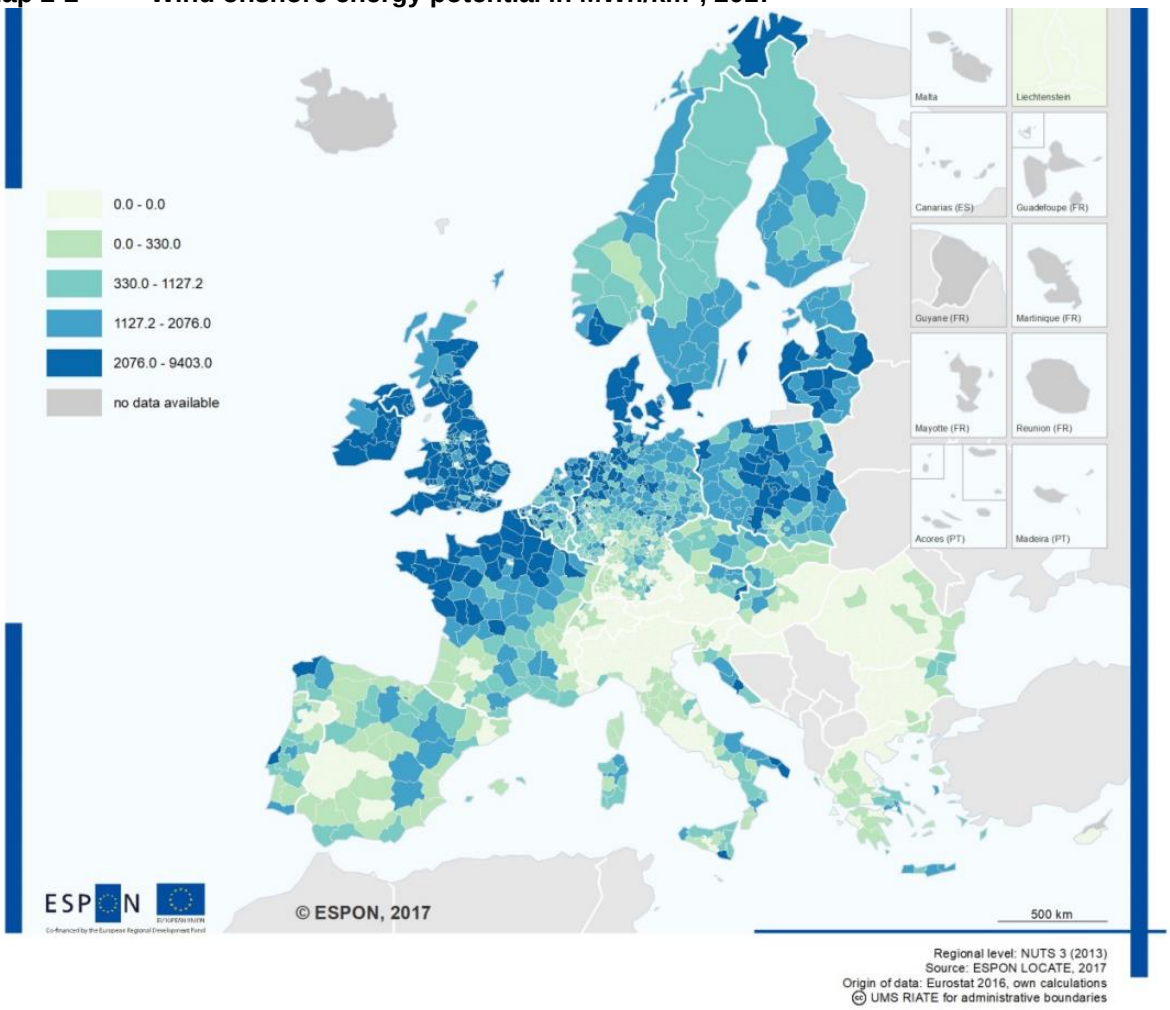
When it comes to the potential of the NWE cooperation area in the different renewable energy sources, this varies per source and type of potential. Map 2-2 shows the potential for wind onshore energy potential. The potential for wind energy depends strongly on average wind speeds and land availability for wind power installations. To account for economic restrictions, areas with low wind energy harvest (less than 1,800 full load hours) are excluded from the potential. The map highlights that the areas with the highest potential are already those where the NWE countries have focused the largest capacity (ESPON, 2018c).

[33] Hydro is normalised and excluding pumping. Wind is normalised. Solar includes solar photovoltaics and solar thermal generation. All other renewables include electricity generation from gaseous and liquid biofuels, renewable municipal waste, geothermal, and tide, wave & ocean.

[34] Hydro is normalised and excluding pumping. Wind is normalised. Solar includes solar photovoltaics and solar thermal generation. All other renewables include electricity generation from gaseous and liquid biofuels, renewable municipal waste, geothermal, and tide, wave & ocean.

[35] In energy statistics, solid biofuels are a product aggregate equal to the sum of charcoal, fuelwood, wood residues and by-products, black liquor, bagasse, animal waste, other vegetal materials and residuals and renewable fraction of industrial waste.

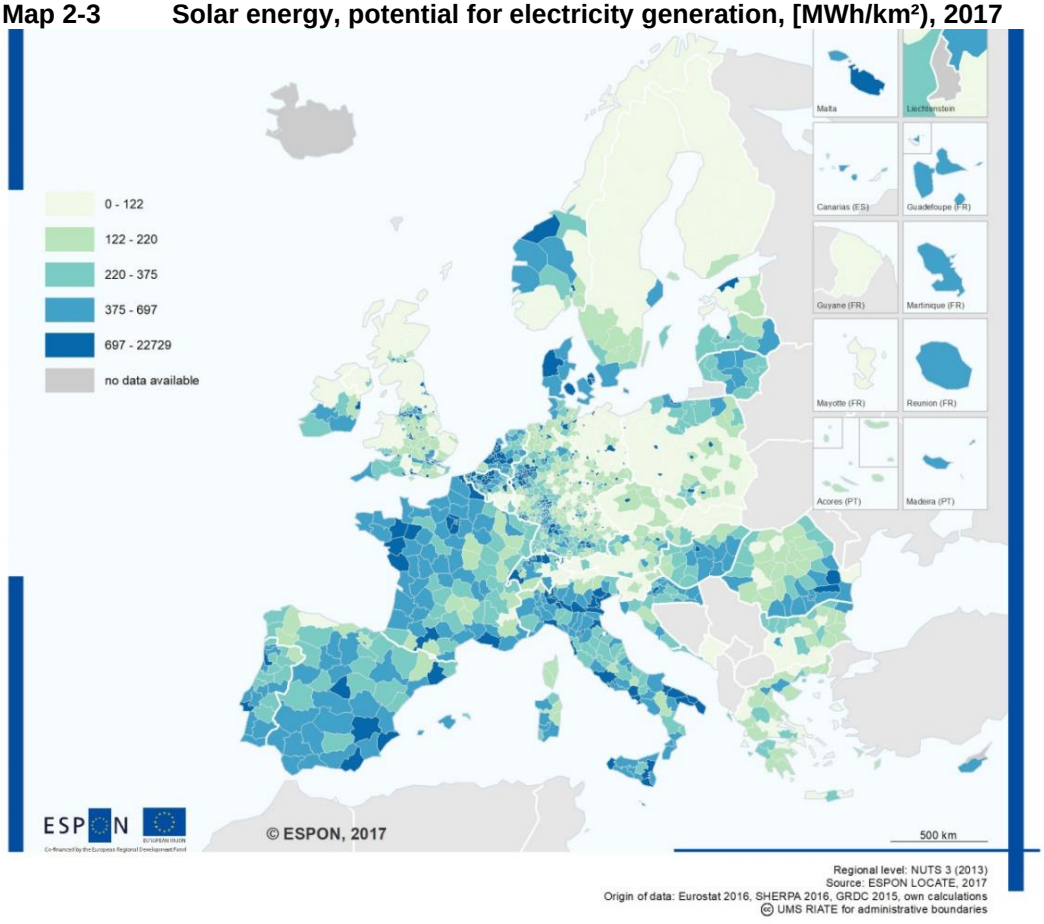
Map 2-2 Wind onshore energy potential in MWh/km², 2017



Source: (ESPON, 2018c)

Regarding the solar energy potential for electricity generation, Map 2-3 indicates that a considerable potential exists in the NWE area in the Netherlands, in France (Bretagne, Pays de la Loire, Ile-de-France, Nord-Pas-de-Calais), in Belgium (Flanders), in Southern and Eastern Ireland, as well as in Germany (Köln, Düsseldorf, and Stuttgart). In Luxembourg, around 3% of households have installed residential solar photovoltaic, while the technical potential for such activities is at 8% (European Commission, 2017a).

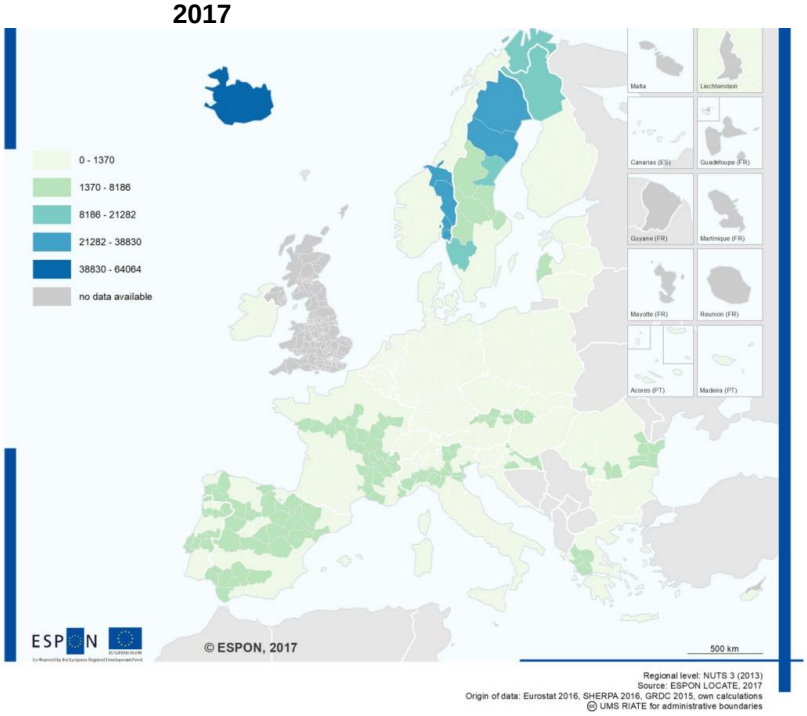
Map 2-3 Solar energy, potential for electricity generation, [MWh/km²), 2017



Source: (ESPON, 2018c)

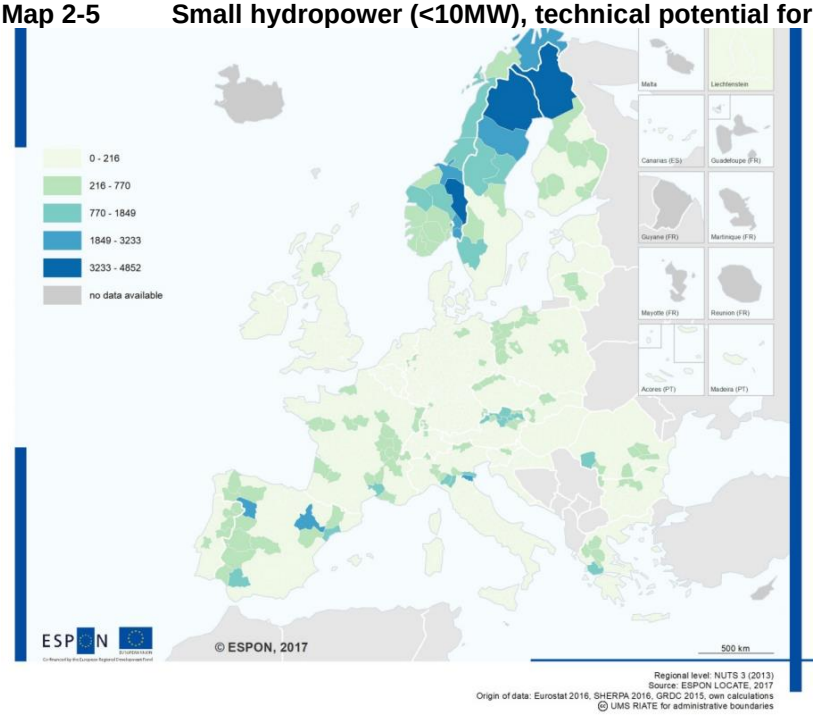
Regarding hydropower, Map 2-4 and Map 2-5 show that the potential for both large-scale (> 10MW) and small-scale (< 10MW) hydropower energy generation is low in the NWE area (ESPON, 2018c).

Map 2-4 Large hydropower (>10MW), technical potential for electricity generation, [GWh], 2017



Source: (ESPON, 2018c)

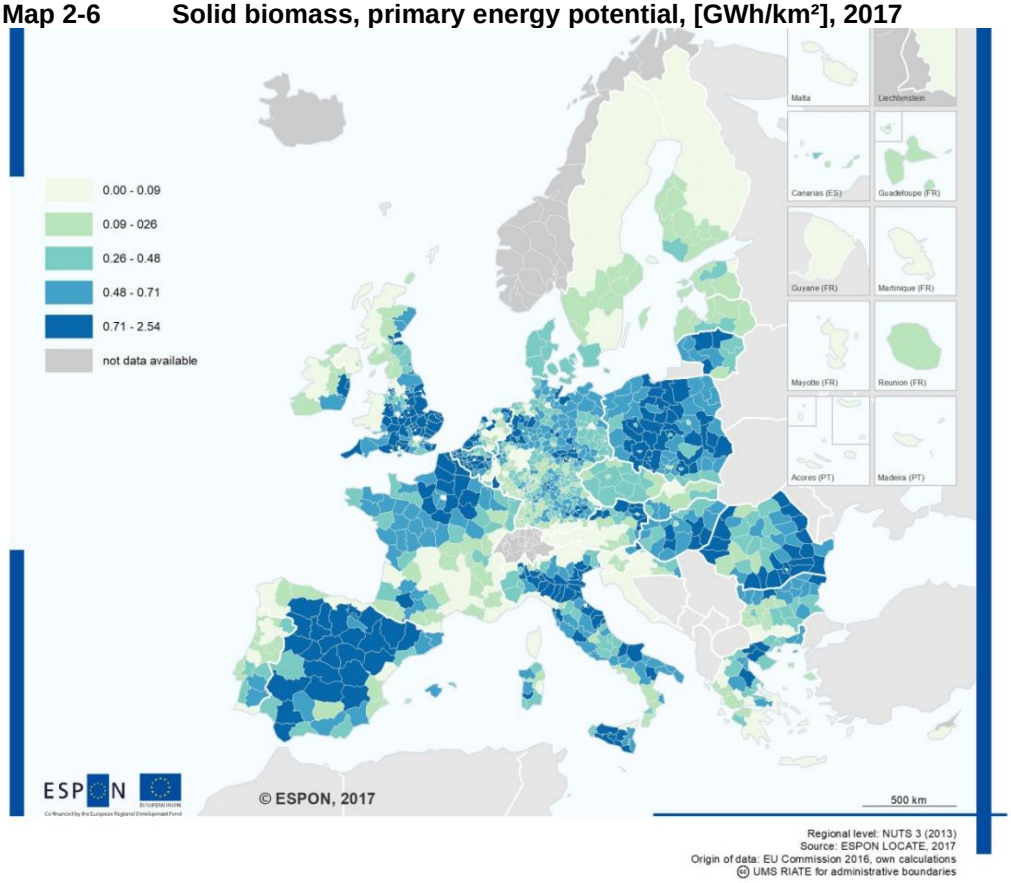
Map 2-5 Small hydropower (<10MW), technical potential for electricity generation, [GWh], 2017



Source: (ESPON, 2018c)

Last but not least, Map 2-6 shows that in most parts of the NWE area the potential to produce energy from biomass is either very high or high.

Map 2-6 Solid biomass, primary energy potential, [GWh/km²], 2017

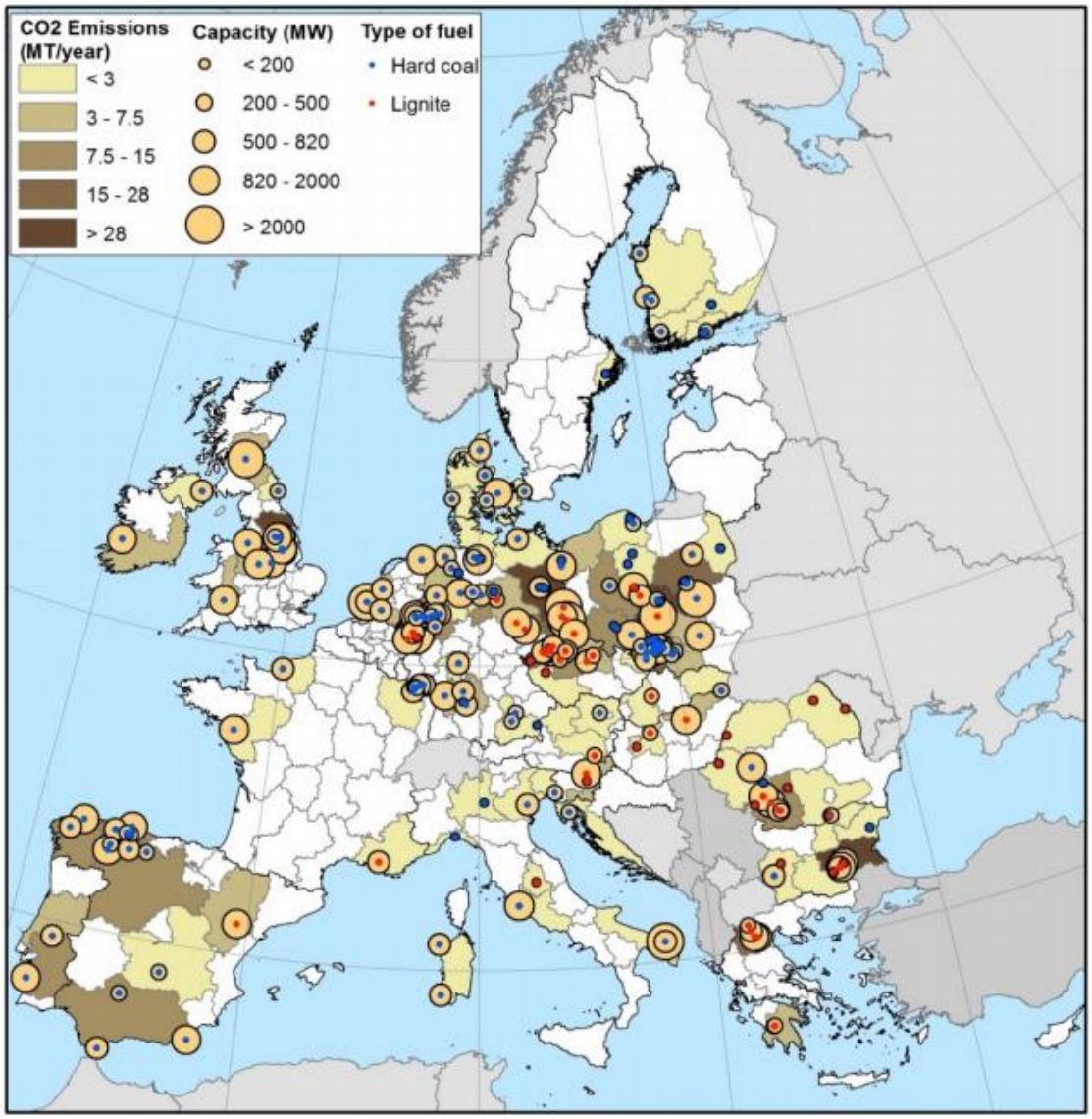


Source: (ESPON, 2018c)

2.1.2 NWE coal regions in transition

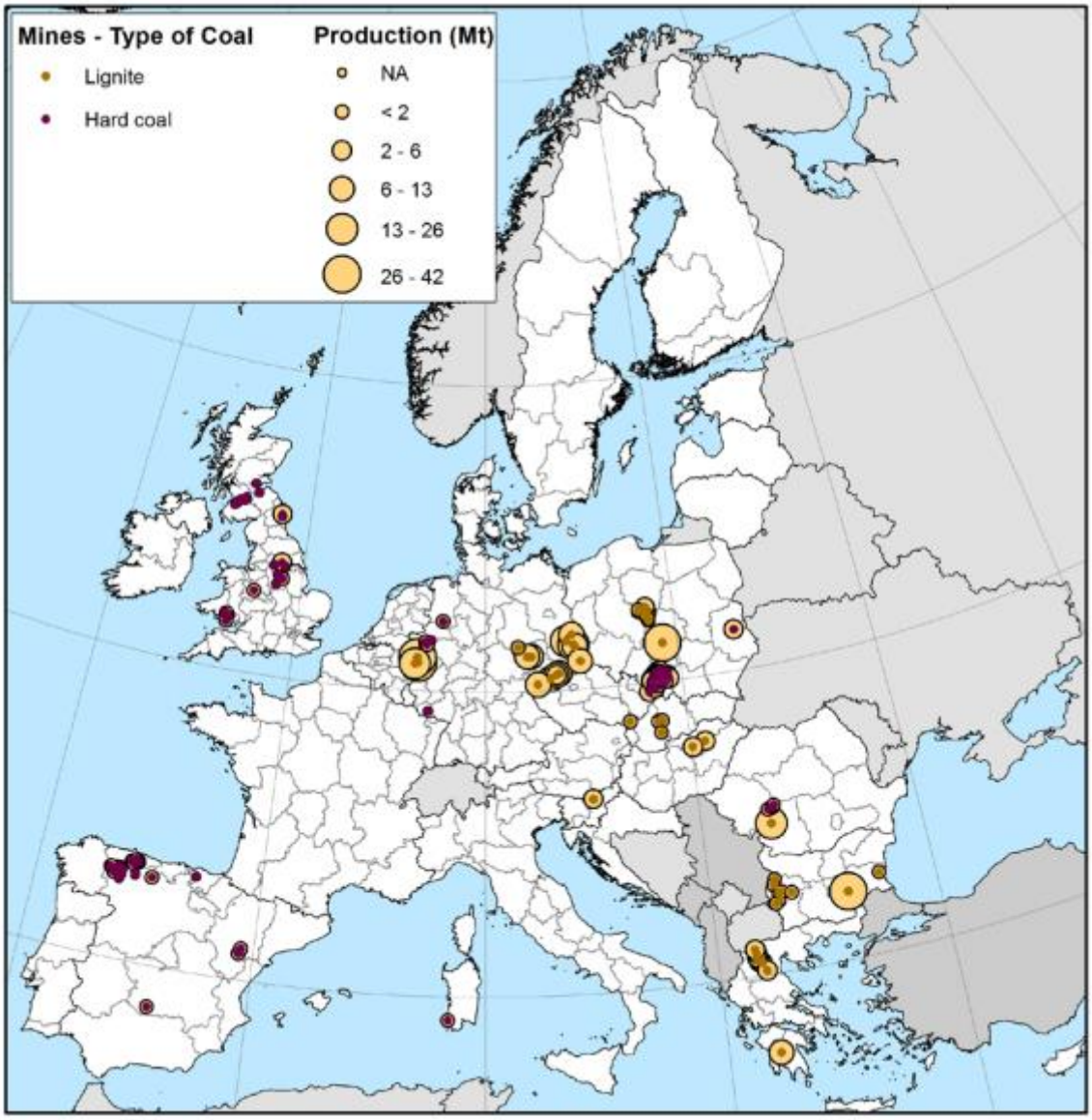
In the NWE cooperation area there are 22 NUTS 2 regions hosting coal-fired plants and 13 hosting coal mines. They are located in France (3), Germany (6), Ireland (1), The Netherlands (3) and in the United Kingdom (10) (Alves Dias, Patricia et al., 2018), as illustrated in Map 2-7 and Map 2-8.

Map 2-7 Location of coal power plants with information on capacity and fuel type; and regional CO_2 emissions at NUTS 2 level, 2016



Source: (Alves Dias, Patricia et al., 2018)

Map 2-8 Location of operating coal mines in EU and types of coal produced, 2015



Source: (Alves Dias, Patricia et al., 2018)

The importance of coal is, however, decreasing, as part of the ongoing transformation of the energy system. The need to reduce greenhouse gas emissions has led to an increasing share for renewables; and coal power generation is actively discouraged with stringent post-2020 emission requirements, high CO_2 emission allowance prices, and likely restrictions on coal eligibility for future capacity remuneration mechanisms. Frequently overlooked, however, are the potential negative impacts of the ongoing shrinkage of the coal sector on employment and the economy in those regions. The NWE cooperation area NUTS 2 regions hit hardest by the decommissioning are likely to be in the United Kingdom (Derbyshire and Nottinghamshire) and in Germany (Köln and Düsseldorf).

Early action therefore needs to be taken to develop alternative business opportunities to maintain or increase regional employment and support economic growth. Close cooperation between companies, regulators, investors, land-use planners and local communities is essential to identify the most

sustainable uses and maximize social-economic development. The reclamation of mining sites not only mitigates environmental impacts but can also contribute to the local economy, if new facilities are developed such as recreation centres, museums or science centres. Although new employment opportunities should come from all sectors of the economy, the energy sector can still remain a driver for regional development. Conversion into wind or solar parks, for example, could provide reemployment opportunities for coal workers after an adjustment of skills, since electrical and mechanical skills, experience of working under difficult conditions and sophisticated safety experience are highly valued in the wind and solar energy industries (Alves Dias, Patricia et al., 2018).

2.1.3 Carbon storage

The Map 2-9 shows that the estimated CO_2 storage capacity in onshore and offshore locations in the EU are mainly located in the NWE area, including several parts of Germany, the Netherlands, Belgium, France and the United Kingdom (Alves Dias, Patricia et al., 2018).

Carbon capture and storage (CCS) is considered a key mitigation option to avoid CO_2 emissions, and is increasingly seen with interest by CO_2-intensive industries such as industries specialised in cement or iron and steel (Alves Dias, Patricia et al., 2018). In the long run this needs to be complemented by carbon capture and utilisation (CCU). A successful implementation of such technologies could potentially create favourable conditions for a life extension of at least some power plants in the NWE area.

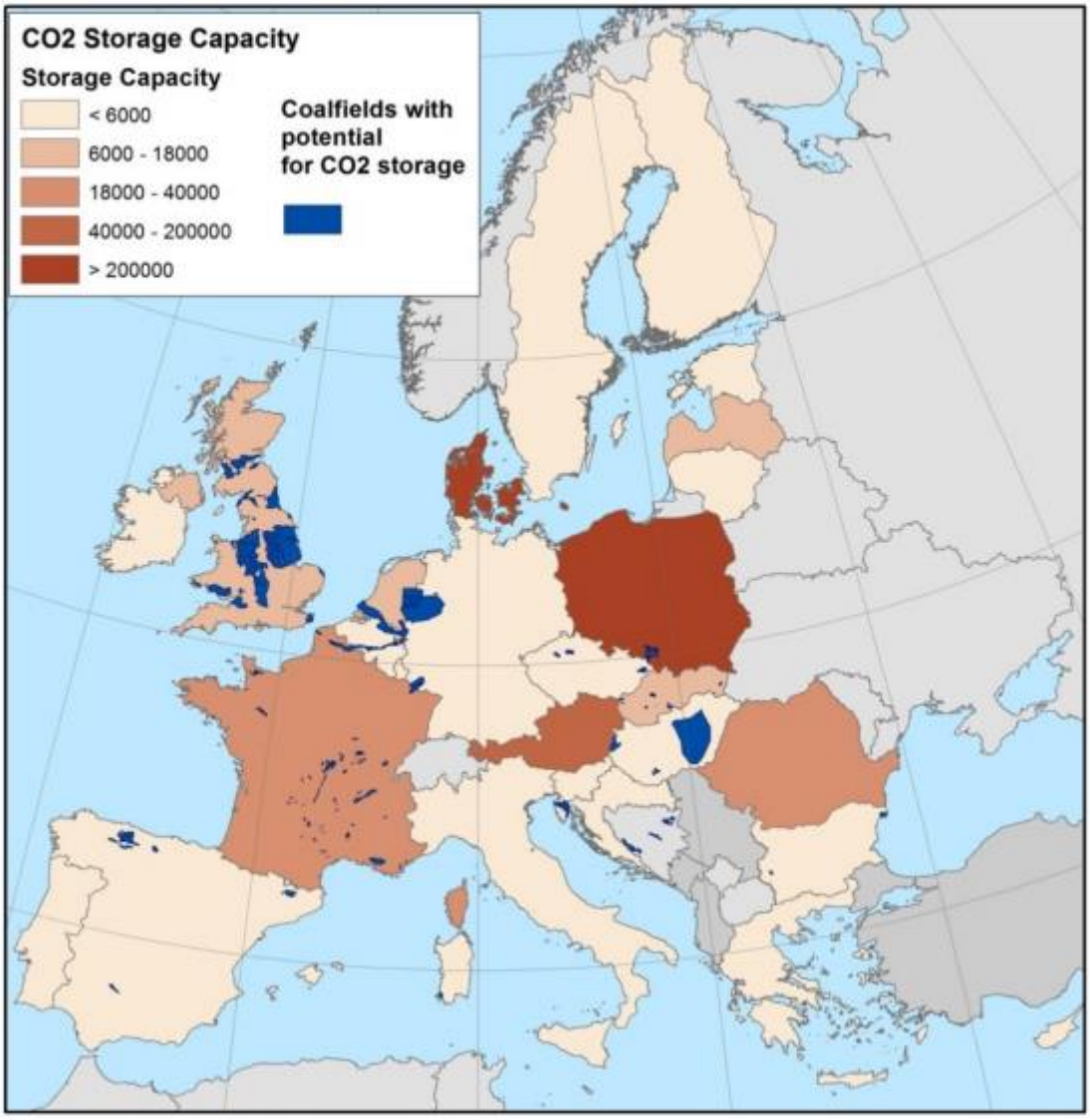
Following capture and transport, CO_2 storage can take place in several suitable geological formations such as deep saline aquifers, depleted hydrocarbon fields, and also certain coalfields. Regarding transition strategies, a possible alternative for some coal regions might be a carbon capture ready power plant, as Düsseldorf (Germany) appears to have a very high potential for this solution, as well as Zuid-Holland (the Netherlands) and Karlsruhe (Germany) (Alves Dias, Patricia et al., 2018). However, both CCS as well as carbon capture and utilisation (CCU) are among the technologies that still need further development and acceptance.[36]

In Europe, CCS technologies and projects are currently more advanced than CCU projects (IOGP, 2019). CCU covers a range of technologies at differing levels of maturity, cost and market size.

CCU technologies present undeniable advantages that make them a must in the mix of solutions that can be deployed against climate change, but have to face important challenges before large scale deployment can be achieved, including lack of a business case, low market demand and absence of product standards, lacking infrastructure and difficult access to key inputs, lack of Life-cycle assessment (LCA) and other standards, as well as lack of financing.

[36] See e.g. https://en.acatech.de/project/ccu-and-ccs-contributing-to-climate-protection-in-industry/

Map 2-9 Estimated CO_2 Storage capacities (in million tonnes) in EU28 and potential coalfields for CO_2 storage



Source of data: EU Geocapacity (2008) and CO_2StoP (CO2StoP, 2014).

Origin of data: Alves Dias, P. et al, 2018

CCS and CCU are mutually supportive solutions since both require access to capture facilities and to gas infrastructure and transportation services. They should both be seen as technology options to cost-effectively meet the EU's climate targets for 2030 and 2050. Europe is well placed to benefit from CCS and CCU due to its extensive pipeline infrastructure which can be used to transport CO_2, hydrogen and synthetic methane, and other renewable and decarbonised gases. The cost-effectiveness and efficiency of future CCS-CCU infrastructure will be shaped by its ability to capture the emissions from clusters of industrial installations, rather than single sources, as such a collective approach drives economies of scale. The highest density of Europe's stationary emission clusters is in the north and includes France, Belgium, the Netherlands and the United Kingdom from the NWE countries (Endrava, 2018).

The EU offers a set of funding programmes to help finance European energy projects, including for CCS and CCU. These cover the full range of technology development levels, from research under Horizon 2020 and Horizon Europe to commercial scale projects in the Innovation Fund. EU funding schemes and innovation networks are vital in supporting early deployment of CCS and CCU. The Connecting Europe Facility (CEF) is a European Commission funding initiative which has a series of calls aimed at developing cross-border CO_2 infrastructure. An example of project having secured CEF funding or Project of Common Interest (PCI) status, is the *Porthos* project, led by Rotterdam (the Netherlands) (Rotterdam CCUS, n.d.). An example of cluster-based CCS-CCU approach is the *Fluxys* (Port of Antwerp, Belgium) project (fluxys, n.d.).

2.1.4 Energy storage

At any moment in time, the consumption of electricity has to be perfectly matched with the generation of electricity. This balance is necessary in all electricity grids to maintain a stable and safe supply. Energy storage can stabilise fluctuations in demand and supply by allowing excess electricity to be saved in large quantities over different time periods, from fast storage in seconds to longer storage over days.

Energy storage has a key role to play in the transition towards a carbon-neutral economy and it addresses several of the central principles in the 'Clean energy for all Europeans' package. By balancing power grids and saving surplus energy, the package represents a concrete means of improving energy efficiency and integrating more renewable energy sources into electricity systems, but it will also help enhance European energy security and create a well-functioning internal market with lower prices for consumers.

According to the International Energy Agency (IEA), the increasing electrification of many sectors, such as transport and heating and cooling, means that the globally installed capacity would have to more than double by 2040. Electricity demand is expected to rise by more than a third by 2050 compared to 2000 levels. Meanwhile, in the EU, the share of renewable energy sources in electricity generation is expected to reach 24% in 2030 and 56% by 2050 (European Commission, 2011a).

Achieving a significant level of decarbonisation already in 2030 will require the power generation system to undergo significant structural changes. There will be a fundamental shift from a centralised energy system based on fossil fuels to a distributed generation system supported by a range of flexibility options. In a system with a high proportion of variable renewable energy sources generation, it will be challenging to ensure that electricity supply and demand are balanced across time and space. In addition, voltages and frequency of grid electricity will have to remain within required ranges. The implementation of these changes necessitates significant investments for the development and large-scale deployment of low-carbon energy technologies. The European Commission estimated that cumulative grid investments costs alone could amount to between €1.5 and €2.2 trillion between 2011 and 2050 (European Commission, 2011a), with the higher range corresponding to greater investment in renewable energy sources. This investment is not only required for RES but also for the technologies that can support an increased share of renewable energy sources in the system, including energy storage, interconnections, and smart grids.

Germany and the United Kingdom lead activity in the EU. German behind-the-meter storage increased even beyond the support of subsidy programmes, reaching over 100,000 installed systems. Flow

batteries emerged in Germany as a potential alternative to the general predominance of lithium-ion. Active debate continued regarding the state of the battery manufacturing industry, as Germany and France together committed EUR 1.7 billion to support local manufacturing (International Environmental Agency, 2019). In Europe the main producers of supercapacitors are based in Germany and France[37]. In Europe, flywheel projects are installed in France, United Kingdom, Germany, and, in particular, in Ireland where a hybrid flywheel plant[38] was built in 2015. The Irish project (promoted by *Schwungrad Energie*) is attracting interest from national grids across Europe, which plan to increase their renewable energy penetration in the years ahead. Underground thermal energy storages (UTES) are commonly used in the Netherlands for seasonal storage of heat in centralised and distributed energy systems. In these countries UTES is applied together with renewable solar or geothermal heat and electricity from photovoltaics in combination with district heating. The world's largest Liquid Air Energy Storage (LAES) demonstration plant was installed in the United Kingdom, which is at the forefront of the development of LAES technologies (Ali, 2016). Some NaS battery projects have been set up in France, Germany, and the United Kingdom[39]. Regarding chemical energy storage (hydrogen) Germany has already identified that Power-to-X[40] has a great opportunity to decarbonise the transport sector and the German Federal Government opened a funding initiative in 2017 to support research and innovation in road and maritime applications. At the Karlsruhe Institute of Technology (KIT) in Germany, a hybrid concept with a Superconducting Magnetic Energy Storage, in combination with hydrogen, has been studied in detail and a first small Magnesium Diboride ($MgB_{2)}$ superconducting coil has been built and tested (EASE and EERA, 2017).

Decisions to invest into the development of storage and deployment of adequate storage capacity will depend on the evolution of the whole energy system. They are closely linked to developments such as penetration of electric vehicles and improvements in demand response/demand side management/smart grids (European Commission, 2013a).

Moreover, many barriers remain, among which are the lack of harmonisation of grid charges, taxes and fees applied to energy storage technologies across the EU. Double charging of storage technologies, once when they draw electricity from the grid and once when they feed energy back into the grid, is particularly damaging to the storage business case and does not reflect the added value of storage for the system. Storage technologies are penalised by energy market modelling which does not take into account intra-hour benefits (while storage provides mostly short-duration services). Another barrier is lack of clarity of existing technical, safety and environmental standards or a lack of specific standards for energy storage technologies.

[37] Within a R&D project in France, the *Centre National de la Recherche Scientifique* (CNRS) developed one of the first high-temperature superconducting SMES with a capacity of 800 kJ and 400kJ and Bi2212 material operating at 20 K36 (-253.15°C). At the Karlsruhe Institute of Technology (KIT) in Germany, a hybrid concept with a SMES, in combination with hydrogen, has been studied in detail37 and a first small MgB2 superconducting coil has been built and tested.

[38] The hybrid flywheel is a disruptive innovation with the potential to revolutionise the system services market, decoupling its provision from electricity generation by delivering energy-less system services.

[39] The University of Leeds has carried out more research on LAES in collaboration with the British company Highview Power Storage and the Japanese company Mitsubishi Heavy Industries and Hitachi.

[40] Power-to-X (P2X) scheme that couples the electricity sector to the gas and oil sectors, providing both effective long-term large-scale energy storage by existing infrastructure and a solution to decarbonise road, sea, and air transport.

2.1.5 Smart energy systems - smart grids low and medium voltage and related storage

The EU has committed itself to a clean energy transition, which will contribute to fulfilling the goals of the Paris Agreement on climate change and provide clean energy to all. To deliver on this commitment, the EU has set binding climate and energy targets for 2030 including guaranteeing at least 15% electricity interconnection levels between neighbouring Member States (European Commission, 2017b).

Increasing the uptake of variable renewable generation also creates challenges in terms of grid management, price volatility and congestion. More flexible and smarter energy grids are required (Recitals 23, 24, 37, 52 - 55, Article 2(23), Articles 19 - 22, Annex II, Internal market for electricity directive, 2019), including at distribution level, to address these challenges and to cover peak loads both locally and trans-regionally. At the same time, well-interconnected countries can cover some part of their flexibility needs via interconnectors (Recitals 23, 24, 37, 52 - 55, Article 2(23), Articles 19 - 22, Annex II, Internal market for electricity directive, 2019).

An electricity system to which renewables will contribute around half of the generation in 2030 and that will be fully decarbonised by 2050 will be the cornerstone of the EU's energy transition. The investment needs to reach a fully European energy grid where all Member States are interconnected and protected against sudden supply disruptions were, and still are, high (Booz&Co, 2013). To ensure the timely delivery of these investments and the construction of the necessary infrastructures, the European Union adopted the Regulation (European Parliament and European Council, 2013, pg.39) on guidelines for trans-European energy networks in 2013. This was accompanied by the Connecting Europe Facility (COM(2018) 438 final, 2018) (CEF) created to support financially the development of trans-European energy, transport and telecommunication networks.

2.1.5.1 Smart meters

Regarding the deployment of smart meters, the European Commission is calling for a fit for purpose deployment of smart metering systems across the Energy Union (Tractebel Impact, 2019). The adoption of the 2009/72/EC Electricity Directive and the 2009/73/EC Gas Directive has triggered the necessity to conduct a cost benefits analysis (CBA) on the deployment of smart metering systems in each Member States. In 2014, a first benchmarking report was presented by the European Commission, presenting the CBAs' outcome.

Among the NWE countries, France, Luxembourg, the Netherlands and the United Kingdom had a positive CBA and took a commitment to deploy 80% of smart meters by 2020, but do not yet exceed 75% of deployment. Belgium, Germany and Ireland are characterized by a lower commitment level towards smart metering deployment and have less than 10% of smart meters (Tractebel Impact, 2019).

The common driver for the development of smart meters of all NWE countries is to digitalize distribution grid and optimize network operations, together with to digitalize retail market to foster innovation and new services by private actors. None of the NWE countries seem to consider supporting actions tackling fuel poverty or supporting energy efficiency as a driver for smart meters rollout in the case of electricity[41].

[41] Digitalise retail market to foster innovation and new services by private actors.

2.1.5.2 Smart grids

The Commission is keen to raise awareness about the thematic area of smart grids, as it is a key element in the clean energy transition. A smart grid is defined in the TEN-E Regulation (European Parliament and European Council, 2013a) as an electricity network that can integrate in a cost efficient manner the behaviour and actions of all users connected to it, including generators, consumers and those that both generate and consume, in order to ensure an economically efficient and sustainable power system with low losses and high levels of quality, security of supply and safety. The TEN-E Regulation has identified smart grid deployment as one of 12 trans-European energy infrastructure priority corridors and areas.

The electricity system relies on its interconnected grid to deliver affordable, secure and sustainable energy to all Europeans. Smart grids facilitate the integration of renewable energy in the system and contributes to the empowerment of energy consumers. The development of smart energy infrastructure should follow at the same speed in order to underpin this transformation.

Two Projects of Common Interest (PCI) have been selected which involve the NWE area:

- The Smart Border Initiative (France, Germany) between Lorraine (France) and Saarland (Germany) (European Commission, 2020b).

- The Data Bridge (Estonia, Latvia, Lithuania, Denmark, Finland, France), which aims to build a common European Data bridge Platform, to enable integration of different data types (smart metering data, network operational data, market data), with a view to develop scalable and replicable solutions for the EU (European Commission, 2020c).

2.1.5.3 Energy interconnections

To achieve its climate and energy goals, Europe also needs to improve its electricity and gas interconnections. Connecting Europe's electricity and gas systems will allow the EU to boost its security of supply and to integrate more renewables into energy markets. The European Union is moving from a highly centralized to a more decentralized energy system relying on more distributed generation, energy storage and a more active involvement of consumers through demand response.

There is one infrastructure corridor covering the NWE countries that has been identified as priority by the Trans-European Networks for Energy (TEN-E), as it requires urgent infrastructure development in electricity in order to connect regions currently isolated from European energy markets, strengthen existing cross-border interconnections, and help integrate renewable energy. The corridor is the North Seas Offshore Grid (‘NSOG’) focusing on integrated offshore electricity grid development and related interconnectors in the North Sea, Irish Sea, English Channel, Baltic Sea and neighbouring waters to transport electricity from renewable offshore energy sources to centres of consumption and storage and to increase cross-border electricity exchange.

Regarding natural gas, the relevant TEN-E corridor for all NWE countries concerns the North-South gas interconnections in Western Europe ('NSI West Gas') to further diversify routes of supply and for increasing short-term gas deliverability[42].

Finally, four TEN-E PCIs have also been identified in the area of carbon dioxide transport networks. The projects are located around the Northern Seas region and involve Belgium, Germany, the Netherlands, the United Kingdom (and Norway). They are especially important for energy intensive industry to further reduce its carbon footprint.

As regards other initiatives, the 2016 Northern Seas Memorandum of Understanding was signed promoting the integration of offshore wind and enhanced interconnection. In 2017 work has begun towards a regionally optimised offshore energy system at least cost, creating jobs and growth, and harnessing the EU's industrial leadership in this field. In order to ensure concrete progress, it was agreed to focus on innovative projects that create synergies between different elements in the energy system, notably by combining renewable generation and transmission. Public and private stakeholders will work together to establish a legal and regulatory framework that is conducive to the development of such projects, and to facilitate cooperation and coordination between project developers. Four clusters have been identified, including Belgium-Netherlands-United Kingdom (European Commission, 2014).

Energy ministers from the North Sea countries have agreed to extend the Political Declaration of North Seas Countries Energy Cooperation and intensify their collaboration on offshore wind at a ministerial meeting in Esbjerg, Denmark on 20 June 2019. It also outlined four priorities for the future of offshore wind production. Firstly, access to sites should be cross-border and there should be a more standardised approach to planning. The development of transmission assets should be opened to develop and optimise grids. Further coordination between new lines from offshore wind to the onshore grid is needed. Finally, technical standards, including with international initiatives projects, should be aligned to reduce costs. European wind industry said that if these are implemented, the development of 450GW of offshore wind power by 2050 is "feasible" (Unwin, 2019).

Germany's electricity networks are still slow to adapt to higher shares of renewables, and there has not been enough investment in transmission and distribution grids. The switch from centralised to decentralised energy generation entails significant investment opportunities and is fundamentally reshaping the German energy market. Significant investments are needed to make the electrical system more flexible in the light of this decentralisation trend, e.g. in electricity storage, the production of low-carbon fuels and green technologies. The lack of appropriate grid infrastructure is causing financial losses to Germany and other EU countries in terms of congestion management. Efforts are being made to improve internal networks, but the need for investment in additional transmission capacity is likely to grow even further. The inadequate transmission capacity of Germany's north-south electricity lines strains the grid capacity of neighbouring countries[43]. Efforts are under way to improve internal networks,

[42] For more information on the Gas regional groups, see: https://ec.europa.eu/energy/topics/infrastructure/projects-common-interest/regional-groups-and-their-role-pci-process/gas-regional-groups_en?redir=1.

[43] However, the issue is most urgent in Germany, where less than 10% of the planned grid extension within the country (just 750 km out of 7 900 km) had been completed by the end of 2017. Germany's under-developed grid results in loop flows of energy with neighbouring countries when the German network cannot cope with excess power transfers. For example, when wind parks in the north of Germany generate excess power, the grid is at times unable to carry all electricity to the south of the country and Austria, where the main demand is located. Electricity must be re-routed through Poland, the Czech Republic and Slovakia. As a consequence, in 2017 the Polish grid received over eight times more electricity than planned from Germany,

but the need for investment in additional transmission capacity is likely to grow still further and are expected to reach EUR 32-34 billion by 2030. By 2030, there will be more capacity from renewable energy sources, and old power plants are expected to be closed. If the grid extension lacks financial support or timely implementation, this will lead to higher costs related to congestion management and further distortions in market functioning, both inside Germany and in cross-border trade.

The Integrated Single Electricity Market (I-SEM) between Ireland and Northern Ireland went live in October 2018. The I-SEM is key to a real all-island market in line with EU market rules[44]. By ensuring efficient energy flows, it should lead to greater security of supply and affordable electricity. So far, it is functioning well, with high volumes traded in the day-ahead market. The balancing market is being monitored closely as it has witnessed high price volatility. For the first time since electricity and gas market price deregulation, the market share of incumbent suppliers is below 50%. Yet electricity and gas prices remain high and above EU average, putting strain on consumers. The electricity smart metering roll-out begun in 2019, aimed to enable consumers to adapt their electricity use to price signals and benefit from energy efficiency schemes. New services will require a regulatory framework for new market actors and the management of energy data.

The JRC database of smart grid R&D and demonstration projects includes 950 projects from the EU-28, totalling around EUR 5 billion of investment. The domains with highest investment are smart network management, demand-side management and integration of distributed generation and storage, together accounting for around 80% of the total investment. Many projects however address several domains at the same time to investigate and test the systemic integration of different solutions (Gangale et al., 2017).

Further integration of the electricity, gas, heat and transport sectors, including through power to hydrogen and synthetic gas, and hybrid technologies for transport and heating, could be a game-changer. As electricity is only one part of the energy system, the emerging smart energy systems approach emphasises the need to look across sectors to identify synergies and cost-effective energy storage options as well as energy efficiency and energy savings options.

In such integrated energy system technologies (most of them already commercially available) are used to ensure a high flexibility both on the energy supply and demand side using the grids and storage available in the system across sectors (thermal storage, gas storage and electricity storage). A high accommodation of renewable energy can be achieved in such systems without batteries or electricity storage (Commission Expert Group, 2017).

2.1.6 Promoting energy efficiency measures

The section on promoting energy efficiency measures focuses on energy efficiency, energy intensity and energy poverty.

despite the fact that the Polish authorities often reduced the German power flows. European Court of Auditors, ECA Special Report 8/2019, Wind and solar power for electricity generation: significant action needed if EU targets to be met, 2019.

[44] For more information about the electricity market design, see: https://ec.europa.eu/energy/topics/markets-and-consumers/market-legislation/electricity-market-design_en.

2.1.6.1 Energy efficiency

The EU has committed itself to a clean energy transition, which will contribute to fulfilling the goals of the Paris Agreement on climate change and provide clean energy to all. To deliver on this commitment, the EU has set binding climate and energy targets for 2030 including increasing energy efficiency by at least 32.5% (European Parliament and the Council of the European Union, 2018).

These targets are expressed in primary and/or final energy consumption and are relative to projected levels of primary energy consumption in 2030 of 1 887 Mtoe and final energy consumption of 1 416 Mtoe. A 32.5% reduction therefore results in 1 273 Mtoe and 956 Mtoe in 2030, respectively. Member States are requested to set indicative targets. Member States shall express their contribution in terms of the absolute level of primary energy consumption and final energy consumption in 2020, and in terms of the absolute level of primary energy consumption and final energy consumption in 2030, with an indicative trajectory for that contribution from 2021 onwards.

In Belgium, for energy efficiency, the 2030 national contribution defined in the draft NECP is set on the basis of the projections of the scenario with additional measures at a level of 39 Mtoe in primary energy consumption and 33.1 Mtoe in final energy consumption in 2030. This can be seen as a low level of ambition (European Commission, 2020a).

Since 2005, France has decreased its primary energy consumption by 13% to reach 239.5 million tons of oil equivalent (Mtoe) in 2017 and its final energy consumption also decreased by 43% to reach 148.7 Mtoe in 2017, whereas the GDP increased by 15.2% over the same period. These figures - together with the primary energy intensity which decreased by a 1.8% annual average rate since 2005 – reflect the general decoupling between economic growth and energy consumption. Based on the assessment made by the European Commission of the draft NECP, as regards energy efficiency, the contribution of France is of modest ambition for primary energy consumption considering the need to increase efforts at the EU level to reach the Union's 2030 energy efficient targets collectively. France's contribution for final energy consumption is of sufficient ambition. It is expected that, if implemented, the planned policies and measures would deliver a significant reduction of energy consumption (European Commission, 2020a). High investment needs and gap mainly concern energy efficiency in buildings. The share of building stock reported to satisfy high energy efficiency standards is lower for firms in France (22%) than the EU (37%) (EIB, 2018). According to the plan for the retrofitting of residential buildings ('*Plan de rénovation énergétique des bâtiments*') adopted in 2017, 500 000 housing units should be retrofitted annually by 2020, of which 120 000 in social housing units, and 380 000 in private housing units.

While Germany has a 2050 objective for energy efficiency, the draft NECP lacks clarity on the country's energy efficiency contribution to the EU target of 32.5% in 2030. The draft plan also does not provide detailed information on the policies and measures beyond the already existing ones which will be in place until 2020 (European Commission, 2020a). Germany is not on track with the European and national indicative energy efficiency targets (European Commission, 2020a). Priority investment needs have been identified to 'promote energy efficiency measures', and in particular to promote energy efficiency in public buildings. Cohesion policy could continue to be used to renovate the existing building stock.

In the draft NECP, Ireland has set a very low contribution for energy efficiency in 2030 for final energy consumption (European Commission, 2020a). Energy consumption is expected to grow compared to

the 2020 energy efficiency target and the energy consumption level in 2017, which goes in the opposite direction of what is needed collectively by the EU. On the other hand, Ireland has proposed a comprehensive set of additional measures for energy efficiency, which equate to an approximate quadrupling of the scale of effort on home retrofits (European Commission, 2020a). Ireland has room to decouple energy use from growth and exploit the potential for energy efficiency also in transport sectors. Attracting investment and unlocking private financing into energy efficiency on the necessary scale is crucial. Market uptake of available energy efficiency solutions, technological innovation, digitalisation and up-skilling of the workforce in the energy renovation sector and promoting the multiple benefits of energy efficiency to further drive demand have the potential to drive the energy efficiency market further.

Luxembourg is currently on track to meet its energy efficiency targets for 2020. In 2017, energy consumption in Luxembourg was at 4.3 Mtoe expressed in primary energy consumption in 2016 and 4.2 Mtoe expressed in final energy consumption. In addition, Luxembourg has also set an energy savings target of 5,993 GWh to be achieved by December 31st, 2020 through a mechanism of energy efficiency obligations set up in 2015. However, the energy savings achieved up to 2017 are below 60% of what is needed, putting at risk the achievement of the target.

In the Netherlands' draft NECP, the energy efficiency contribution is set in primary energy consumption of 1950 petajoules (PJ) by 2030, which in primary energy can be considered sufficiently ambitious. However, the potential contribution on final energy consumption seems to be only of rather modest ambition, although with an estimated absolute level of final energy consumption of 49.5 Mtoe, the Netherlands has already exceeded its 2020 target (European Commission, 2020a).

The United Kingdom has already met its 2020 primary energy consumption target but remains 3.2% above its 2020 final energy consumption target. The United Kingdom has to increase its effort to cut final energy consumption by the required levels.

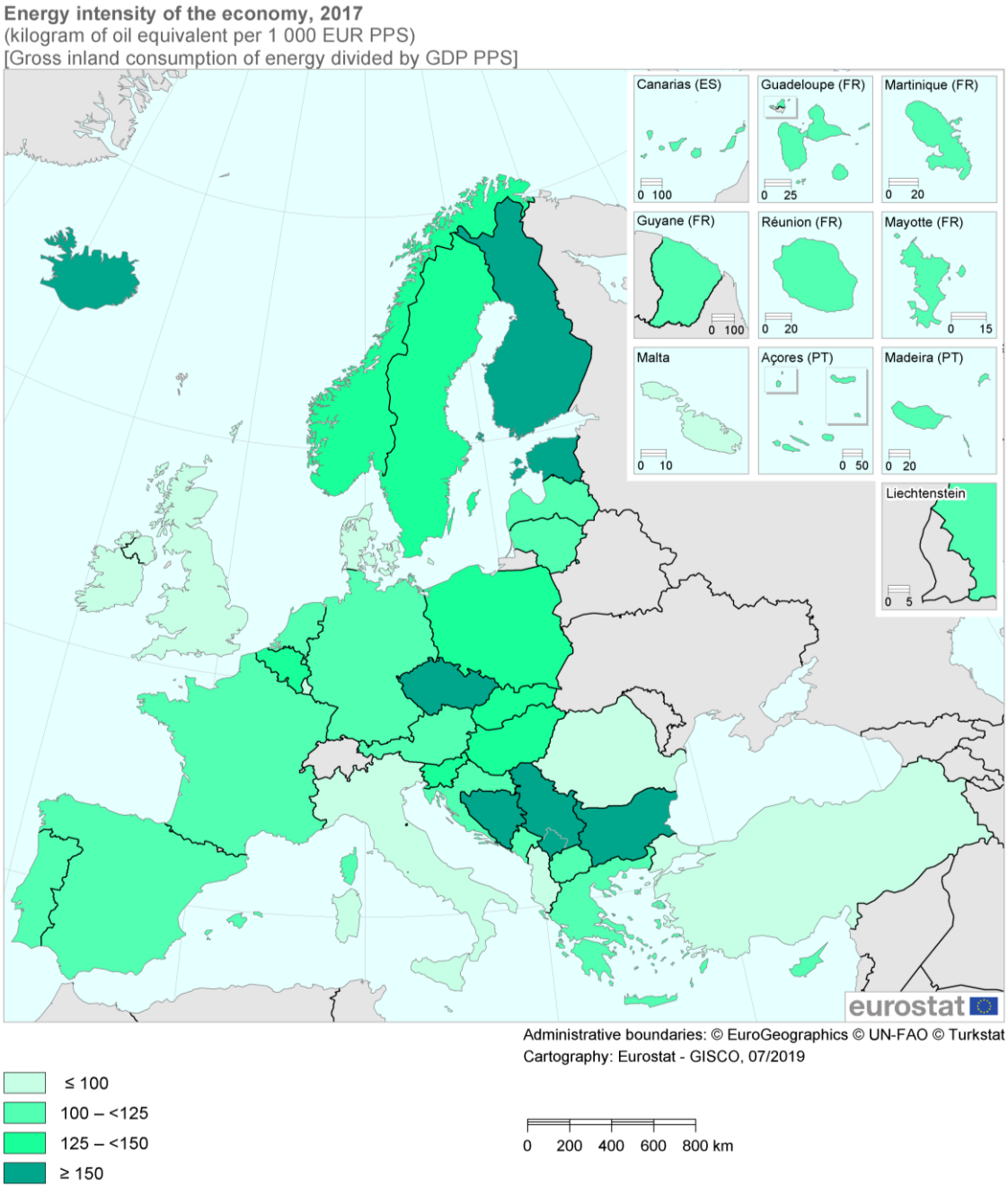
2.1.6.2 Energy intensity

Energy intensity is one of the indicators to measure the energy needs of an economy. It is often used as an approximation of energy efficiency. Many factors influence energy intensity. It reflects on structure of economy and its cycle, general standards of living and weather conditions in the reference area. Energy intensity is calculated as units of energy per unit of GDP.

Historically, economic growth led to higher energy consumption, thus increasing the pressure exerted by energy production and consumption on the environment. The energy intensity indicator identifies to what extent there is decoupling between energy consumption and economic growth. Relative decoupling occurs when energy consumption grows, albeit more slowly than the economy (i.e. GDP). Absolute decoupling occurs when energy consumption is stable or falls while GDP grows. Absolute decoupling is likely to alleviate the environmental pressures from energy production and consumption. The decoupling may result from reducing the demand for energy services (e.g. heating, lighting and passenger or freight transport) by using energy in a more efficient way (thereby using less energy per unit of economic output) or a combination of the two. From an environmental point of view, overall impacts depend on the total amount of energy consumption, and the fuels and technology used to generate the energy.

As illustrated in Map 2-10, the NWE countries are characterised by a level of energy intensity which is high in Belgium, moderate in France, Germany and The Netherlands, and very low in Ireland, Luxembourg and in the United Kingdom.

Map 2-10 Energy intensity of the economy, 2017



Source of data: Energy data are from Eurostat's dataset nrg_bal_s and GDP data are from Eurostat's dataset nama_10_gdp, 2020

Investments in energy efficiency are able, in most cases, to support citizens in the reduction of energy bills, lowering their dependence on external suppliers, as well as to decrease the environmental impact

from energy consumption. Although a variety of solutions are already available in the market, energy efficient technologies still require an extra push from cooperation initiatives in order to distribute their benefits around North-West Europe at costs that fit the citizens' pockets.

2.1.6.3 Energy poverty

The North-West Europe area is considered as one of the most dynamic and prosperous areas of the European Union, however households from some regions still face severe difficulties in affording their energy bills or suffer from a lack of adequate energy services at home. Generated in many cases by low energy performances in buildings, energy poverty is a common challenge to almost all urban areas of NWE, as 80% of the residential housing stock dates from pre 1990's.

As regards the access to affordable energy, Table 2-7 shows the share of population in the NWE countries being unable to keep home adequately warm. This is well below the EU-27 (7.6%) and EU-28 (7.3%) average. This indicator ranges from 5.4% in the United Kingdom and 5.2% in Belgium to 2.2% in the Netherlands and 2.1% in Luxembourg[45].

Table 2-7 Share of population unable to keep home adequately warm - EU-SILC survey, 2018

Country	2018
EU27_2020	**7.6**
EU_28	**7.3**
Belgium	5.2
Germany	2.7
Ireland	4.4
France	5.0
Luxembourg	2.1
the Netherlands	2.2
United Kingdom	5.4

Source: Eurostat, code ilc_mdes01, 2020

2.2 Climate change adaptation, risk prevention and disaster resilience

Reflecting the importance of tackling climate change in line with the Union's commitments to implement the Paris Agreement and the United Nations Sustainable Development Goals, the Funds will contribute to mainstream climate actions and to the achievement of an overall target of 25% of the EU budget expenditure supporting climate objectives (COM(2018) 375 final, 2018). Operations under the ERDF are expected to contribute 30% of the overall financial envelope of the ERDF to climate objectives.

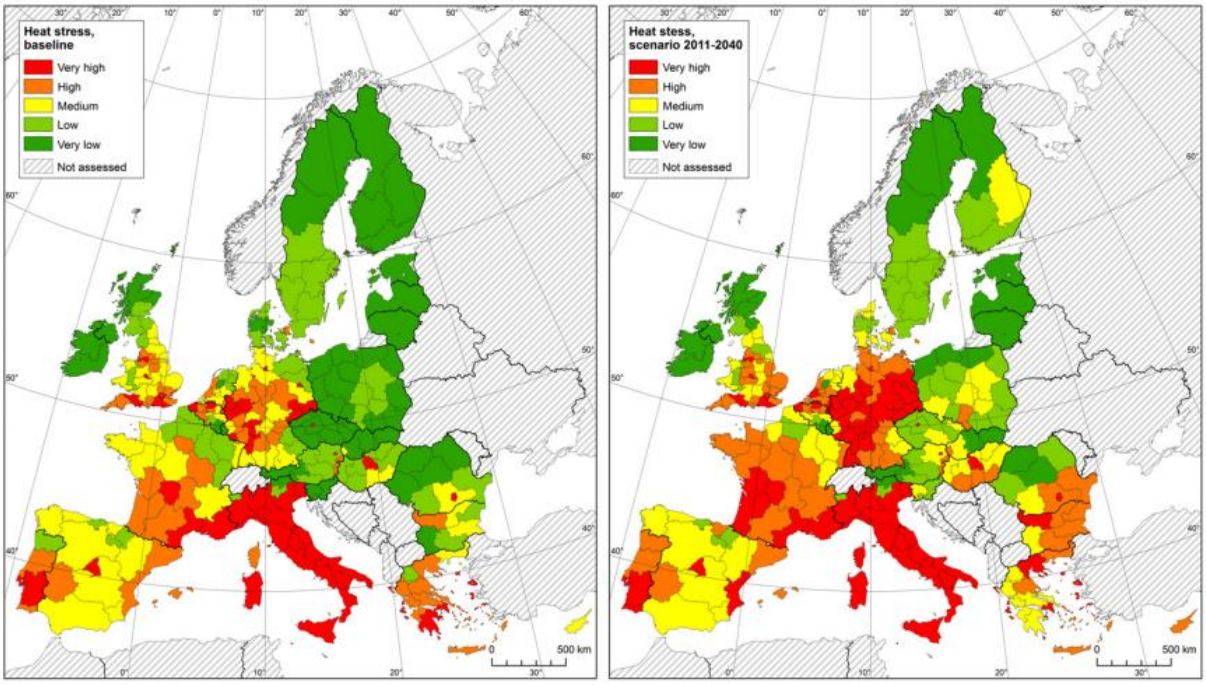
2.2.1 Heat stress

The spatial distribution of the heat stress indicator for the baseline period shows the highest potential impact for major parts of Germany with almost all NUTS 2 regions classified as high or very high, parts of Belgium, and Southern United Kingdom. A distinctive pattern is seen for highly urbanised regions, such as Amsterdam, Brussels, and London, which stand out as (very) high impact regions in relation to

[45] https://ec.europa.eu/eurostat/web/products-datasets/product?code=ilc_mdes01

their neighbouring regions. For the 2011–2040 scenario heat stress is projected to further increase, particularly in Germany, France and the Netherlands (Map 2-11) (Lung, Tobias et al., 2013).

Map 2-11 Heat stress – baseline and development scenario, 2011-2040

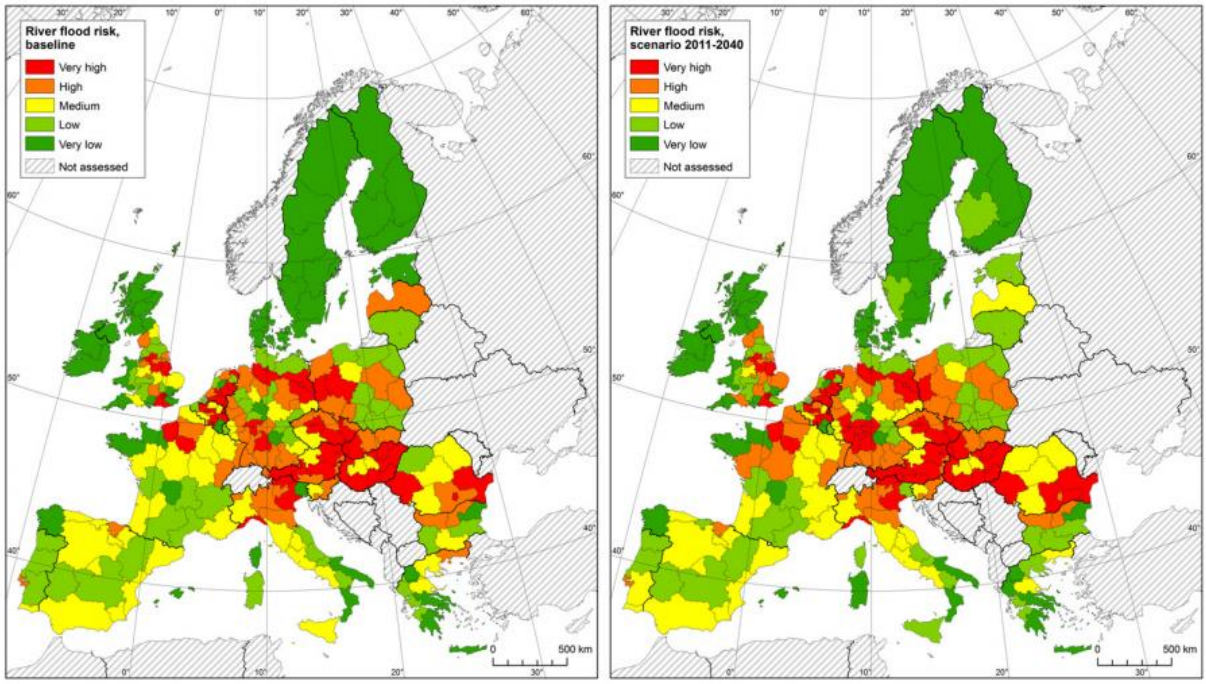


Source: (Lung, Tobias et al., 2013)

2.2.2 Flooding

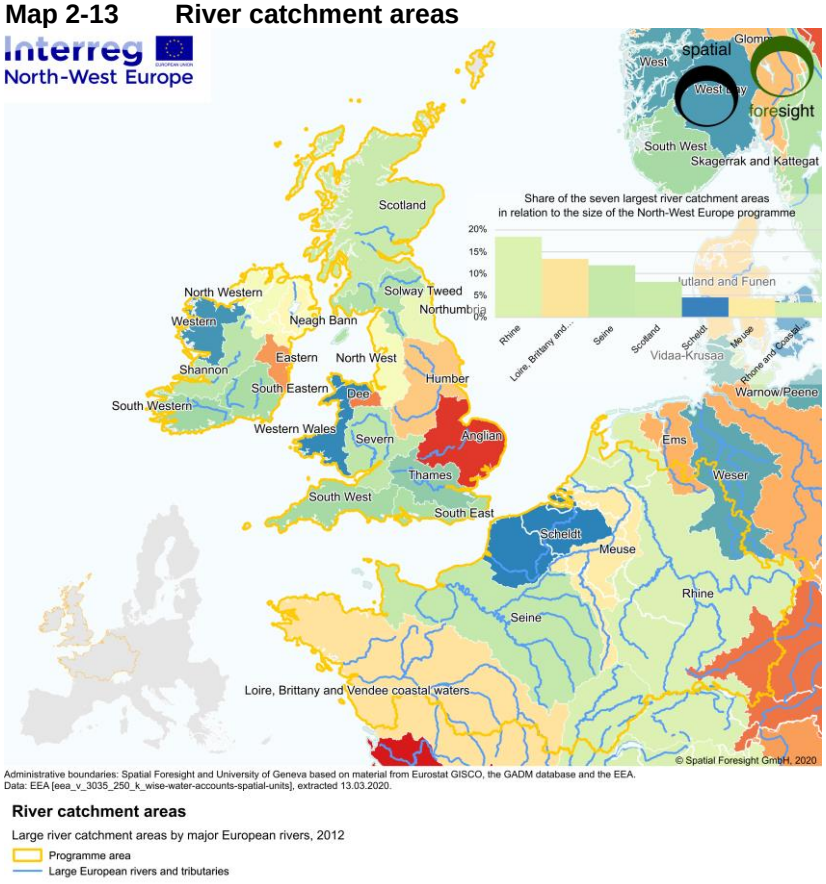
Baseline river flood risk baseline and development scenario (Map 2-12) reveals a rather homogeneous picture throughout North West Europe, with highest risks in the Netherlands and Belgium, in parts of England. The risk pattern reflects the interaction between human settlements and the hydro-geographical setting of Europe, that is the major river catchment areas (see Map 2-13), with clusters of high or very high risk found e.g. along the course of the Scheldt in France, Belgium and the Netherlands, the Moselle in Luxembourg, France and Germany, and the regions along the Rhine from south-western Germany to the Netherlands. A generally slight increase in flood risk is seen for a number of regions in northern and western France. (Vandecasteele, Ine and Lavalle, Carlo, 2015, Lung, Tobias et al., 2013))

Map 2-12 River flood risk – baseline and development scenario, 2011-2040



Source: (Lung, Tobias et al., 2013)

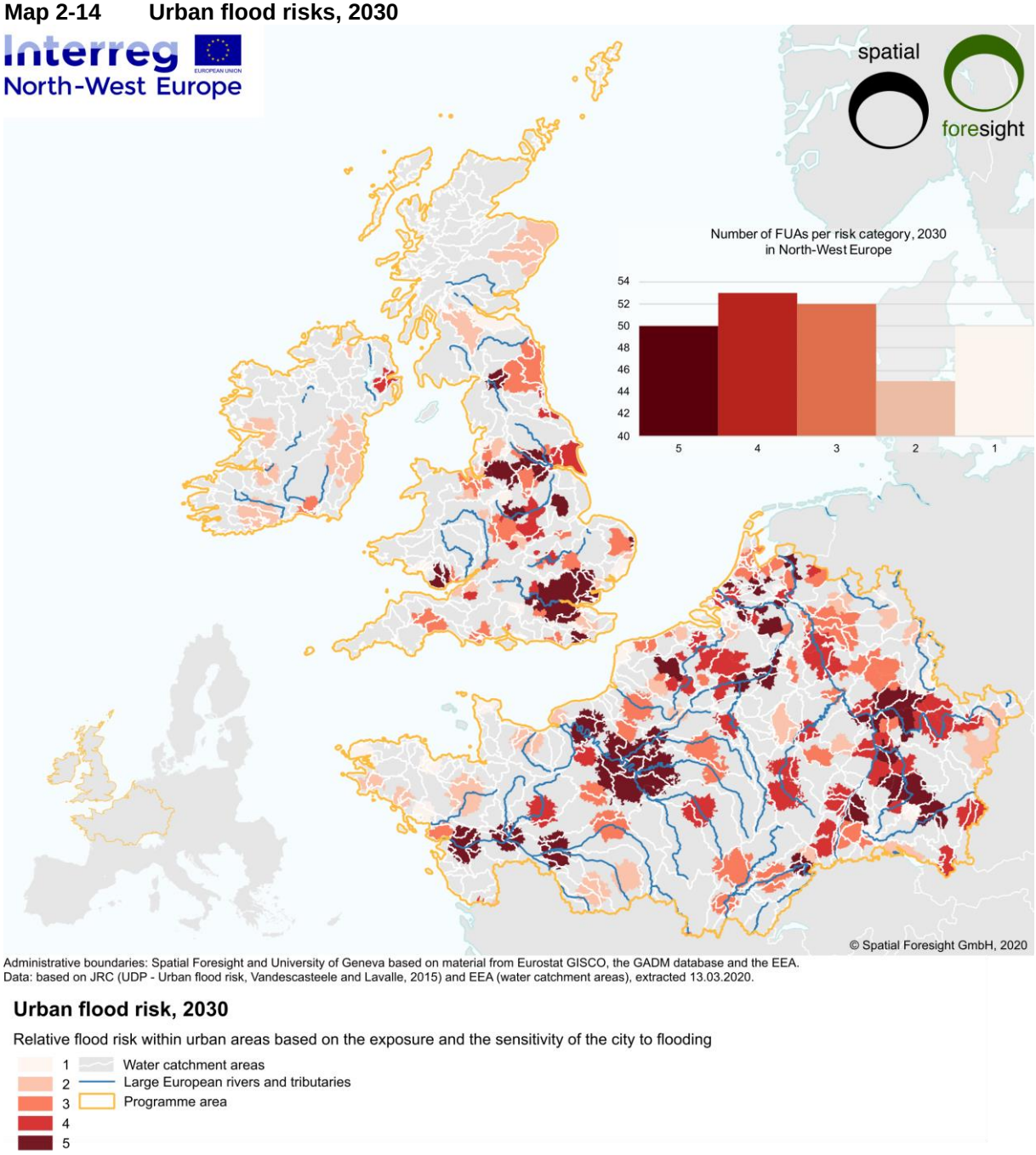
Map 2-13 River catchment areas



Source: own presentation, 2020

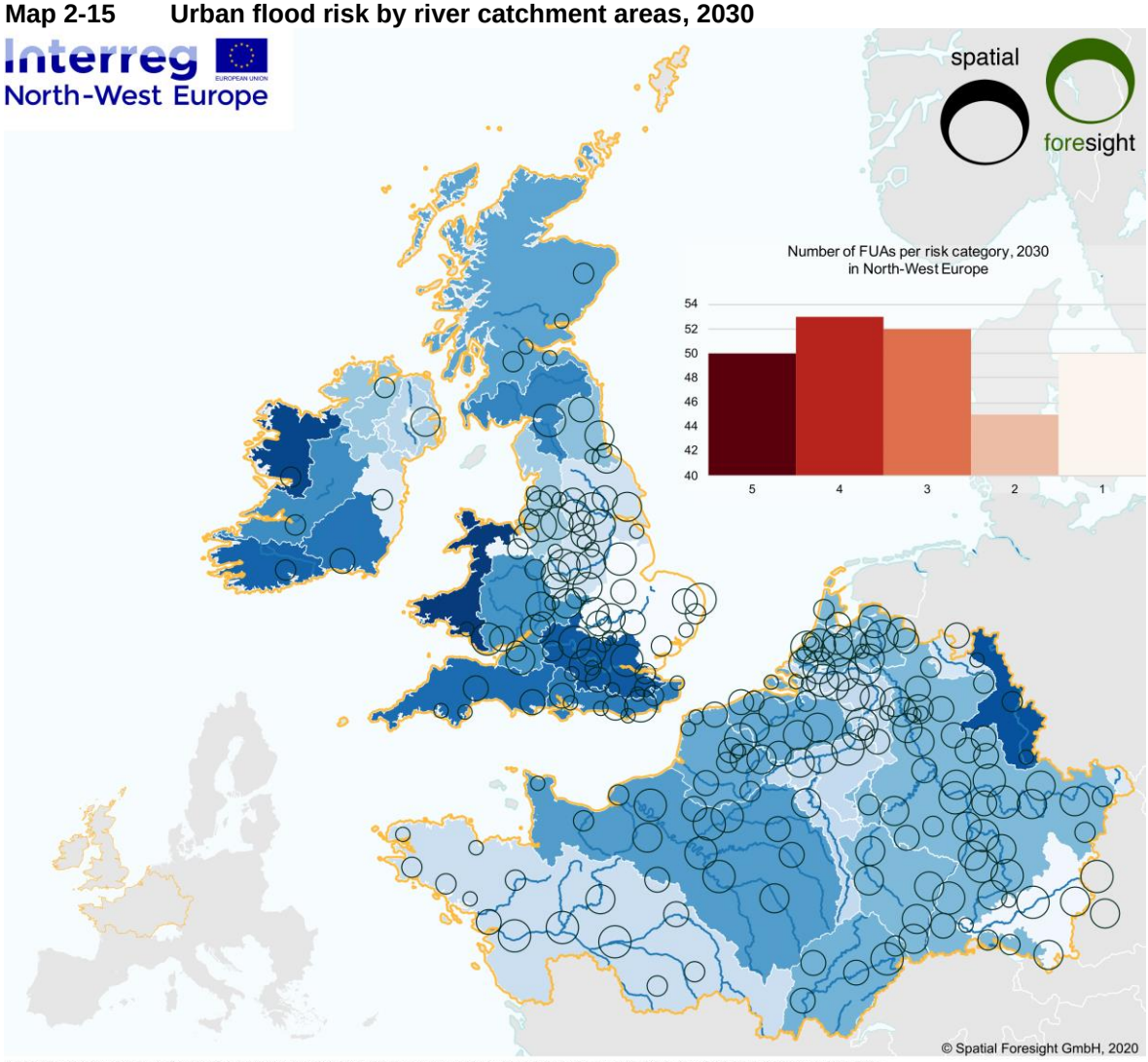
Map 2-14 illustrates the relative flood risk within urban areas based on the exposure and the sensitivity of the city to flooding. This is particularly relevant for the urban areas of Paris and London, but also other cities in Germany, Belgium, the Netherlands and France. Nine functional urban areas have the highest urban flood risk, mainly those around the river catchment areas. Map 2-15 specifically shows the urban flood risk per by river catchment areas by 2030.

Map 2-14 Urban flood risks, 2030



Source: own presentation, 2020

Map 2-15 Urban flood risk by river catchment areas, 2030



Administrative boundaries: Spatial Foresight and University of Geneva based on material from Eurostat GISCO, the GADM database and the EEA.
Data: based on JRC (UDP - Urban flood risk, Vandescasteele and Lavalle, 2015) and EEA (water catchment areas), extracted 13.03.2020.

Urban flood risk, 2030

Relative flood risk within urban areas based on the exposure and the sensitivity of the FUA to flooding

1 2 3 4 5

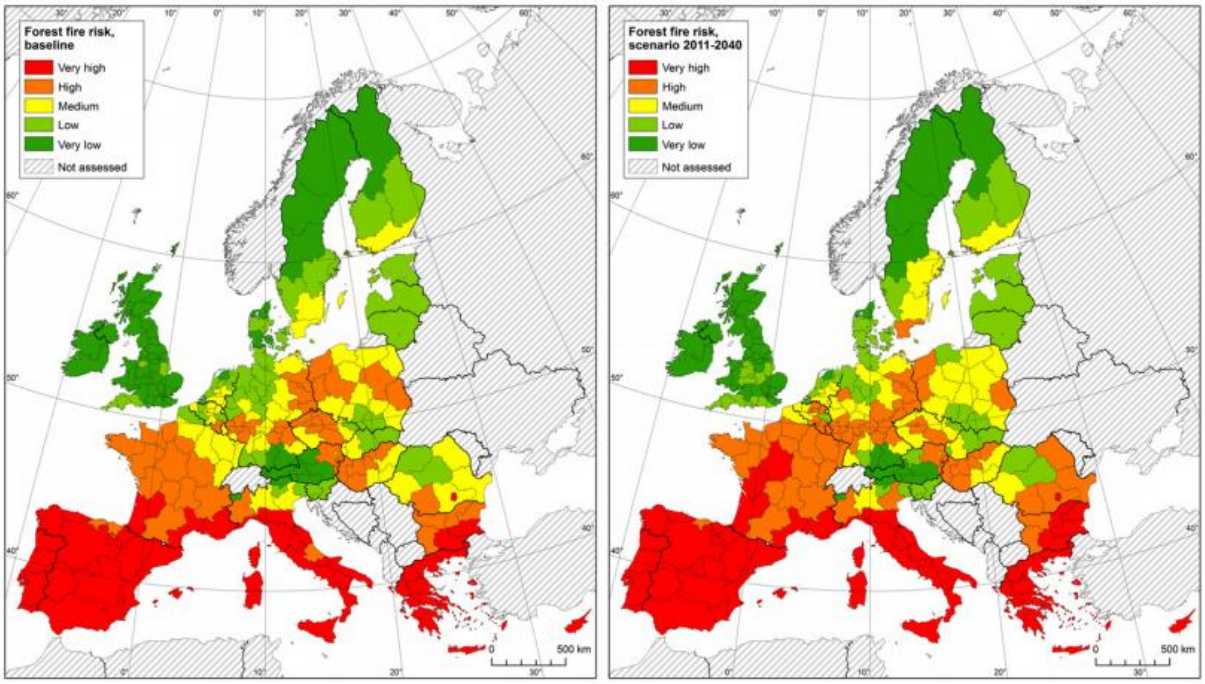
River catchment area
Large European rivers and tributaries
Programme area

Source: own presentation, 2020

2.2.3 Forest fire

With regards to forest fire, the NWE area appears to be mostly at very low or low risk. Notable exceptions of high risk areas are in Belgium (Brussels Capital Region and Wallonia), Germany (Trier, Koblenz, Saarland, and Rheinland Pfalz) and France (Haute Normandie, Basse Normandie, Bretagne, Pays de la Loire, Centre, Ile de France, and Bourgogne), whose sensitivity shows signs of worsening and expansion in the medium-term scenario (Map 2-16). (Lung, Tobias et al., 2013)

Map 2-16 Forest fire risks – baseline and development scenario, 2011-2040



Source: (Lung, Tobias et al., 2013)

2.2.4 Main impacts of extreme weather and climate related events

The impacts of extreme weather and climate related events has been quite important in the NWE countries. The average loss per capita amounts to almost EUR 1,000, with Luxembourg and Germany being the most affected countries, and Germany, Luxembourg, the United Kingdom and the Netherlands having suffered the greatest loss per square km, as shown in Table 2-8.

Table 2-8 Impacts of extreme weather and climate related events in the NWE member countries (1980-2017)

Country	Losses (million Euro)	Loss per capita (Euro)	Loss per sq.km (Euro)	Fatalities
Belgium	4,308	415	141,125	2,168
France	62,059	1,026	98,011	23,415
Germany	96,494	1,271	270,008	9,856
Ireland	4,014	1,017	57,515	69
Luxembourg	718	1,627	277,817	130
Netherlands	8,111	517	195,240	1,729
United Kingdom	50,504	848	203,208	3,535
Total NWE	225,490	960		40,902

Source: EEA, https://www.eea.europa.eu/data-and-maps/daviz/impacts-of-extreme-weather-and-1#tab-chart_2, 2020

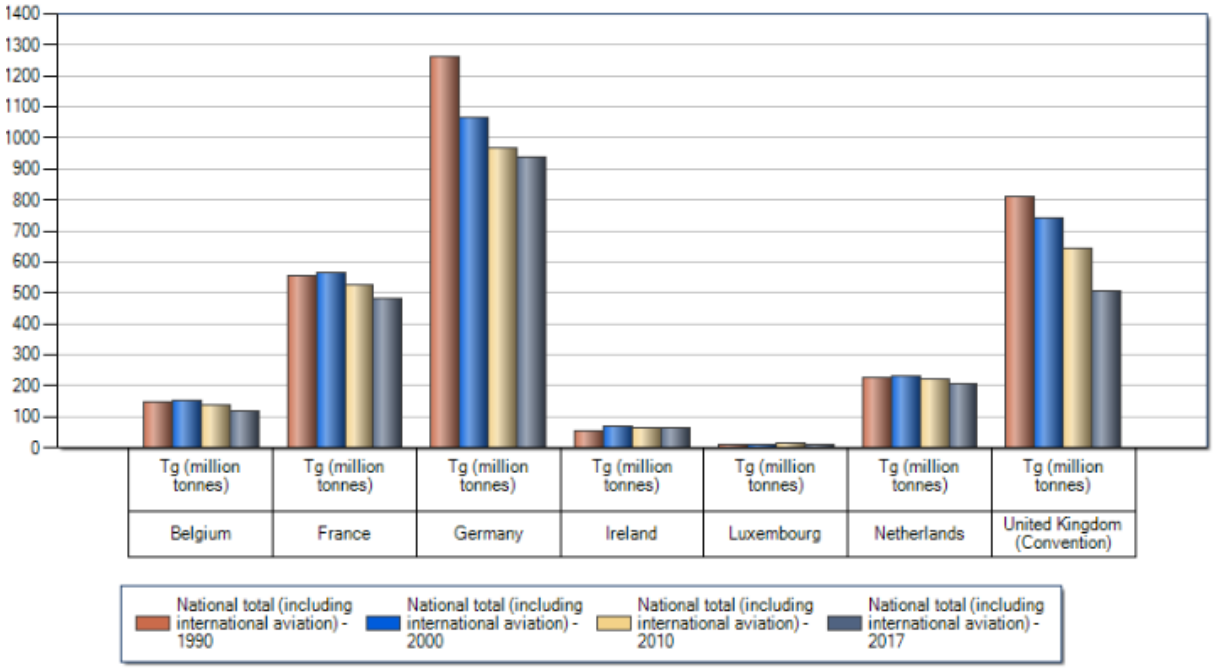
2.3 Greenhouse emissions and air quality

The section on greenhouse emissions and air quality focuses on the topics of greenhouse gas emissions and air quality.

2.3.1 Greenhouse gas (GHG) emissions

The EU has committed itself to a clean energy transition, which will contribute to fulfilling the goals of the Paris Agreement on climate change and provide clean energy to all. To deliver on this commitment, the EU has set binding climate and energy targets for 2030 including reducing greenhouse gas emissions by at least 40% (European Commission, 2014).

Figure 2-2 Evolution of greenhouse gas emissions by NWE country (1990, 2000, 2010, 2017)



Data source: National emissions sent to UNFCCC and to the EU Greenhouse Gas Monitoring Mechanism, https://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer.

Source: EEA, 2020.

Belgium's 2030 target for greenhouse gas (GHG) emissions not covered by the EU Emissions Trading System (non-ETS), is -35% compared to 2005, as set in the Effort Sharing Regulation (ESR) (European Parliament and European Council, 2018b). Adopted policies would lead to 13% reductions and the draft National Energy and Climate Plan (NECP) 2021-2030 aims at achieving the -35% target domestically (European Commission, 2020a).

France's 2030 target for greenhouse gas (GHG) emissions not covered by the EU Emissions Trading System (non-ETS), is -36% compared to 2005, as set in the ESR. France has set itself a target of being carbon neutral by 2050 and presents a trajectory towards this target. If France follows this trajectory, it may overachieve its 2030 non-ETS target by 4%. This would require implementation of additional policies that keep emissions within the carbon budgets proposed in the National Low-Carbon Strategy, from 2019 onwards. These additional policies are not yet clearly defined. With existing policies and measures only, France projects to fall short of its 2030 non-ETS target by 11%. France is the 7th lowest EU country in terms of greenhouse gas emission per capita. However, with 482 million tons of CO_2 equivalent in 2017, France is the third emitter of CO_2 in absolute terms. The building sector is the second largest emitter of greenhouse gas emissions after transport (respectively 23% and 40% of national

emissions) (European Commission, 2020a). The NUTS3 regions with the highest greenhouse gas emission intensities are Bouches-du-Rhône in region Provence-Alpes-Côte d'Azur (energy, chemical and steel industry) and Nord in Hauts-de-France (steel industry). These industrial sectors are an important source of employment in the two regions as they provide for more than 150,000 jobs. Given the likely socioeconomic impact of the transition, the Just Transition Fund could focus its intervention on these regions. In both cases, the support should promote economic diversification and reskilling and increase the attractiveness of the regions for investments in line with the corresponding RIS3, which identify the sectors and activities with most potential.

Germany's 2030 target for greenhouse gas (GHG) emissions not covered by the EU Emissions Trading System (non-ETS) is -38% compared to 2005, as set in the ESR. With the existing policies and measures outlined in the draft NECP Germany is not on track to achieve this target (European Commission, 2020a). In particular, the transport sector and agriculture have done particularly badly at cutting emissions of both greenhouse gases and local air pollutants.

Ireland is falling further behind in decarbonising its economy and engaging on a path of sustainable development. Greenhouse gas emissions are steadily rising, with particularly severe challenges in transport, agriculture, energy and the built environment. The lack of progress will make the challenge of meeting Ireland's EU obligations that more difficult. There are no signs yet that a reversal in trend is to be expected. On the basis of existing measures, Ireland is projected to keep emissions stable in sectors outside of the EU emissions trading system (non-ETS sectors) by 2020 (compared to 2005 levels), while its target is -20%. By 2030, Ireland is still not projected to reduce emissions in non-ETS sectors, compared with the target of-30%. With the transport, building and agriculture policies set out in the draft NECP Ireland projects to miss this target by at least 17.5 percentage points (European Commission, 2020a).

Compliance with EU commitments will become increasingly challenging and could become costly. The lack of early action means that Ireland will need to use all the flexibilities under the Effort Sharing Decision and Effort Sharing Regulation to comply with its EU obligations. Even so, Ireland will need to purchase allocations from other Member States for the 2013-2020 compliance period. Despite allocations under the Effort Sharing Regulation being significantly higher during 2021-2025 than the 2020 target, Ireland is also expected — under current projections — to have to buy allocations from other Member States on a large scale during 2021-2030. This would likely entail a large budgetary cost.

Luxembourg is also expected to miss its 2020 greenhouse gas emission reduction targets in the sectors not covered by the emissions trading system. Luxembourg's target for greenhouse gas (GHG) emissions not covered by the EU Emissions Trading System (non-ETS), is -40% compared to 2005, as set in the ESR. Luxembourg plans to overachieve by 10 to 15 percentage points this target (European Commission, 2020a).

The Netherlands' 2030 target for greenhouse gas (GHG) emissions not covered by the EU Emissions Trading System (non-ETS) is -36% compared to 2005, asset in the ESR. The draft NECP also includes a high ambition for the national total GHG emission target of -49% by 2030 compared to 1990. The draft NECP mainly describes existing policies and measures without setting out additional policies and measures. Based on this, the binding target for 2030 under the ESR could be missed by a short margin of 4.6 Mt CO_2eq. (European Commission, 2020a). A significant reduction will be achieved through

investments in renewable energy and energy efficiency. The electricity sector, whose emissions must be reduced the most by 50%, would require additional investment of EUR 1.1 billion per year depending on the options chosen (solar power or offshore wind and scale of deployment). The industrial sector could need further investment of between EUR 0.9-1.6 billion per year depending on the scenarios - from the scaling up of recycling to a new infrastructure for carbon capture and storage to full electrification. The construction sector could make use of additional investment ranging from EUR 0.1-1.3 billion per year in insulation to reach its target of near-zero energy consumption buildings. The Dutch government also uses fiscal instruments and minimum prices for CO_2 emissions. While the tax burden on labour is being reduced, taxation in the fields of energy, environment and consumption is being increased. The government also aims to introduce a minimum price for CO_2 from electricity generation - a carbon price floor - starting at EUR 18 in 2020 and rising to EUR 43 by 2030 to supplement the price signal from the EU Emissions Trading System. Companies that produce electricity would be charged an additional levy based on the price difference between the EU allowances and the price floor. To better reflect CO_2 emissions, the energy tax on consumers will be recalibrated across energy products. The rate on natural gas will increase while the rate on electricity will fall.

The main drivers of the United Kingdom's energy and climate policy are carbon budgets – legally binding five-year emission caps, which need to be set 12 years in advance. The third, fourth and fifth budgets represent the years 2018- 2022, 2023-2027 and 2028-2032, and commit the United Kingdom to greenhouse gas emission reductions of 37%, 51% and 57%, respectively, compared to 1990. Achieving the United Kingdom's domestic target set in the fifth carbon budget, would also likely achieve the 2030 target of -37% greenhouse gas emissions compared to 2005 for sectors outside the EU Emissions Trading System (non-ETS) set under the ESR. However, it is unclear if existing and planned policies, which are only set out for the transport and buildings sectors, are sufficient to achieve the ESR target (European Commission, 2020a).

2.3.2 Air quality

Belgium is performing well with regards to air emissions. In 2017, for the selected air pollutants (NH3, NMVOC, NOx, PM2.5 and SO2) it met the current emissions ceilings of the National Emissions Ceiling Directive. However, for NO2 a percentage of the population (3.5%) was exposed to concentrations above the EU standards[46].

France is performing well with regards to air emissions. In 2017, for the selected air pollutants (NH3, NMVOC, NOx, PM2.5 and SO2) it met the current emissions ceilings of the National Emissions Ceiling Directive. However, as for the reduction of several pollutants, France gives cause for severe concern, and additional efforts are needed to attain the emission reduction commitments for NO2, O3 and PM10, as a percentage of the population was exposed to concentrations above the EU standards, respectively 2%, 6.9% and 0.4%[47].

Air quality in Germany gives serious cause for concern, as the country is still failing to meet EU air quality standards, notably for NO2 limit values. Traffic accounts for about 60% of harmful NOx emissions in urban areas, and of this 72.5% is caused by diesel vehicles. Vehicles running on alternative fuels

[46] https://www.eea.europa.eu/data-and-maps/data/aqereporting-8.
[47] https://www.eea.europa.eu/data-and-maps/data/aqereporting-8

have seen the steepest increase in new registrations, but the numbers remain far below the target value of one million electric cars by 2020 set by the government.

In 2017, Ireland met the current emissions ceilings of the National Emissions Ceiling Directive or all the selected air pollutants but for NH3. With regard to air quality, no percentage of the population was exposed to concentrations above the EU standards[48].

Luxembourg is performing well with regards to air emissions. In 2017, for all the selected air pollutants (NH3, NMVOC, NOx, PM2.5 and SO2) it met the current emissions ceilings of the National Emissions Ceiling Directive. However, with regards to air quality, for NO2 a percentage of the population (4.6%) was exposed to concentrations above the EU standards[49].

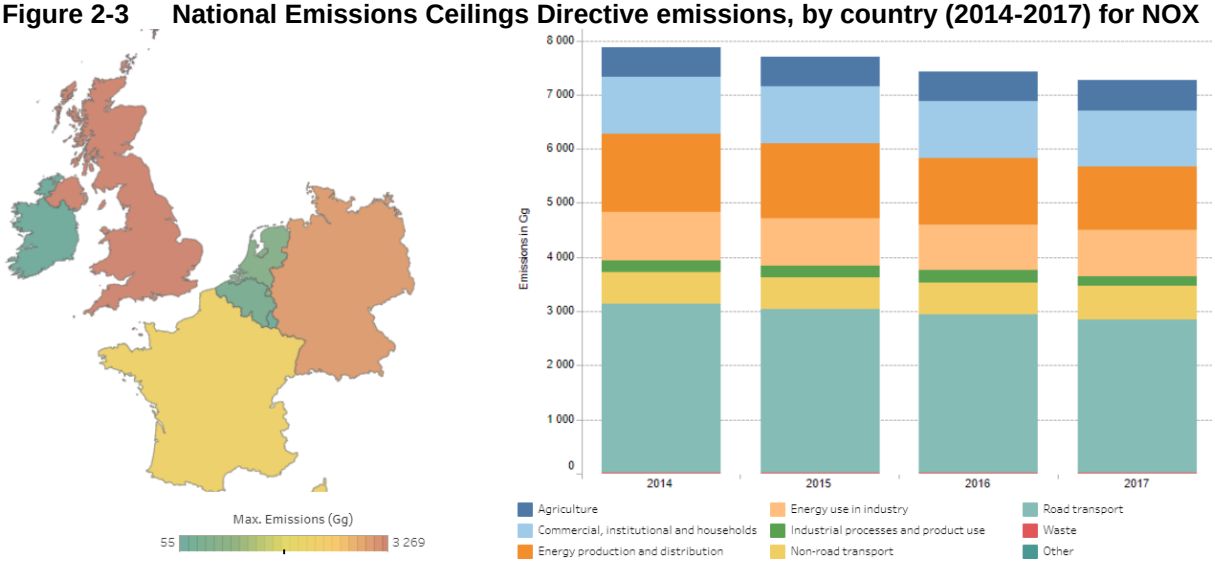
The Netherlands are underperforming with regards to air emissions. In 2017, it met the current emissions ceilings of the National Emissions Ceiling Directive for NOx, PM2.5 and SO2, but not those for NH3 and NMVOC, mainly due to emissions caused by the agriculture and industry sectors. With regards to air quality, 2% of the population was exposed to NO2 concentrations above the EU standards[50].

The United Kingdom is performing well with regards to air emissions. In 2017, for all the selected air pollutants (NH3, NMVOC, NOx, PM2.5 and SO2) it met the current emissions ceilings of the National Emissions Ceiling Directive. However, with regards to air quality, for NO2 a percentage of the population (6.5%) was exposed to concentrations above the EU standards[51].

In 2018, the Commission decided to refer France, Germany and the United Kingdom to the Court of Justice of the EU for failure to respect limit values for nitrogen dioxide (NO_2), and for failing to take appropriate measures to keep exceedance periods as short as possible. The zones located in the NWE area where annual concentrations were exceeded include Köln and Stuttgart (Germany), Paris (France); London, Birmingham, Leeds, and Glasgow (United Kingdom). Figure 2-3 - Figure 2-7how the national emissions ceilings for 6 different air pollutants.

[48] ibid
[49] ibid
[50] ibid
[51] ibid

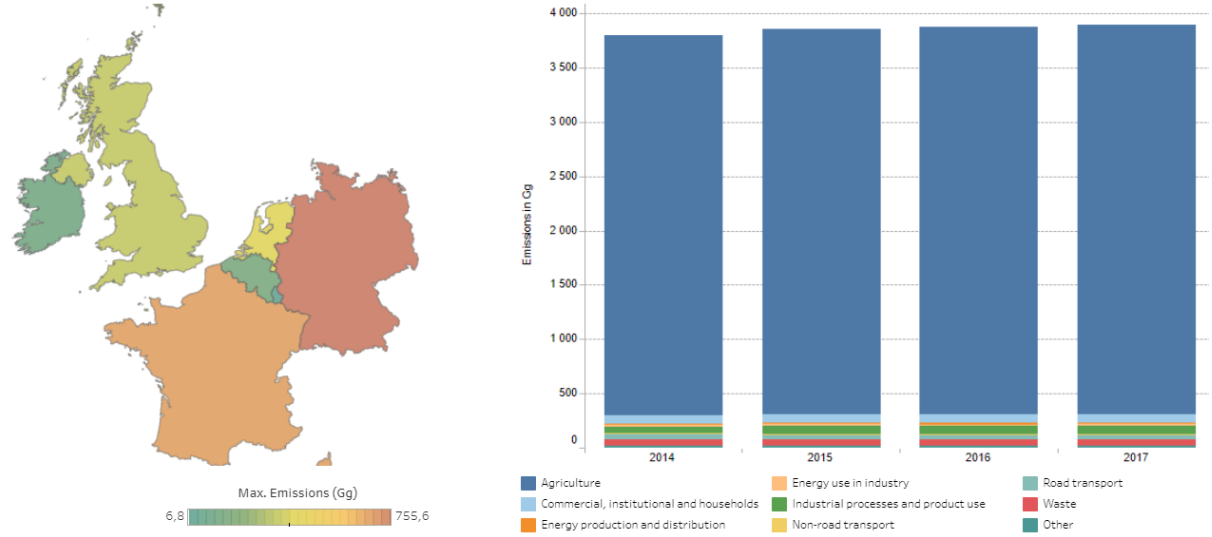
Figure 2-3 National Emissions Ceilings Directive emissions, by country (2014-2017) for NOX



Source: EEA, data viewer 1990-2017, (2020).

Source of data: National Emission Ceilings Directive emissions inventory data.

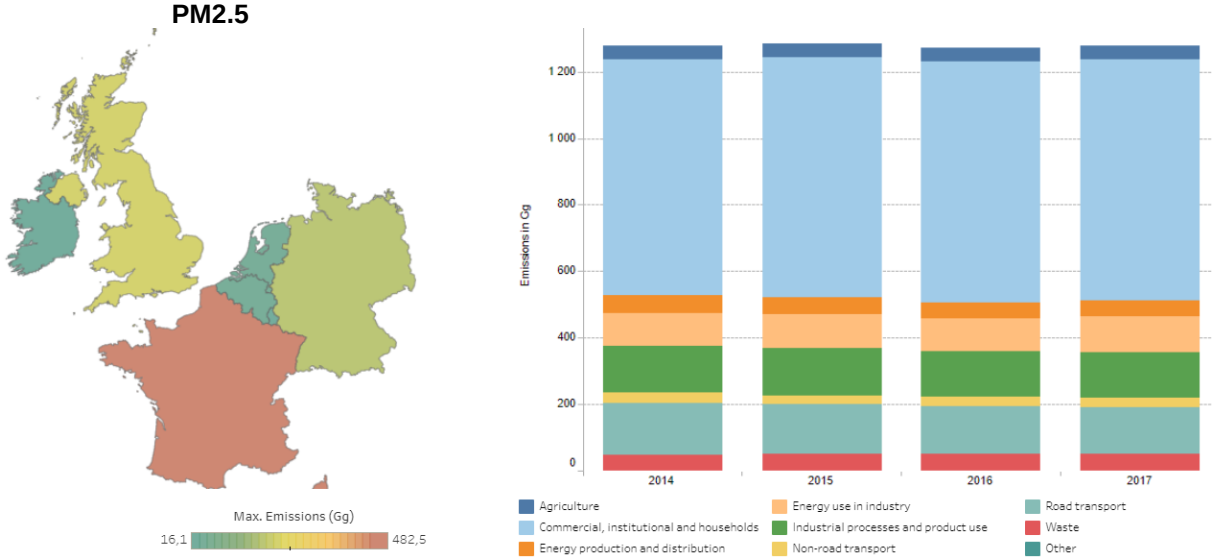
Figure 2-4 National Emissions Ceilings Directive emissions, by country (2014-2017) for NH3



Source: EEA, data viewer 1990-2017, (2020).

Source of data: National Emission Ceilings Directive emissions inventory data

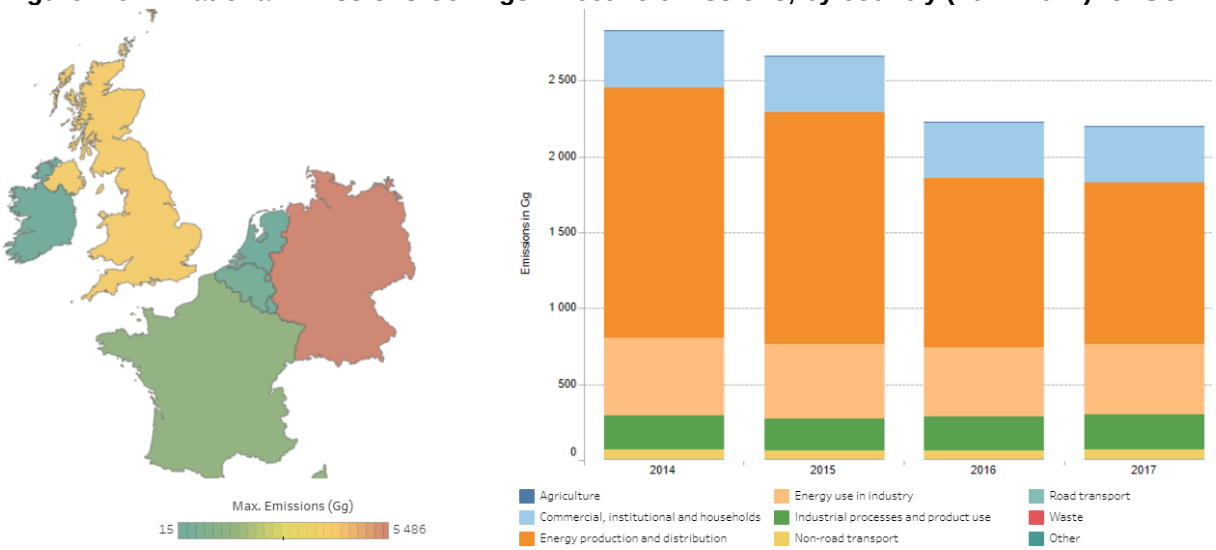
Figure 2-5 National Emissions Ceilings Directive emissions, by country (2014-2017) for PM2.5



Source: EEA, data viewer 1990-2017, (2020).

Source of data: National Emission Ceilings Directive emissions inventory data

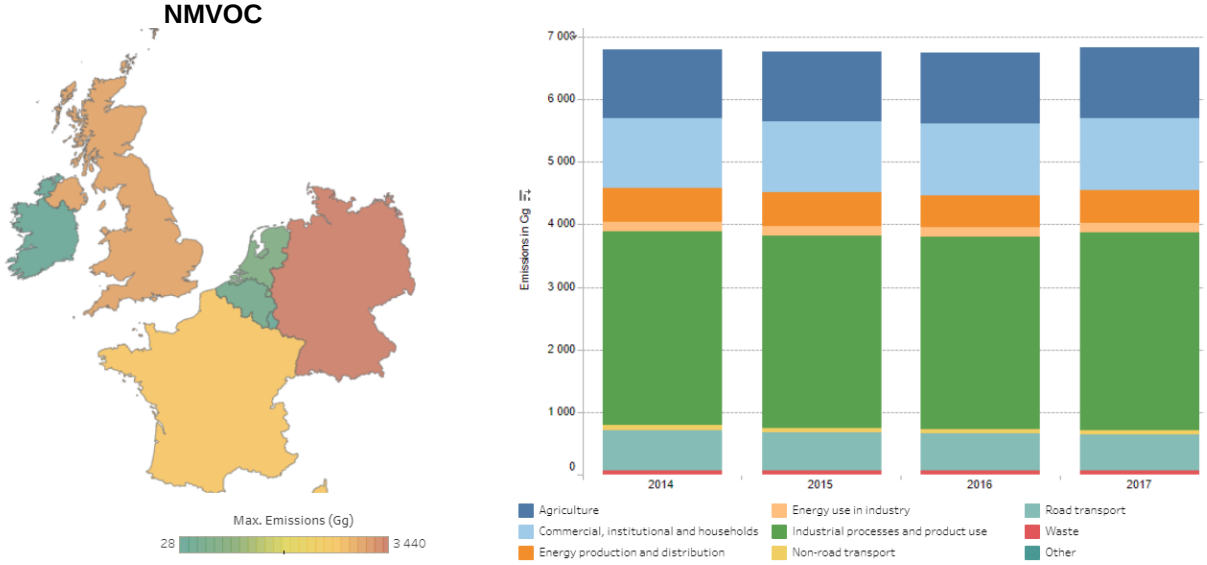
Figure 2-6 National Emissions Ceilings Directive emissions, by country (2014-2017) for SO2



Source: EEA, data viewer 1990-2017, (2020).

Source of data: National Emission Ceilings Directive emissions inventory data.

Figure 2-7 National Emissions Ceilings Directive emissions, by country (2014-2017) for NMVOC



Source: EEA, data viewer 1990-2017, (2020).

Source of data: National Emission Ceilings Directive emissions inventory data

2.4 Green infrastructure in urban environment and reduced pollution

Developing green infrastructure is a key step towards the success of the EU 2020 Biodiversity Strategy (European Comission, 2011). The Strategy's target 2 requires that 'by 2020, ecosystems and their services are maintained and enhanced by establishing green infrastructure and restoring at least 15% of degraded ecosystems'. According to the latest EEA SOER (EEA, 2019), although Natura 2000 areas and other protected areas with national designations have a positive effect on ecosystem condition and biodiversity in surrounding areas, pressures remain high and the conservation measures undertaken are still insufficient. To achieve this target, it seems therefore important that green infrastructure (GI) is integrated into key policy areas, improving the knowledge base and encouraging innovation in relation to GI, improving access to finance including supporting EU-level GI projects.

A Green Infrastructure (GI) can, be defined as a "strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas. On land, GI is present in rural and urban settings" (European Commission, 2013b). This definition embraces three aspects that are important for effectively implementing GI into sectoral policies: (i) connectivity, i.e. the idea of a network of geographical areas; (ii) the concept of multifunctionality, i.e. the idea that the same geographical area can be used for several purposes/activities and, at the same time, supply multiple (ES); and (iii) the links to spatial planning and management.

GI relates to the identification and mapping of ecological networks. Two primary components of ecological networks are hubs and links. Hubs are areas of natural vegetation, other open space, or areas of known ecological value, and links are the corridors that connect the hubs to each other. A set of hubs connected by links constitutes a network that can be used to inform conservation and other related land-use decisions.

A GI consists of ecological networks, made up of areas of natural vegetation, other open space, or areas of known ecological value, and links that connect these areas to one another. GI solutions are particularly important in urban environments in which approximately 70% of the EU population lives. In cities, GI features like green walls and roofs, urban woodlands and garden allotments deliver health-related benefits such as clean air and better water quality. GI also creates opportunities to connect urban and rural areas and provides appealing places to live and work in. Furthermore, the restoration of land in cities can be a cost-effective and economically viable way of making them more sustainable, resilient, greener and healthier.

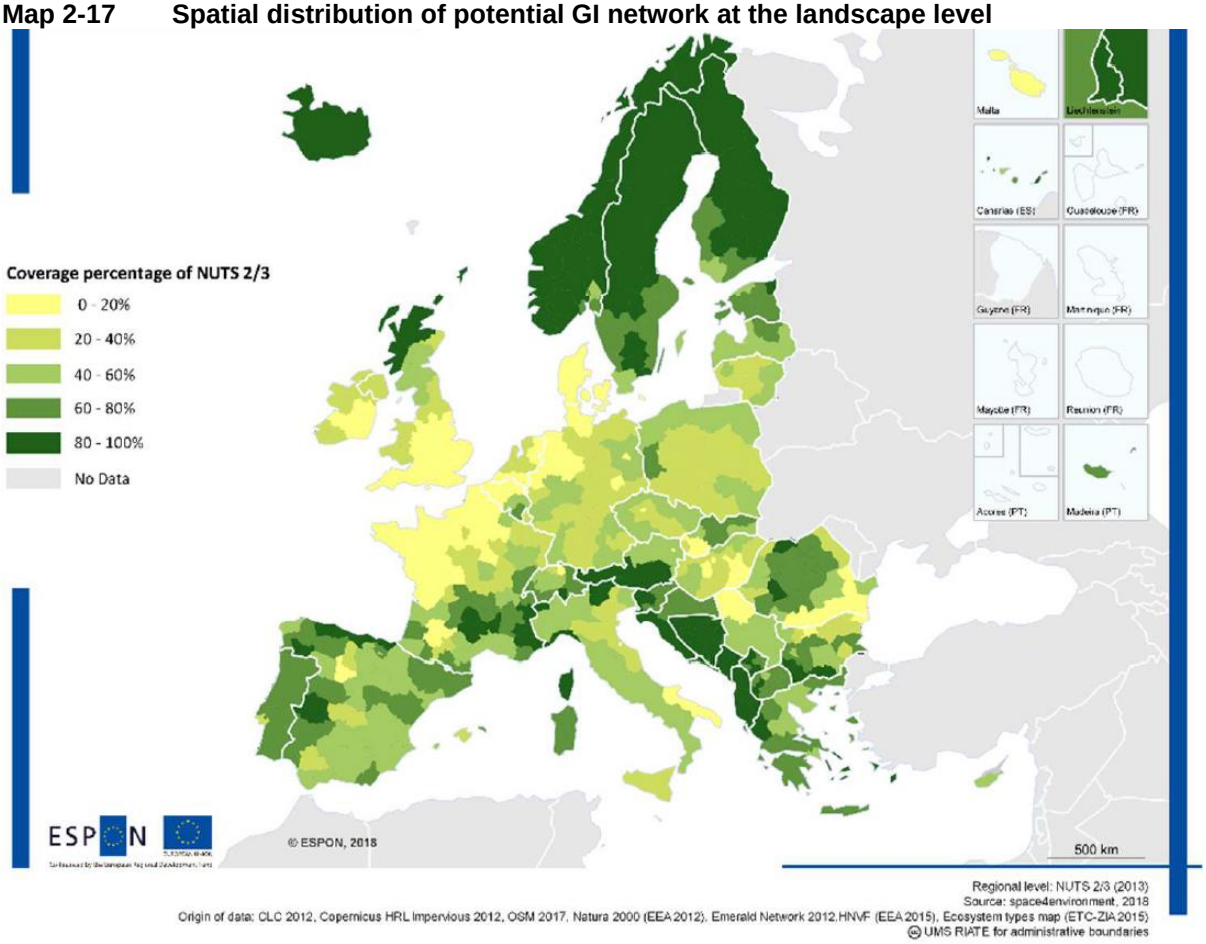
GI networks, integrating ecological systems, aim to promote ecosystem health and resilience, contribute to biodiversity conservation and provide other benefits to human populations. They contribute to the maintenance and enhancement of ecosystem services and to long term sustainable development. Therefore, quantification of the availability of GI (i.e. the share of total area and hectares of GI per capita) is important, especially in areas where sprawl of artificial land uses may compete with natural and semi-natural land uses, such as in Functional Urban Areas (FUA). The availability of GI in urban areas is indicative of the environmental quality, which should be protected and developed according to the Territorial Agenda of the European Union 2020 (JRC Technical Reports, 2015).

As pointed out in the Territorial Agenda of the European Union 2020 (TAEU, 2011), changes in land use such as urbanization, agricultural intensification, infrastructure development, etc., threaten cultural assets and landscapes. They may lead to a decrease in ecological value and environmental quality that are crucial to human well-being and to economic prospects which offer unique development opportunities.

Although biodiversity remains at the core of green infrastructure, GI is much more than a biodiversity conservation instrument. The underlying principle of GI is that the same area of land can offer many environmental, social, cultural and economic benefits simultaneously, provided its ecosystems are in a healthy condition. Using a green infrastructure approach can improve the connectivity between and within protected areas and surrounding non-protected parts of the landscape, between urban and rural areas, and provide many other benefits such as increasing resilience to climate change, improving human health and well-being, flood prevention, pollination and recreation.

Potential for GI is lower in north-western France, Belgium, Luxembourg, the Netherlands and Germany, south-eastern United Kingdom, and Ireland, where land-use is the most intense and natural ecosystems are fragmented (Map 2-17). This makes the maintenance of existing GIs, the improvement of connectivity between protected areas and restoration of natural and semi-natural areas, particularly important in those areas (Trinomics B.V., 2016).

Map 2-17 Spatial distribution of potential GI network at the landscape level

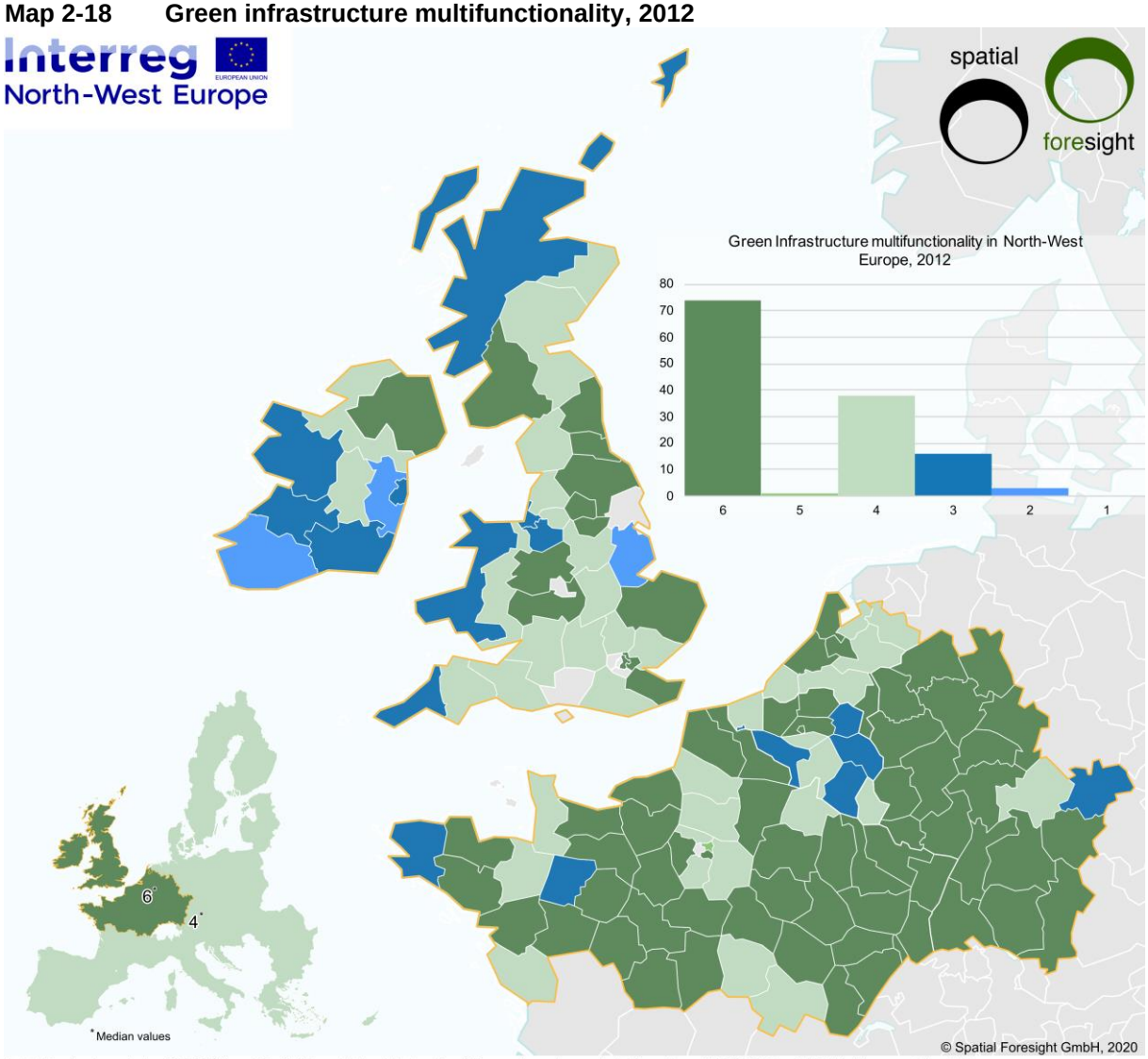


Source: (ESPON, 2019a)

It can be observed that, except for Luxembourg, Scotland and some regions in southern-central Germany, the proportion of protected areas in the potential GI network is below 40% for the majority of NUTS 2 across the NWE area. This suggests that on average 60% of the potential network at the regional level is composed of unprotected landscape elements that deserve special attention to avoid their conversion into urban or intensively managed agricultural areas.

Map 2-18 shows the level of multifunctionality of GIs in the NWE area, which for most NUTS 3 regions is multifunctional, bifunctional or monofunctional supporting multiple policies, notably for biodiversity, climate and disaster risk reduction, and water policies. This means that the amount of services delivered simultaneously by GIs in those areas and the number of policies benefiting from it are considerably high.

Map 2-18 Green infrastructure multifunctionality, 2012



Administrative boundaries: © ESPON and Spatial Foresight and University of Geneva based on material from Eurostat GISCO, the GADM database and the EEA.
Origin of data: based on ESPON EGTC (Green Infrastructure multifunctionality - mfGI_ind), extracted 13.03.2020. FR, UK and IE: NUTS3, LU, BE, NL: NUTS2.

Green Infrastructure multifunctionality

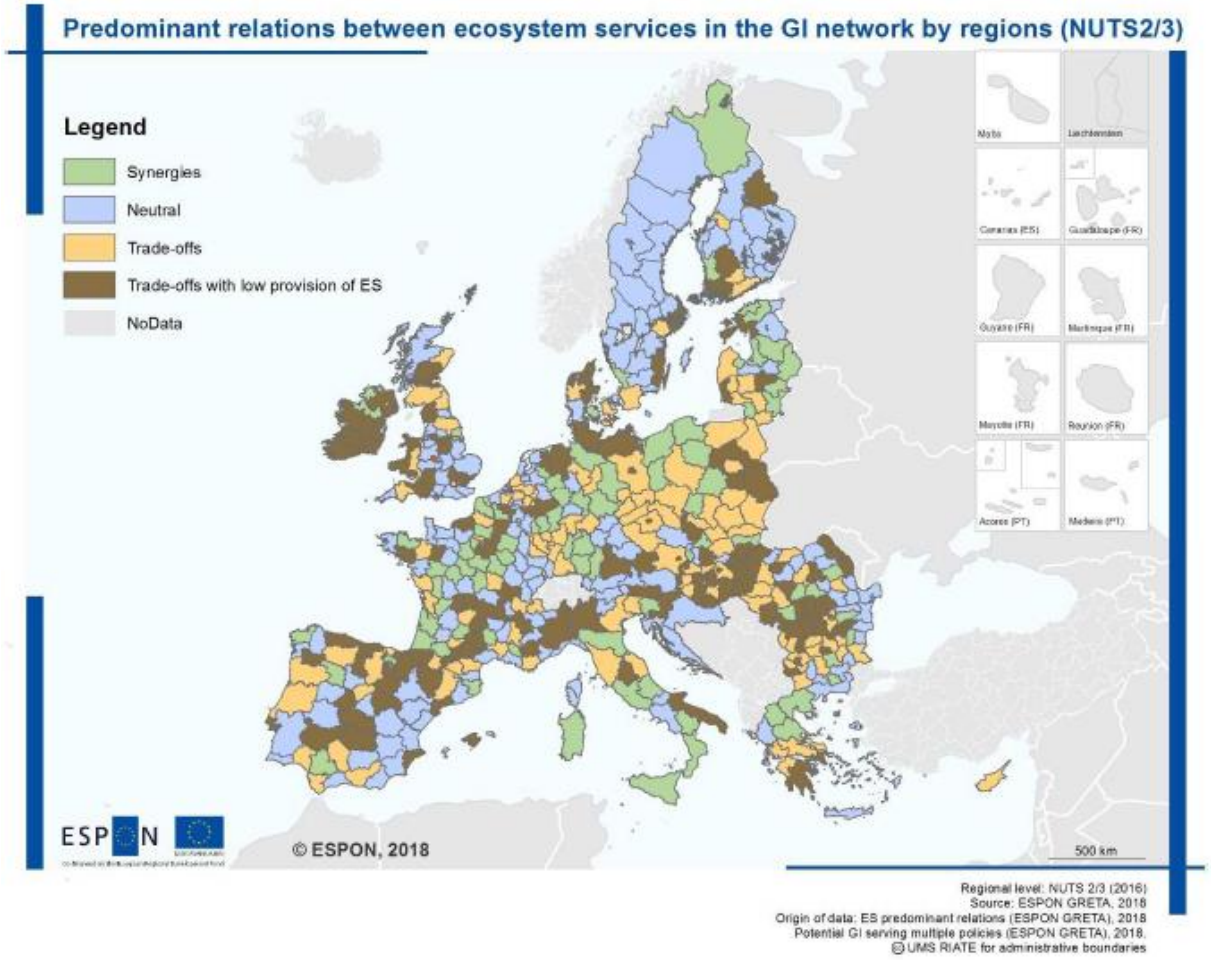
Green Infrastructure multifunctionality, representing the number of ecosystem services with a substantial added value, 2012

- 1 = Monofunctional GI supporting a single policy
- 2 = Bifunctional supporting a single policy
- 3 = Multifunctional supporting a single policy
- 4 = Monofunctional supporting multiple policies
- 5 = Bifunctional supporting multiple policies
- 6 = Multifunctional supporting multiple policies
- Programme area
- no data / no NWE territory

Source: own presentation, 2020

The relatively high multifunctionality of NWE GIs needs to be considered also in view of the predominant type of relationship between different ES, to identify where the implementation of GIs would result in benefits, facilitating the accomplishment of several policy objectives rather than in a degradation of other ES. As illustrated in Map 2-19, four regional patterns can be identified: synergies, neutral, trade-offs, and trade-offs with low ecosystem provision.

Map 2-19 Predominant relations between ecosystem services in the GI network (NUTS2/3)



Source: © ESPON, Working paper Territorial potentials for green infrastructure, 2018

- **NWE areas with synergies**. In these regions – in the NWE area in France (Nord Pas de Calais, Picardie, Champagne-Ardenne and Bretagne), in Luxembourg, in Germany (Rheinland Pfalz), in Ireland (Border), and in the United Kingdom (Yorkshire & the Humber) – most of the ES have a (strong) synergistic relationship. Therefore, the improvement of certain ES always has a multiplier effect on other ES (increasing the provision of ES). It means that the implementation of GI will be highly efficient in those regions since focussing on the improving of key ES will result in co-benefits, facilitating the accomplishment of several policy objectives.

- **NWE areas with neutral relations between ecosystem services in the GI network**. This is the larger group, including in the NWE area NUTS3 regions from the Netherlands (West, East and South), Germany (Nordrhein Westfalen), Belgium, France and in the United Kingdom. Changes in one ES have no effect on another ES. In practical terms, it is likely that improving ES in these regions will not have unwanted side effects.

- **NWE areas with trade-offs**. In these cases, management of GI requires further understanding of these trade-offs and the need to identify alternatives to minimise side effects. The implementation of GI may be hampered by the fact that focussing in certain objectives may lead

to the degradation of other ES, resulting in a general imbalance on the system. These regions are located in Germany (Saarland, Rheinland Pfalz), in the Netherlands, to a lesser extent in Belgium and France, as well as in the northern and eastern parts of the United Kingdom.

- **NWE areas with trade-offs with low ecosystem provision**. These regions are scattered across NWE; they are the dominant pattern in Ireland. These regions would require special attention since the trade-offs are combined with low potential of provision of several ES.

With the exception of Germany, which adopted a 'national green infrastructure concept'[52] in early 2017 aimed at implementing the EU's GI strategy, no other Member State has yet adopted national strategies dedicated to green infrastructure. Nevertheless, other policies and legislative instruments (in broader biodiversity and nature conservation policies and legislation) address at least implicitly the concept of green infrastructure as defined by the EU's GI strategy[53]. Several NWE countries have established national ecological networks or equivalent instruments (ESPON, 2018d). These include:

- the Flemish Ecological Network, the Wallonia Nature Network and the Ecological Network of the Brussels Capital Region (*Maillage vert et bleu*), in Belgium;
- the French 'green and blue network' (*Trame verte et bleue*);
- the German National Ecological Network (*Biotopverbund*);
- the National Nature Network in the Netherlands.

In Ireland the National Spatial Strategy 2002-2020 produced by the Department of the Environment and Local Government advocates the development of a 'Green Structure' through regional and county-level plans, but this is focussed on containing urban sprawl rather than conservation. Therefore, at national level, an overall strategy for GI is lacking at the moment; consequently, its implementation is currently enacted by the local governments via county and city development plans.

As Luxembourg is the most fragmented country in Europe, the National Nature Protection Plan mentions that a network of GI should be created to improve the connectivity of Natura 2000 and other nature areas and ensure the delivery of ecosystem services. The German-Luxembourgish Nature Park was the first cross-border nature park created in Europe. Transnational cooperation of the natural parks in Eifel (Germany) and Luxembourg has been subsequently developed.

Transboundary river basins form an essential part of the Water Framework Directive. Strategic and integrated cross-border programmes could be achieved by introducing GI projects at EU level. This would allow for the implementation of a coherent set of GI measures and NWRMs along river basins, improving for example continuity and connectivity by restoring floodplains (recreating functional and

[52] https://www.bfn.de/themen/planung/bundeskonzept-gruene-infrastruktur.html

[53] The French National Biodiversity Strategy (2011-2020) includes a target to 'build a green infrastructure including a coherent network of protected areas.' Luxembourg's National Nature Protection Plan (2017), which also includes the national biodiversity strategy, mentions green infrastructure and ecosystem restoration, including actions such as reducing fragmentation and improving connectivity of Natura 2000 sites and other nature areas. Ireland's National Peatlands Strategy. Germany's 'Blue Belt' programme (which aims to develop a national system of interlinked biotopes along the federal waterways and their associated floodplains). EUROPEAN COMMISSION Brussels, 24.5.2019 SWD (2019) 184 final.

biodiverse wetlands) or removing physical barriers in rivers, which would help fish migration along rivers from source to sea. Well established international river basin commissions and dedicated environment pillars of the macro-regional strategies could facilitate implementation of such GI projects at EU level (European Commission, 2019c).

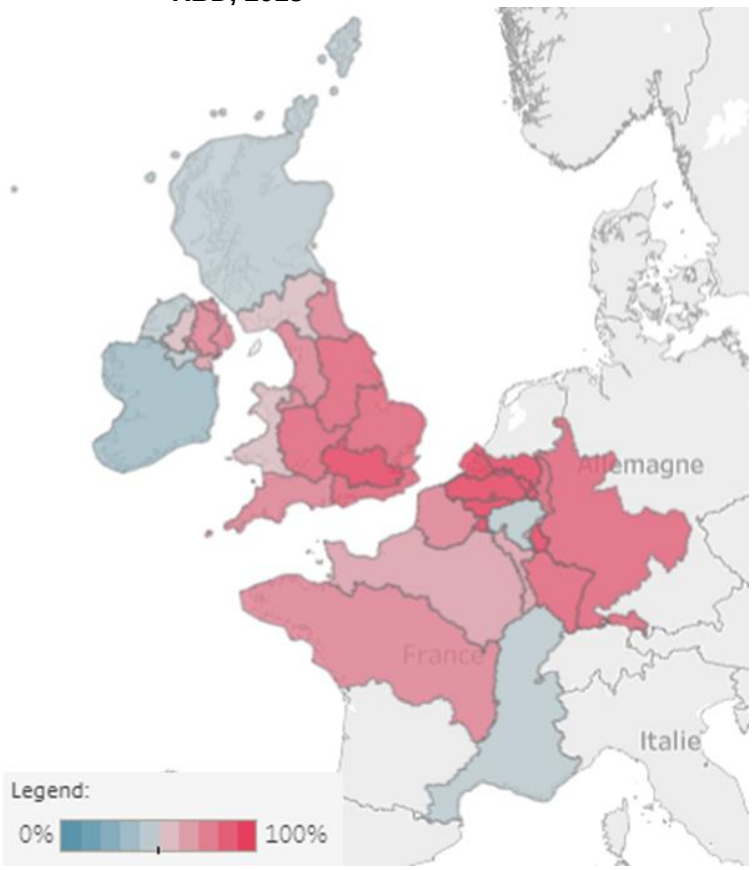
2.5 Water efficiency

The section on water efficiency focuses on the topics of ecological status, quantitative status, chemical status and urban water waste treatment.

2.5.1 Ecological status

The large majority of NWE water bodies[54] are not in good ecological status or potential, as shown in Map 2-20.

Map 2-20 NWE water bodies failing to achieve Good Ecological status in second RBMPs, by RBD, 2018



Source: EEA, WISE-WFD database, data product: DAS-42-en, 2018

[54] In the context of the WFD, the 'water environment' includes rivers, lakes, transitional waters, groundwater and coastal waters out to 1 nautical mile (12 nautical miles for chemical status, i.e. for territorial waters). These waters are divided into units called water bodies.

The main significant pressures on surface water bodies are diffuse sources and atmospheric deposition affecting 65% of NWE water bodies, followed by hydromorphological pressures[55] (34%), point sources (15%), anthropogenic pressures (13%) and abstraction (10%), as illustrated in Table 2-9.

Table 2-9 NWE surface water bodies: Significant pressures (2nd RBMPs)[56], 2018

RBMP	Pressure type group	Number	
2nd	P1 - Point sources	21 468	15%
	P2 - Diffuse sources	47 139	33%
	P2-7 - Diffuse - Atmospheric deposition	46 093	32%
	P3 - Abstraction	8 050	6%
	P4 - Hydromorphology	49 006	34%
	P5 - Introduced species and litter	3 445	2%
	P6 - Groundwater recharge or water level	155	0%
	P7 - Anthropogenic pressure - Other	2 705	2%
	P8 - Anthropogenic pressure - Unknown	14 968	10%
	P9 - Anthropogenic pressure - Historical pollution	748	1%
	P0 - No significant anthropogenic pressure	40 448	28%
(*)		143 565	100%

Source: EEA, WISE-WFD database, data product: DAS-42-en, 2018.

Diffuse sources are particularly caused by agriculture (68%, i.e. Belgium, France, Ireland, the Netherlands, and United Kingdom), discharges not connected to sewage treatment plants (32%). Another important typology of diffuse pressure is atmospheric deposition.

The main hydromorphological pressures are caused by dams, barriers and locks (73%), followed by physical alteration of channels/bed/riparian/shores (54%), including for flood protection and agriculture.

As regards point sources, they are primarily caused by urban wastewater treatment (68%, i.e. Belgium, Germany, France, Ireland, Luxembourg, and United Kingdom), and to a lesser degree by storm overflows (24%, i.e. Germany, and the Netherlands).

The most significant anthropogenic pathway for release into the environment is the burning of fossil fuels.

The main causes of water abstraction pressures are agriculture (49%, i.e. France, Luxembourg, and the Netherlands), public water supply (35%, i.e. France, Ireland, and Luxembourg), hydropower (26%) and industry (25%, i.e. Belgium, and France).

2.5.2 Quantitative status

The Water Framework Directive (2000/60/EC) requires Member States to promote the sustainable use of water resources based on the long-term protection of available water resources, and to ensure a balance between abstraction and the recharge of groundwater, with the aim of achieving good groundwater status by 2015 (European Parliament and Council of the European Union, 2000). The EU's

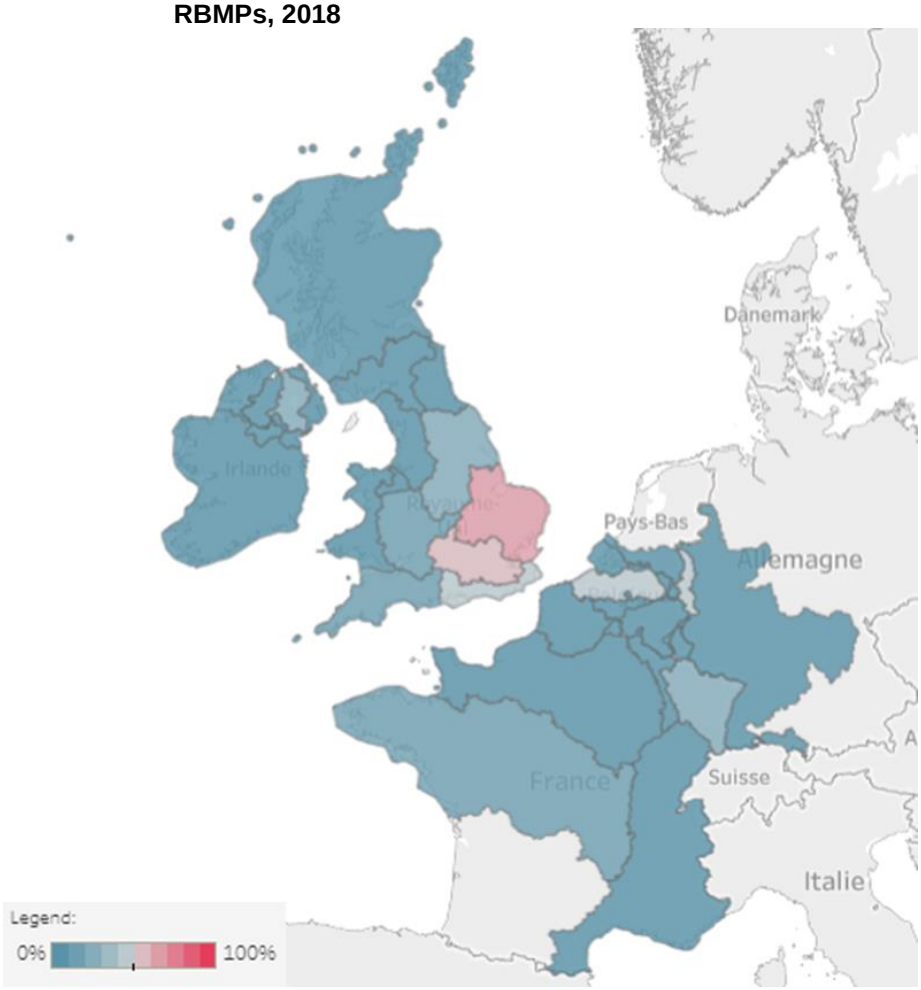
[55] Hydromorphological pressures comprise all physical alterations to water bodies (including continuity interruptions) that modify their channels, shores, riparian zones and water levels/flows, such as dams, embankments, channelisation and flow regulation. These activities may cause damage to the morphology and hydrology of water bodies and result in altered habitats, with significant impacts on ecological status.

[56] A water body may be affected by more than one pressure; therefore, the sum of percentages is greater than 100%.

Seventh Environment Action Programme (7th EAP) (European Parliament and European Council, 2013b) aims to ensure that stress on renewable water resources is prevented or significantly reduced by 2020. The EU's Roadmap to a Resource Efficient Europe (European Commission, 2011b) also includes a milestone for 2020, namely that "water abstraction should stay below 20% of available renewable freshwater resources".

North West Europe is relatively rich in annual renewable freshwater resources. Most of NWE area has a good quantitative status, with the only exception of two RBDs in southern United Kingdom (Map 2-21).

Map 2-21 NWE groundwater bodies failing to achieve good quantitative status, by RBD, 2nd RBMPs, 2018

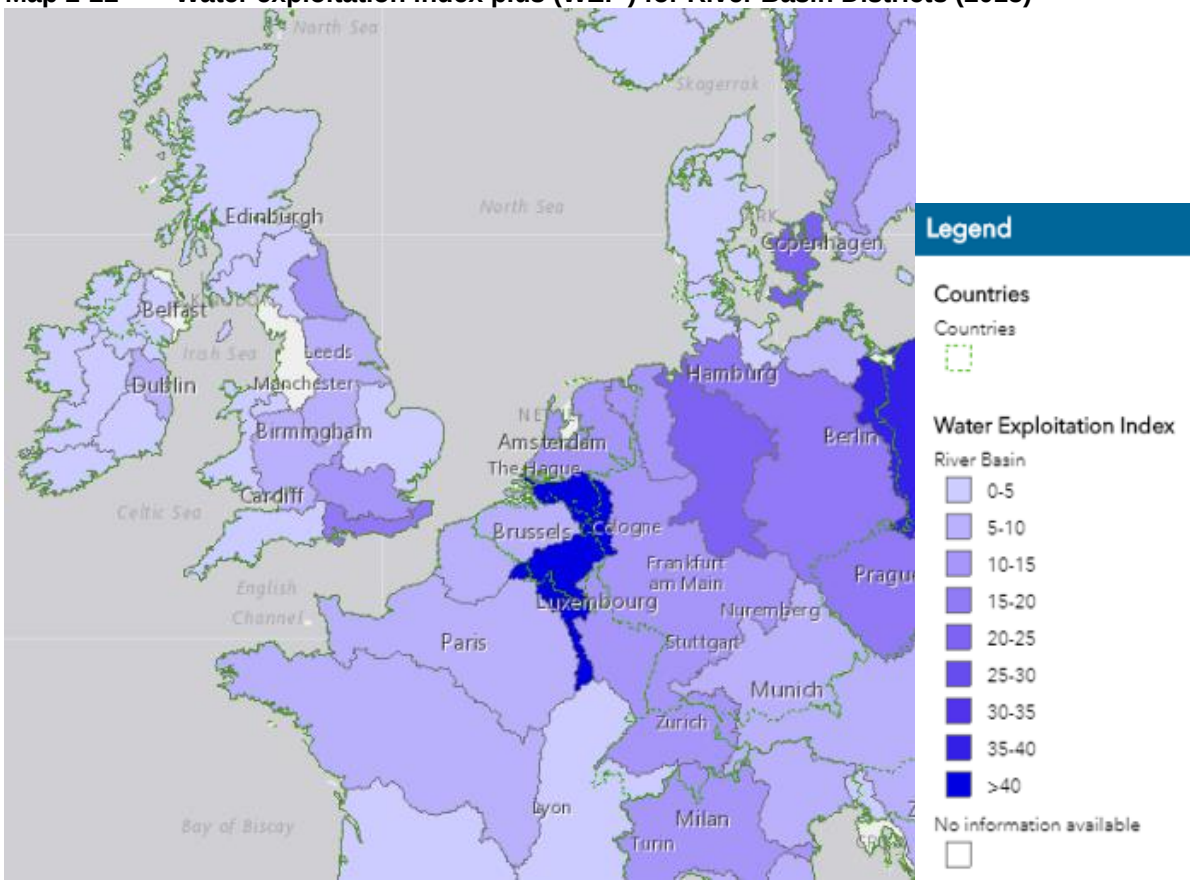


Source: EEA, WISE-WFD database, data product: DAS-42-en, 2018

However, in a few River Basin Districts (RBD) located mainly in the United Kingdom, Belgium, France and the Netherlands, water abstraction pressure is important (between 20% and 40%), and the use of

freshwater resources is at the limit of sustainability[57]. This is notably the case of the Maas, Northumbria, Humber, Anglian, South-East and Dee, as illustrated in Map 2-22[58].

Map 2-22 Water exploitation index plus (WEI+) for River Basin Districts (2015)[59]



Source: EEA, Water exploitation index plus (WEI+) for river basin districts (1990-2015)

2.5.3 Chemical status

Good chemical status is defined by limits (environmental quality standards (EQS)) on the concentration of certain pollutants found across the EU, known as priority substances. A smaller group of priority hazardous substances were identified in the Priority Substances Directive[60] as uPBT (ubiquitous,

[57] REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL on the implementation of the Water Framework Directive (2000/60/EC) and the Floods Directive (2007/60/EC) Second River Basin Management Plans, First Flood Risk Management Plans, and Accompanying documents; Eurostat, Water Statistics; EEA, Waterbase; EEA, Report No 7/2018, European waters, Assessment of status and pressures 2018, ISSN 1977-8449; Raskin, P., Gleick, P.H., Kirshen, P., Pontius, R. G. Jr and Strzepek, K. (1997), Comprehensive assessment of the freshwater resources of the world. Stockholm Environmental Institute, Sweden. Document prepared for UN Commission for Sustainable Development 5th Session 1997 - Water stress categories are described on page 27-29. European Commission, RIVER BASIN DISTRICTS AND SUB-UNITS, RBD list as received from DG ENV in August 2019, https://circabc.europa.eu/sd/a/ed88b390-a569-4ee9-abce-fff8db59de9f/RBD%202019%20-%20List%20_%2019092019.pdf.

[58] EEA, Use of freshwater resources in Europe, 2019.

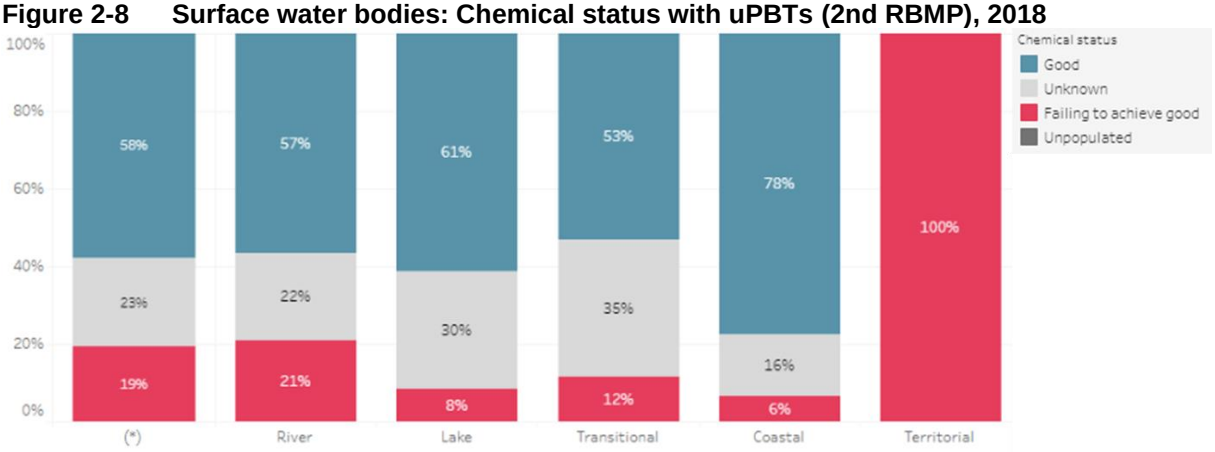
[59] The water exploitation index plus (WEI+) aims to illustrate the pressure on the renewable freshwater resources of a defined territory (country, river basin, sub-basin etc.) during a specified period (e.g. seasonal, annual), as a consequence of water use for human purposes. Values above 20% indicate that water resources are under water stress, and values above 40% indicate that water stress is severe and the use of freshwater resources is clearly unsustainable (Raskin et al., 1997).

[60] DIRECTIVE 2013/39/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 12 August 2013 amending Directives 2000/60/EC and 2008/105/EC as regards priority substances in the field of water policy.

persistent, bioaccumulative and toxic). uPBT substances persist in the environment, can be transported long distances and pose long-term risks to human health and ecosystems. Owing to widespread environmental contamination, achieving concentrations at or below the EQS for this group of substances can be particularly challenging.

Counting uPBTs in the assessment of surface water chemical status, in spite of some progress realised in comparison to the report of the first generation of RBMPs (2012) (European Commission, 2012), the whole NWE area fails to achieve a good ecological status, in particular due to the excessive concentrations of mercury, Benzo(g,h,i)perylene + indeno(1,2,3-cd)pyrene, and benzo(a)pyrene. Notably, 21% of rivers, 12% of transitional waters, 8% of lakes and 6% of coastal waters are characterised by concentrations above EQS limits Figure 2-8.

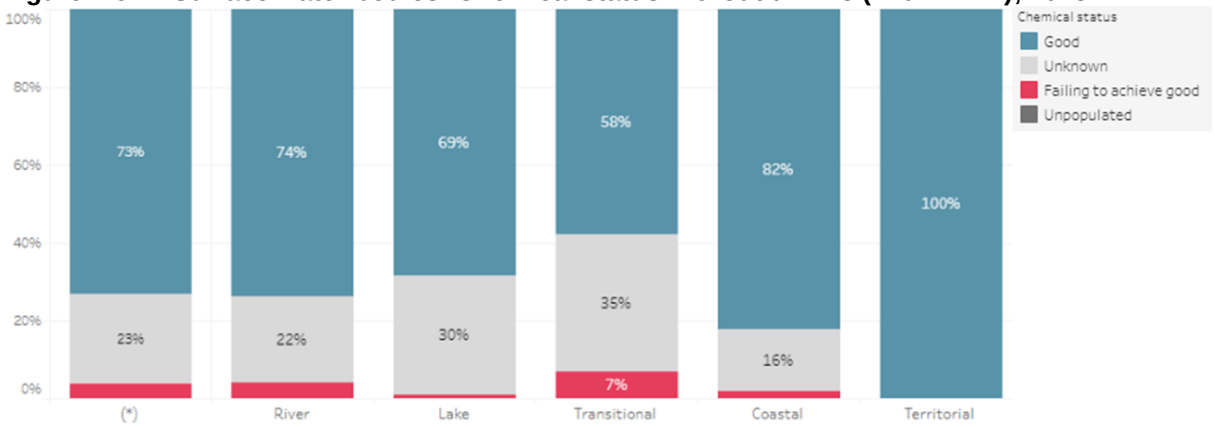
Figure 2-8 Surface water bodies: Chemical status with uPBTs (2nd RBMP), 2018



Source: EEA, WISE-WFD database, data product: DAS-42-en, 2018

If uPBTs were omitted from the assessment, only 7% of transitional waters, 4% of rivers, 2% of coastal waters and 1% of lakes would fail to achieve good ecological status (Figure 2-9).

Figure 2-9 Surface water bodies: Chemical status without uPBTs (2nd RBMP), 2018



Source: EEA, WISE-WFD database, data product: DAS-42-en, 2018

It is notably in Luxembourg, Germany and Belgium that a good chemical status is not achieved, mainly due to metals, polyaromatic hydrocarbons, phosphate fertilizers, pesticides, and biocide agents for ships and boats, although also a relevant share of surface water bodies in the Netherlands (36%) and in France (21%) show clear signs of chemical pollution. If uPBT are omitted from the assessment, Luxembourg still fails to achieve a good ecological status, together with 30% of water bodies in the Netherlands and 25% in Belgium, and 10% in Germany, mainly due to the levels of tributiltyncation, diuron, and cadmium (Figure 2-10 and Figure 2-11)[61].

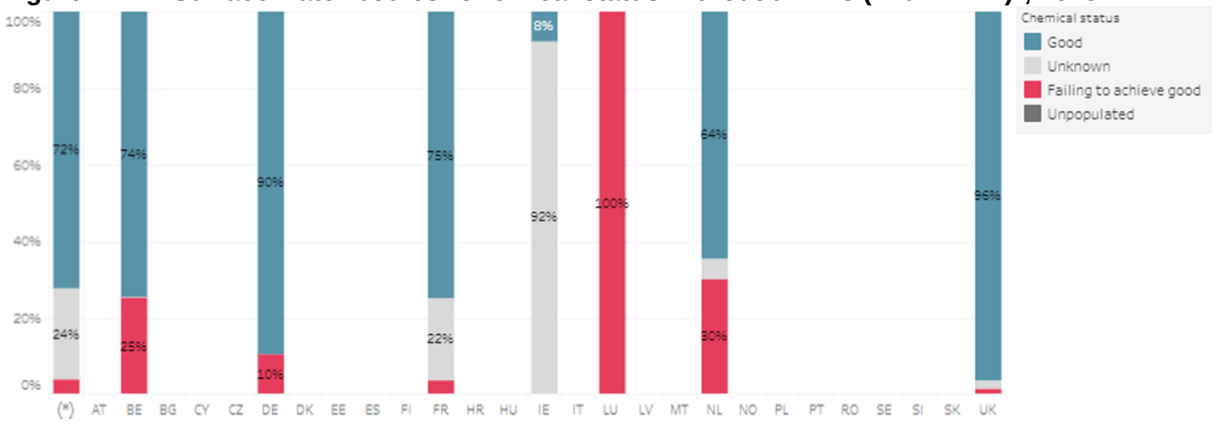
Figure 2-10 Surface water bodies: Chemical status with uPBTs (2nd RBMP)*, 2018

* data from IE not available

Source: EEA, WISE-WFD database, data product: DAS-42-en, 2018

[61] Luxembourg failed to achieve good chemical status for any of its surface water bodies, as it applied the 2013 EQS for fluoranthene, whereas neighbouring countries applied the 2008 standard.

Figure 2-11 Surface water bodies: Chemical status without uPBTs (2nd RBMP)*, 2018



* data from IE not available

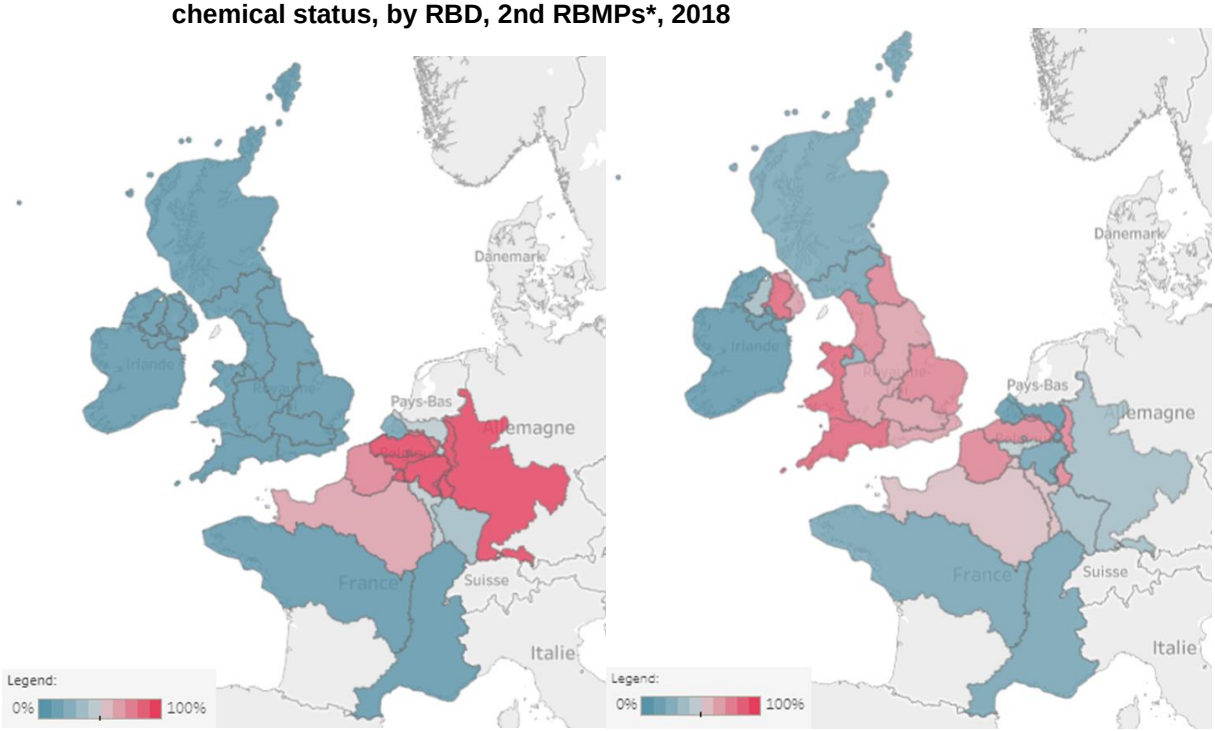
Source: EEA, WISE-WFD database, data product: DAS-42-en, 2018

The status of groundwater across NWE is generally better than that of surface waters. The chemical status of NWE groundwater bodies is assessed as good or failing to achieve good chemical status according to its compliance with EU standards for nitrates (50 mg/l (34)) and pesticides (35) (0.1 µg/l for individual pesticides; total maximum 0.5 µg/l), and with Member States' established 'threshold values' for other groundwater pollutants.

As shown in Map 2-23 the main pressures on the quality of NWE groundwater bodies are located in most parts of the United Kingdom and Belgium, and to a lesser extent in few parts of France, Germany and Luxembourg. The most common reason given for failure to achieve good chemical status is 'general water quality', which includes significant impairment of human uses and environmental risk from pollutants across the groundwater body, but it does not include an assessment of more stringent objectives, such as those for drinking water or for dependent terrestrial ecosystems and associated surface waters. Nitrates are present in six of the NWE countries and affect an area larger that 280 thousand km^2, followed by pesticides (5 NWE MS and 176 thousand km^2), ammonium, sulphate and chloride (4 MS and about 30 thousand km^2)[62].

[62] WISE-SoW database (IE data not available).

Map 2-23 NWE surface water (left) and groundwater (right) bodies failing to achieve good chemical status, by RBD, 2nd RBMPs*, 2018



* data from IE not available

Source: EEA, WISE-WFD database, data product: DAS-42-en, 2018

More than half of NWE groundwater bodies are not affected by significant pressures. However, a bit more than one third of them is affected by diffuse sources of pollution (34%), 17% by abstraction and 14% by point sources. (Table 2-10)

For 82% of groundwater bodies the diffuse sources of pollution are caused by agriculture, for 22% by discharges not connected to the sewage network and for 19% by mining.

Regarding abstraction, public water supply (73%), agriculture (55%) and industry (34%) are the main sources of pressures.

As for point sources, the pollution is primarily caused by contaminated sites or abandoned industrial sites (48%), IED plants[63] (43%), urban wastewater (34%), waste disposal sites (31%), non-IED plants (22%), and mining waters (19%).

[63] IED plants are industrial emissions covered by the Industrial Emissions Directive (Directive 2010/75/EU of the European Parliament and the Council on industrial emissions).

Table 2-10 NWE groundwater bodies: significant pressures, by RBMP, 2018

RBMP	Pressure type group	Area (km²)	
2nd	P0 - No significant anthropogenic pressure	2 381 068	56%
	P2 - Diffuse sources	1 469 253	34%
	P3 - Abstraction	721 964	17%
	P1 - Point sources	605 010	14%
	P8 - Anthropogenic pressure - Unknown	121 359	3%
	P6 - Groundwater recharge or water level	89 139	2%
	P7 - Anthropogenic pressure - Other	43 732	1%
	P2-7 - Diffuse - Atmospheric deposition	26 966	1%
	P9 - Anthropogenic pressure - Historical pollution	10 527	0%
	P4 - Hydromorphology	1 784	0%
(*)		4 284 995	100%

Source: EEA, WISE-WFD database, data product: DAS-42-en, 2018

The main impacts reported are chemical (21% of groundwater bodies) and nutrient (18%) pollution.

Table 2-11 NWE groundwater bodies: significant impacts, 2018

RBMP	Impact Type	Area (km²)	
2nd	Chemical pollution	910 176	21%
	Nutrient pollution	765 434	18%
	Organic pollution	117 337	3%
	Microbiological pollution	23 241	1%
	Saline or other intrusion	95 120	2%
	Associated surface waters	192 857	4%
	Dependent terrestrial ecosystems	209 061	5%
	Water balance / Lowering water table	336 692	8%
	Acidification	13 195	0%
	Other	29 497	1%
	Unknown	147 295	3%
	None	2 600 723	60%
(*)		4 304 009	100%

Source: EEA, WISE-WFD database, data product: DAS-42-en, 2018

2.5.4 Urban wastewater treatment

The treatment of urban wastewater is fundamental to ensuring public health and environmental protection. Reducing pollution to meet the objectives of the WFD requires Member States to correctly implement and enforce several other directives and regulations. These include the Urban Waste Water Treatment Directive (UWWTD) (European Council, 1991), the Nitrates Directive (Council of the European Union, 1991), the Directive on Sustainable Use of Pesticides (European Parliament and European Council, 2009), the Industrial Emissions Directive (European Parliament and European Council, 2010) and the REACH regulation (European Commission, 2006), all of which play a key role in tackling point and diffuse source pollution.

Over the past few decades, clear progress has been made in reducing emissions into surface waters through measures taken for improved wastewater treatment. The implementation of the UWWTD, together with national legislation, has led to improvements in wastewater treatment across much of the European continent. These positive trends are due to increased connection to sewers, improvements in wastewater treatment and a reduction in substances at source, such as lowering the phosphate content in detergents. Likewise, average levels of nitrate concentration declined by 20% in European rivers

between 1992 and 2015, while by 2011 groundwater nitrate concentrations had almost returned to the levels in 1992. The decline in nitrate concentration reflects the effects of measures to reduce agricultural emissions of nitrates, as well as improvements in wastewater treatment.

The proportion of the population connected to wastewater treatment plants in NWE has been above 70% since 1995, with more than 80% of urban wastewater receiving tertiary treatment (in 2015), as illustrated in Figure 2-12[64].

Figure 2-12 Changes in urban waste water treatment in NWE area (1970-2015)

Source: Eurostat, data product ten00020, (2017)

In the Netherlands and in Germany almost the whole population is connected to sewage collection systems applying stringent treatment, followed by Belgium, Luxembourg, the Netherlands and the

[64] Initially, for the treatment of wastewater, sewage collection systems must be installed (orange bars). Wastewater can then be subject to primary treatment (yellow bars), such as settling, followed by secondary treatment (green bars) to reduce the amount of dissolved and suspended organic material. Secondary treatments include those using biological methods. More stringent 'tertiary' treatment (dark green bars) can then be applied to remove mainly nutrients. Population connected to urban wastewater collecting and treatment systems, by treatment level (ten00020) provided by Statistical Office of the European Union (Eurostat).

United Kingdom. In Ireland, considerable progress has been achieved during the same timespan, although less than 20% of the population is connected to tertiary treatment systems.

2.6 Circular economy (European Commission, 2020d)

The new Circular Economy Action Plan 'For a cleaner and more competitive Europe' (European Commission, 2020e) ('the Action Plan') emphasises that the EU cannot deliver alone the ambition of the European Green Deal for a climate-neutral, resource-efficient and circular economy (European Commission, 2019b). The Action Plan also confirms that the EU will continue to lead the way to a circular economy at the global level and use its influence, expertise and financial resources to implement the 2030 Agenda for Sustainable Development and its Sustainable Development Goals, in the EU and beyond.

Belgium is among the best performers in the EU as regards waste management and has already reached the EU's 2020 municipal waste recycling target. However, there are differences in separate collection rates between the regions, with the Brussels Capital Region performing much worse (43% in 2017 versus Flanders and Wallonia at 70%) (European Commission, 2020f).

France performs well in the use of circular material. A law on anti-waste and the promotion of circular economy (*Loi anti-gaspillage pour une économie circulaire)* was promulgated early 2020. With a recycling rate of 43% in 2017, France is not considered to be at risk of missing the European target of recycling 50% of all municipal waste by 2020[65].

In Germany, the new 2030 Climate Action Programme does not take much account of the potential of the circular economy. This is referred to by the Commission as a "missed opportunity" (European Commission, 2020). A number of strategies and initiatives address elements of the circular economy. For instance, the resource efficiency programme *PROGRESS II*, the national programme on sustainable consumption and the German high-tech strategy deal with different circularity aspects. Unlike a growing number of EU Member States, Germany does not have a comprehensive strategy to further develop the regulatory framework, make full use of synergies with digitisation and mobilise finance. In recognition of this, and with support from the Federal Ministry of Education and Research, the new Circular Economy in Germany initiative (*CEID, Circular Economy Initiative Deutschland*), has been tasked with drawing up a circular economy Roadmap for Germany by 2021.

In Ireland, progress towards the mandatory recycling EU targets has slowed in the recent years. However, the projections show that the country should be close to meeting the 2020 recycling target for municipal waste (Eunomia, 2018). The recycling rate slightly increased from 37% in 2013 to 41% in 2016 and the landfill rate fell substantially from 38% to 26% on the back of a successful increase in the landfill levy (European Commission, 2020g). However, some caution is required regarding the increase in incineration capacity from 16% to 29% which may discourage efforts to increase recycling. Ireland's toxic waste rate is below the EU average, suggesting a good potential for recycling.

Luxembourg is well advanced in the field of the circular economy but in some respects exhibits insufficient results. Building on the "Third Industrial Revolution" strategy[66], Luxembourg promotes small

[65] Commissariat Général au Développement Durable, 2016.

[66] The Ministry of the Economy of the Grand Duchy of Luxembourg, "Third Industrial Revolution" strategy.

and medium-sized enterprises' transition to a circular economy (e.g. the "*Fit4Circularity" programme*"[67] and the "*SuperDrecksKëscht fir Betriber*" label[68], and gave a strong environmental dimension to its Small Business Act (European Commission, 2018a). Luxembourg performs better than the EU average on resource productivity, but the use of recycled materials has decreased and is now below the EU average. It complies with the 2020 municipal waste recycling targets, but further efforts will be needed to comply with post-2020 targets, and waste generation per capita is much above the EU average[69].

The Netherlands is in many cases leading by example and partnering up to push circularity in the EU. Circular (secondary) use of materials in the Netherlands stood at 29% of total material use in 2016, compared to an EU-28 average of 11.7%. Following the government's commitment to a greener economy and its good practice of over 200 'green deals' already with private sector and other organisations, a new green deal on circular procurement was signed by 50 public and private organisations and companies in June 2018, leading to EUR 100 million in 'green' purchasing power. Circularity is for example also applied in the area of medicine waste aiming to reduce the amount of unused medications ending up in the environment[70]. Investments in waste management are needed to meet the municipal waste recycling targets (up to 65% of all municipal waste). Moreover, projects that support a shift in recyclable waste away from incineration towards recycling should be prioritised as, recycling is more in line with the circular economy and is also higher up in the 'waste hierarchy' than incineration.

In the United Kingdom circular and waste indicators are better than the EU average. However, as the physical waste intensity is above the EU average, there seems scope to improve the efficiency of using materials in production (European Commission, 2020h).

NWE countries can obtain many social and economic benefits from treating waste as a resource. In addition to reducing environmental pressures, better waste management can secure vital resources, create jobs and boost competitiveness. Business model innovation (e.g. Service- and function-based business models, Collaborative consumption, Waste-as-a-resource business models, Finance mechanisms for innovative business models), waste prevention, reuse and repair have a central role in enhancing resource efficiency and creating a circular economy that enables society to maximise the economic returns on finite resources.

As in all transition processes, benefits of the transition to circular economy will not be evenly distributed: some industrial sectors, businesses, regions and societal groups are likely to lose, while others will benefit. For example, jobs in industries producing virgin materials or low-quality consumer goods, often outside Europe, could be lost through such strategies. Policies will be needed to manage these effects. Realising the benefits will also depend upon how well and quickly adequate skills and education for the circular economy can be developed and rolled out (European Environment Agency, 2016).

[67] http://www.innovation.public.lu/fr/innover/pme-artisanat/fit-for-circularity/index.html.

[68] https://www.yde.lu/labels-clubs/labels/le-label-superdreckskescht-fir-betriiber.

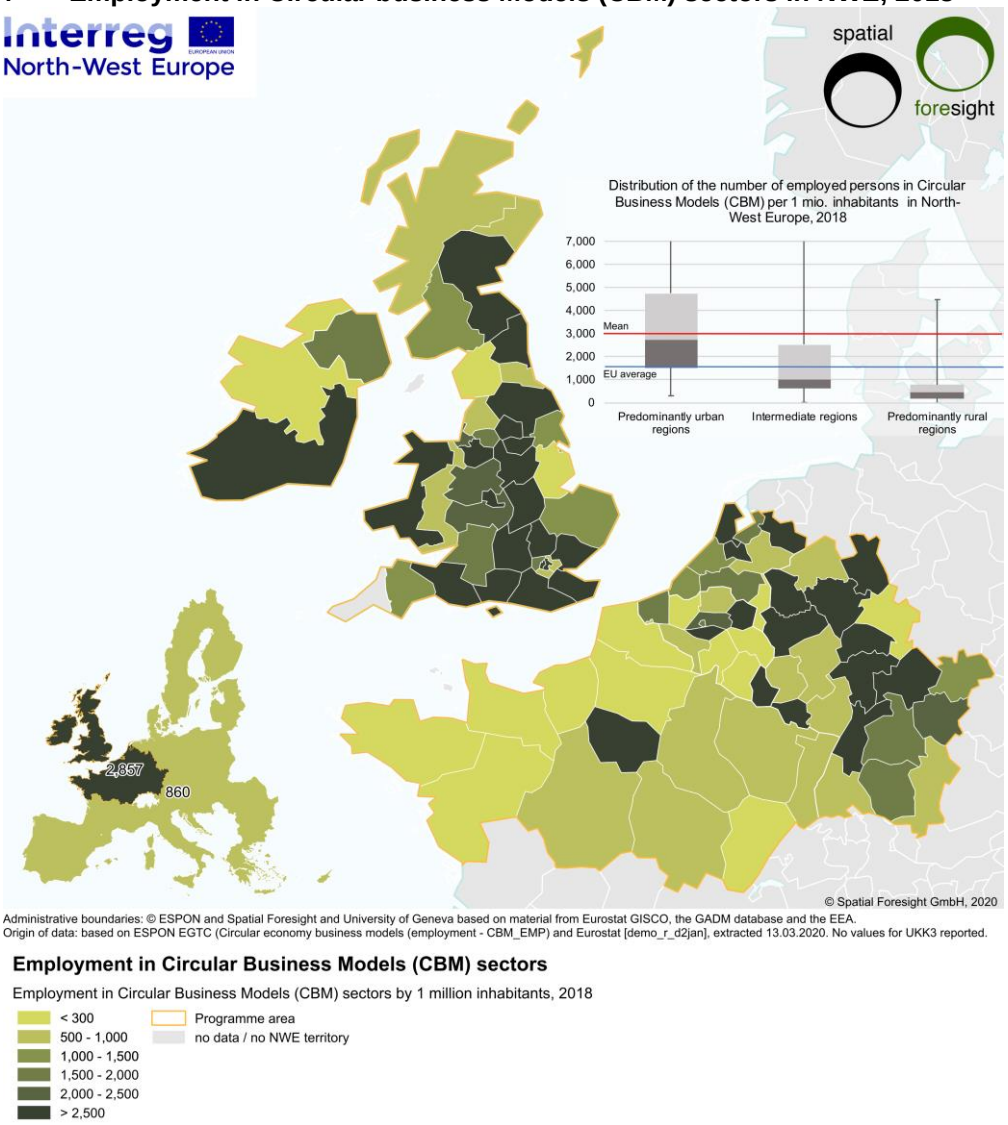
[69] Directive (EU) 2018/851, Directive (EU) 2018/852, Directive (EU) 2018/850 and Directive (EU) 2018/849 amend the previous waste legislation and will set more ambitious recycling targets for the period up to 2035.

[70] The Royal Dutch Pharmacists Organisation has initiated medicine use monitoring and incentives for a new waste collection system in pharmacies.

2.6.1 Business model innovation

Circular Business Models (CBM) facilitate the uptake of circular processes through innovative services and new forms of consumption by connecting businesses to businesses (B2B), businesses to consumers (B2C) and consumers to consumers (C2C). According to our analysis, circular business strategies and models are responsible in the NWE area for EUR 2,857 employed persons per 1 million. inhabitants. The distribution of the number of employed persons is primarily and above EU average in predominantly urban regions, as illustrated in Map 2-24.

Map 2-24 Employment in Circular business Models (CBM) sectors in NWE, 2018



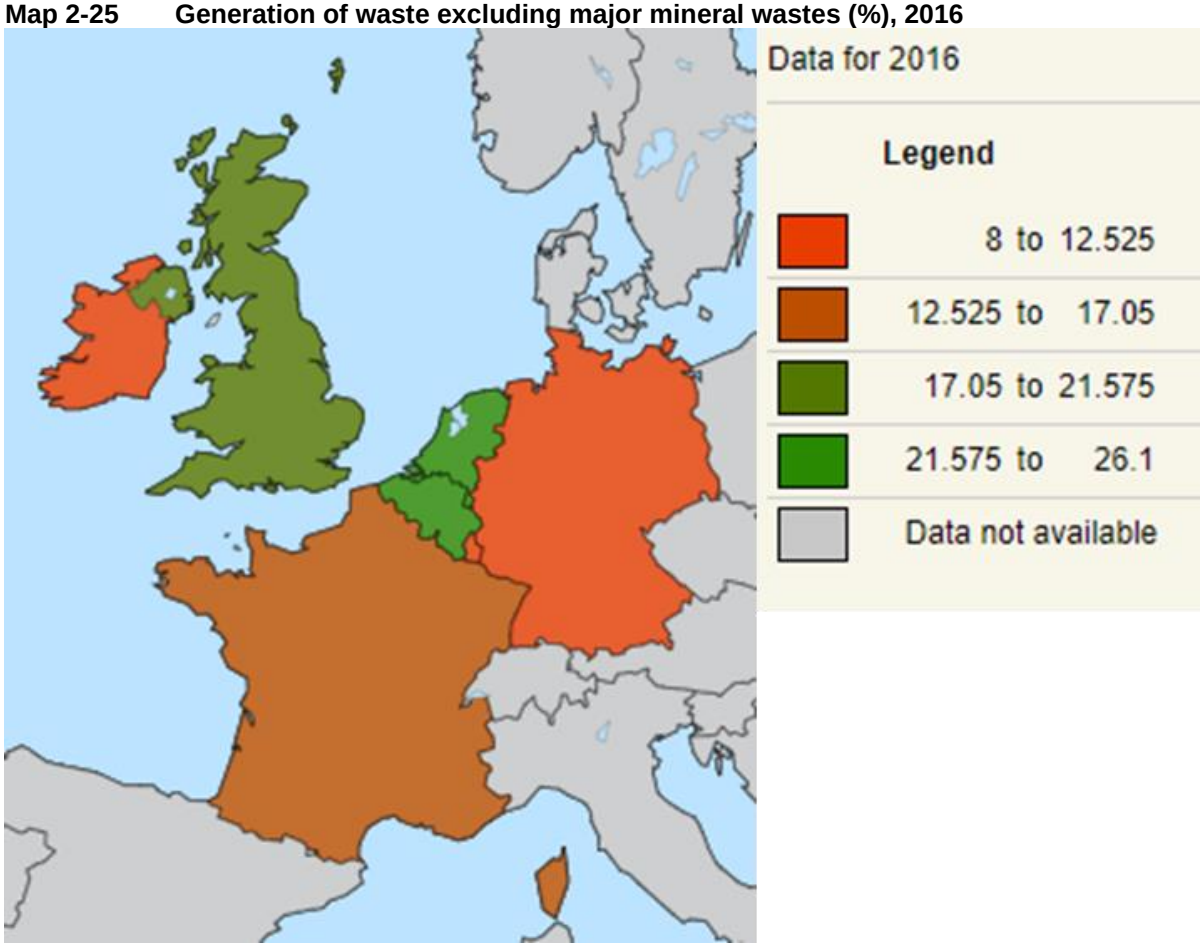
Source: own presentation, 2020

The implementation and diffusion of Circular Business Models is favoured by agglomerations (both industrial and urban), knowledge hubs and established territorial milieus.

2.6.2 Production and consumption

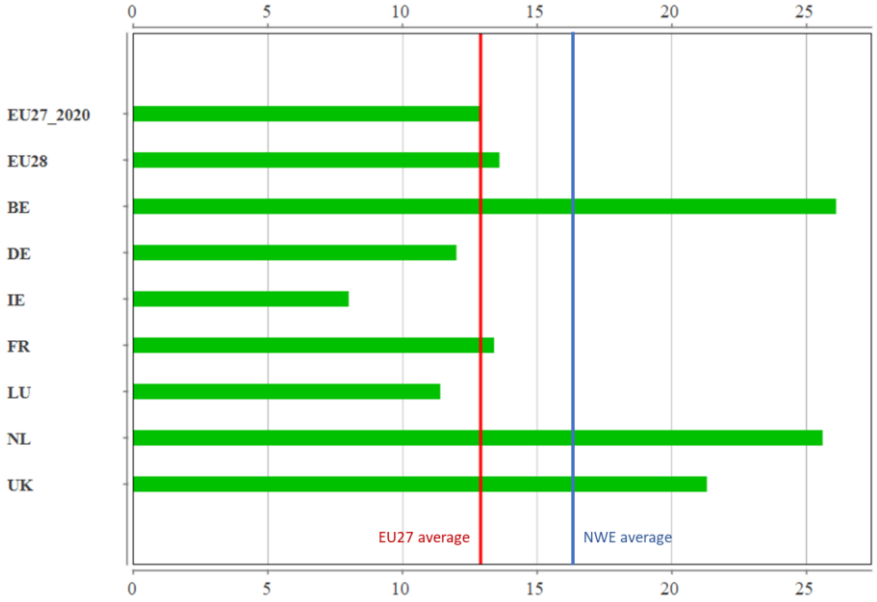
In a more circular economy, the value of products, materials and resources is maintained in the economy for as long as possible and the generation of waste is to be reduced where practical, with attention to prospects for recycling and reductions in biotoxicity. Waste prevention is closely linked with improving manufacturing methods and influencing consumers to demand greener products and less packaging. By making the transition to a circular economy the EU aims at decreasing waste generation while maintaining or increasing economic output. Comparing waste generated to GDP reflects the waste intensity of the economy and provides a measure of 'eco-efficiency'. The assessment of the ratio of the waste generated per domestic material consumption (excluding major mineral wastes) confirms that Belgium (26.1%), the Netherlands (25.6%) and the United Kingdom (21.3%) are well beyond both the EU-27 (12.9%) and the EU-28 (13.6%) average; France (13.4%) is in proximity of the EU-28 average value; and the other countries are at lower levels, as illustrated in Map 2-25.

Map 2-25 Generation of waste excluding major mineral wastes (%), 2016



Source: Eurostat, Code: t2020_rt100, 2016

Figure 2-13 Generation of waste excluding major mineral wastes per domestic material consumption (%), 2016[71]



Source: Eurostat, data product cei_pc033, 2016.

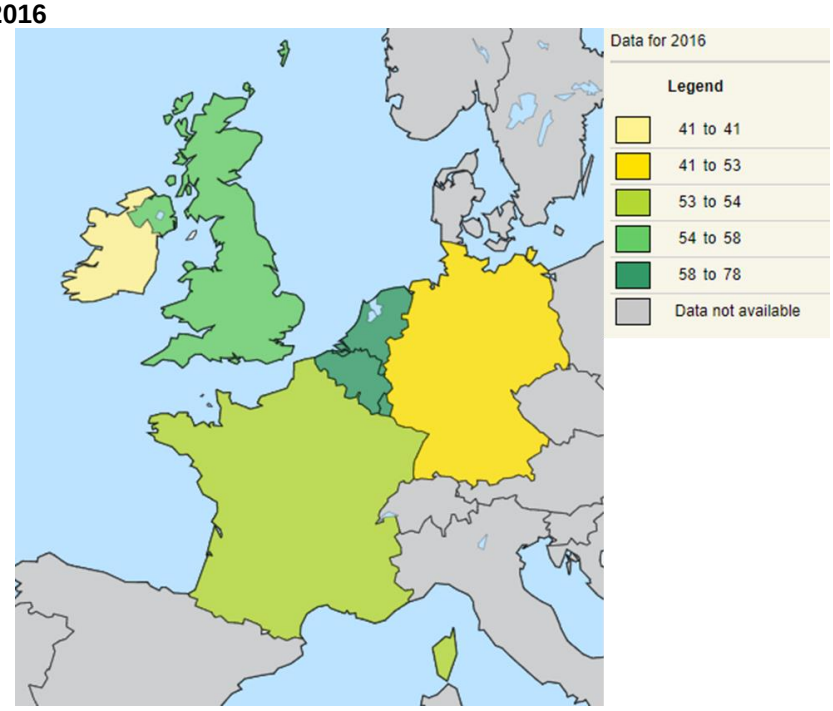
The NWE average ratio of the waste generated per domestic material consumption (excluding major mineral wastes) is 16.8% which is well above the EU-27 and EU-28 average. If the data for the United Kingdom are not considered this value worsens slightly (16.1%), but remains above both the EU-27 and the EU-28 average values (Figure 2-13).

2.6.3 Recycling rate

Last, but not least, the analysis of the recycling rate of waste (excluding major mineral wastes), indicates that all NWE countries, except for Ireland, have met the EU target of 50% recycling of municipal waste by 2020. Belgium leads with 78%, followed by the Netherlands (72%), Luxembourg (64%) and the United Kingdom (58%) that are all above the EU-27 (56%) and EU-28 (57%) average, next comes France (54%) and Germany (53%, data from 2014) slightly below and Ireland lying much further at 41% (Figure 2-14). Map 2-26 shows the visually the recycling waste.

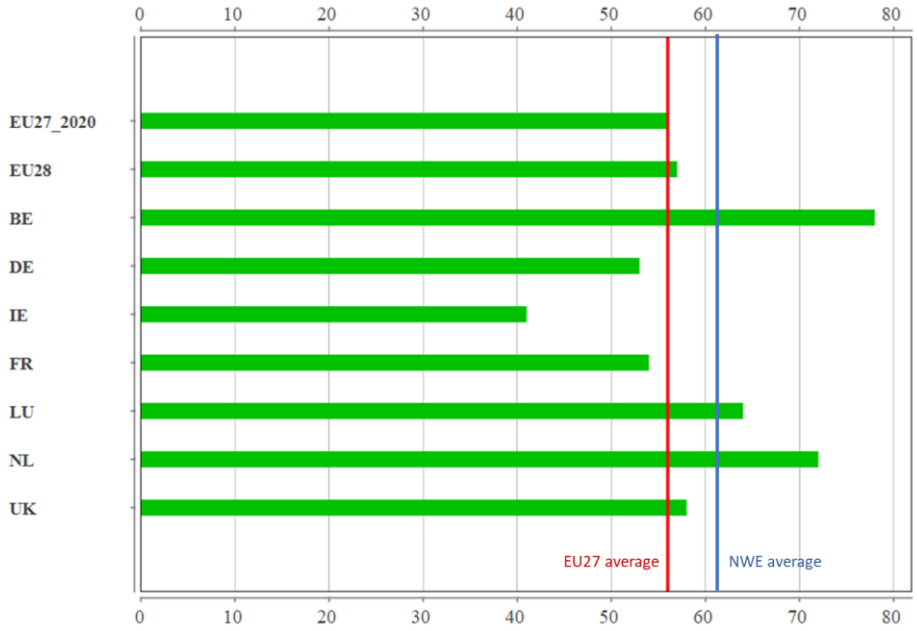
[71] The indicator is defined as all waste generated in a country (in mass unit), excluding major mineral wastes, divided by the domestic material consumption (DMC) of a country. The ratio is expressed in percent (%) as both terms are measured in the same unit, namely tonnes. https://ec.europa.eu/eurostat/tgm/table.do?tab=table&plugin=1&language=en&pcode=cei_pc033.

Map 2-26 Recycling rate of waste, excluding major mineral wastes (% total waste treated)[72], 2016



Source: Eurostat, data product sdg_12_60, 2016 (Data for DE 2014).

Figure 2-14 Recycling rate of waste, excluding major mineral wastes (% total waste treated), 2016



Source: Eurostat, data product sdg_12_60, 2016 (Data for DE 2014).

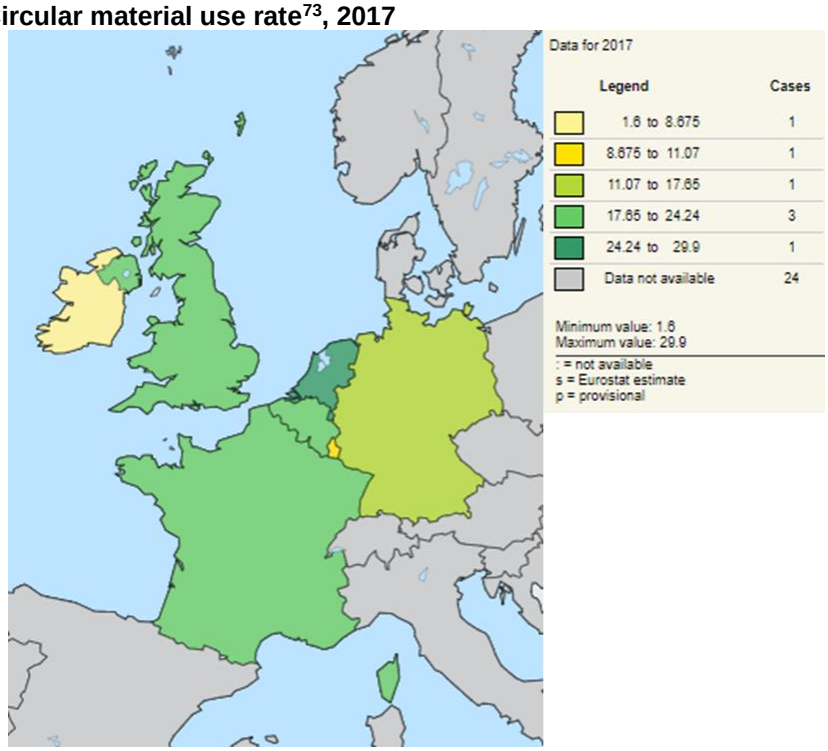
[72] Major mineral waste is excluded in order to avoid situations where trends in ordinary waste generation can be drowned out by massive fluctuations in the generation of wastes in the mineral extraction and transformation sector. This also permits more meaningful comparison across countries, as mineral waste accounts for very substantial quantities in countries characterized by major mining and construction sectors. https://ec.europa.eu/eurostat/web/products-datasets/product?code=cei_wm010.

The NWE average recycling rate of waste (excluding major mineral wastes) is 60%, which is above the EU-27 and EU-28 average. If the data for the United Kingdom are not considered this value improves slightly (60.3%).

2.6.4 Secondary raw materials

The circular (secondary) material use rate (CMR) is a useful indicator to measure the share of material recovered and fed back into the economy in overall material use. A higher circularity rate value indicates that more secondary materials substitute for primary raw materials thus reducing the environmental impacts of extracting primary material. The analysis of this indicator shows that the Netherlands (29.9%), France (18.6%), Belgium (17.8%) and the United Kingdom (17.8%) stand above the EU-27 (11,2%) and EU-28 (11.7%) average, Germany (11.6%) is close to the EU average, whereas Luxembourg (8.9%) and especially Ireland (1.6%) are lagging behind, as highlighted by Map 2-27 and Figure 2-15.

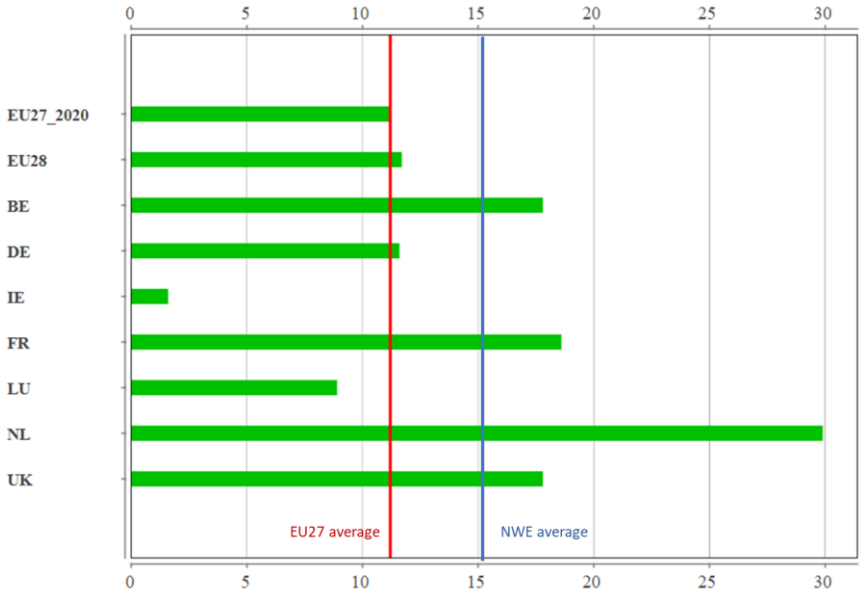
Map 2-27 Circular material use rate[73], 2017



Source: Eurostat, data product sdg_12_41, (2017)

[73] The circular material use rate (CMR) measures the share of material recovered and fed back into the economy in overall material use. The CMU is defined as the ratio of the circular use of material to the overall material use. The overall material use is measured by summing up the aggregate domestic material consumption (DMC) and the circular use of materials. DMC is defined in economy-wide material flow accounts. The circular use of materials is approximated by the amount of waste recycled in domestic recovery plants minus imported waste destined for recovery plus exported waste destined for recovery abroad. A higher CMU rate value means that more secondary materials substitute for primary raw materials thus reducing the environmental impacts of extracting primary material. https://ec.europa.eu/eurostat/tgm/graph.do?tab=graph&plugin=1&pcode=sdg_12_41&language=en&toolbox=type

Figure 2-15 Circular material use rate, by country, 2017



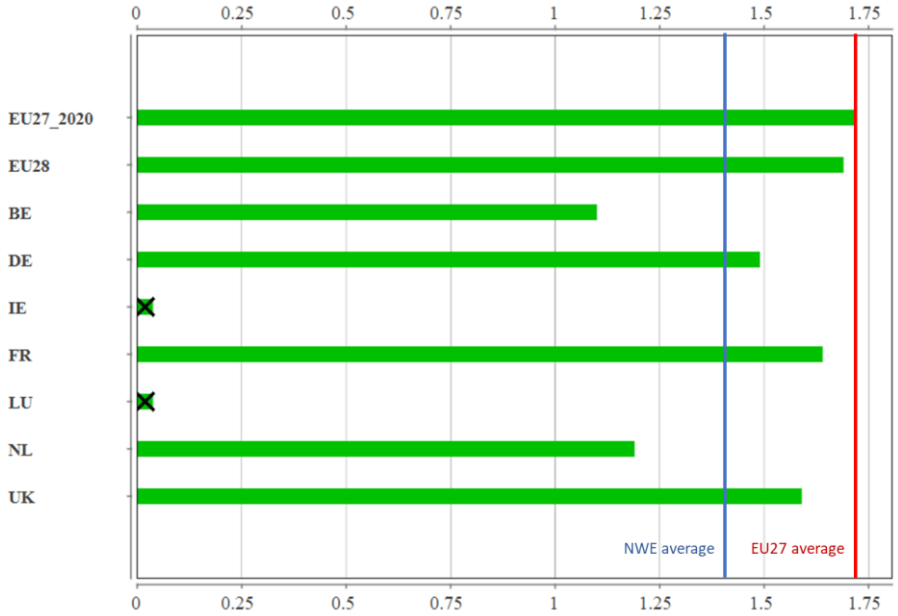
Source: Eurostat, data product cei_srm030, 2017.

Overall, the NWE CMR average is 15.2% which is well above the EU-27 and EU-28 average. If the data for the United Kingdom are not considered this value decreases slightly (14.7%).

2.6.5 Competitiveness and innovation

The share of persons employed in circular economy in the NWE countries out of total employment is below EU-27 and EU-28 average. It is the closest in France (1.64%) and in the United Kingdom (1.59%, data from 2015) and in Germany (1.5%) and furthest in Belgium (1.1%). No data are available for Ireland and Luxembourg (Figure 2-16).

Figure 2-16 Persons employed in circular economy (percentage of total employment), 2017

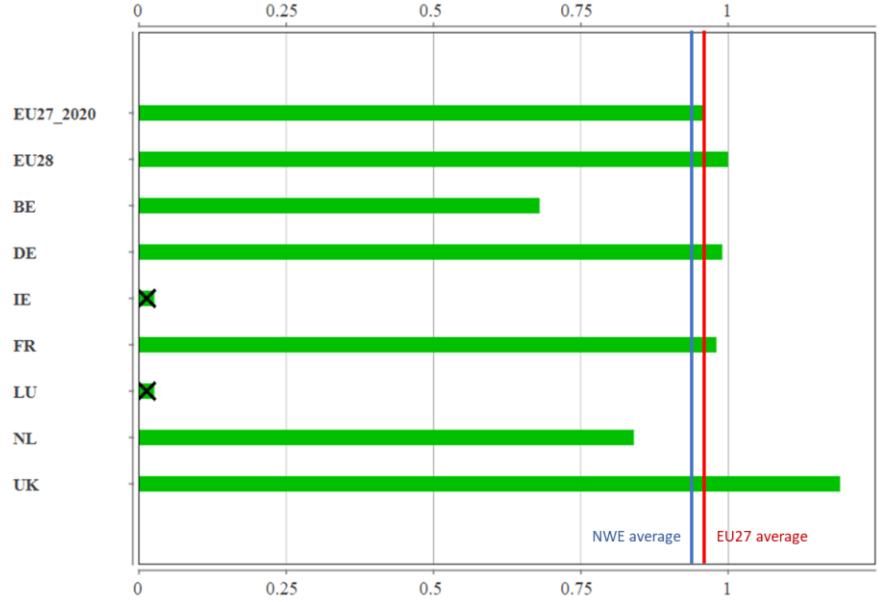


Source: Eurostat, data product cei_cie010, 2017. No data for Ireland and Luxembourg. Data for UK from 2015.

The NWE average share of persons employed in circular economy out of total employment is 1.4% which is well below the EU-27 and EU-28 average. If the data for the United Kingdom are not considered this value worsens slightly (1.35%).

The value added at factor cost as a percentage of gross domestic product shows a partially different situation, with Germany (0.99%), France (0.98%) and the United Kingdom (1.19, data from 2016) above the EU-27 average, and the Netherlands (0.84%) and Belgium (0.68) following below. These results indicate the relatively higher productivity achieved in circular economy-related sectors in the United Kingdom, Germany and France, compared to the rest of EU-27. No data are available for Ireland and Luxembourg (Figure 2-17).

Figure 2-17 Value added at factor cost as a percentage of gross domestic product, 2017



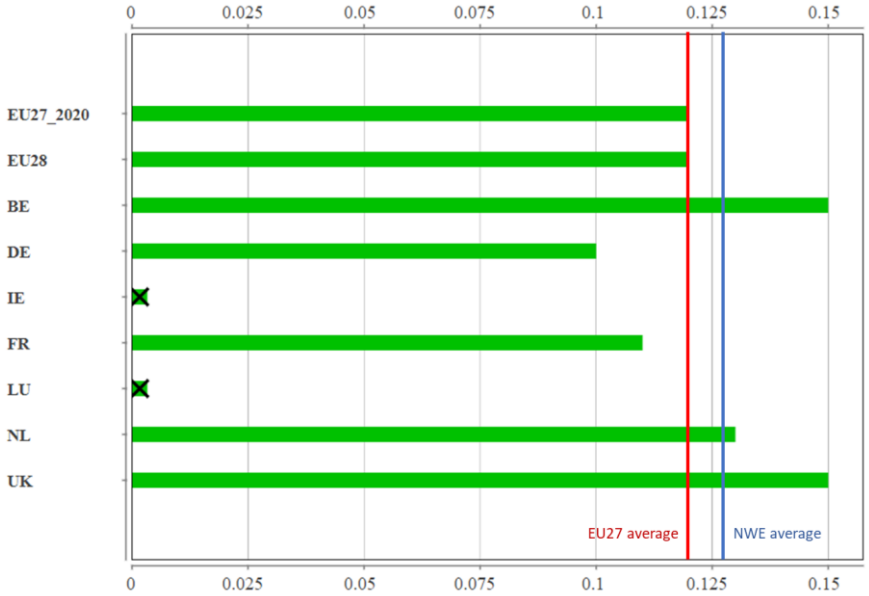
Source: Eurostat, data product cei_cie010, 2017.No data for Ireland and Luxembourg. Data for United Kingdom from 2016.

The NWE average value added at factor cost as a percentage of gross domestic product is 0.94% which is well below the EU-27 and EU-28 average. If the data for the United Kingdom are not considered this value worsens slightly (0.87%).

Belgium (0.15%), the Netherlands (0.13%) and the United Kingdom (0.15%) are above EU-27 average also in terms of the share of GDP related to gross investment in tangible goods, whereas France (0.11%) and Germany (0.1%) are below the EU-27 average. Data from Ireland and Luxembourg are not available. Included are new and existing tangible capital goods, whether bought from third parties or produced for own use (i.e. capitalised production of tangible capital goods), having a useful life of more than one year including non-produced tangible goods such as land. Investments in intangible and financial assets are excluded (Figure 2-18).

Overall, the NWE average share of GDP related to gross investment in tangible goods is 0.13%, which is slightly above both the EU-27 and EU-28 average. If the data for the United Kingdom are not considered this value remains substantially stable (0.12%).

Figure 2-18 Gross investment in tangible goods (percentage of gross domestic product), 2017



Source: Eurostat, data product cei_cie010, 2017. No data for IE and LU. Data for FR and UK from 2015.

2.6.6 Critical raw materials

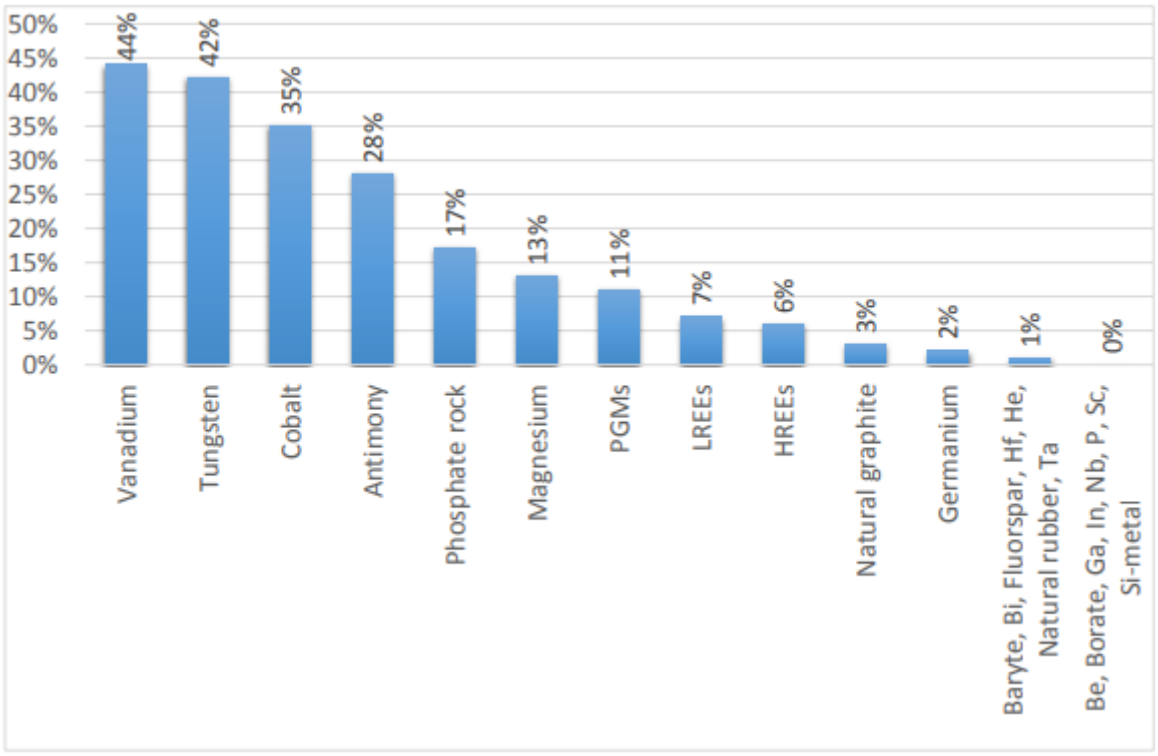
From smartphones to wind turbines, the rapid technological progress of the last decades has been made possible by using many metals not widely used before the 1990s. But supplies of these metals are not infinite. For example, for copper, which is widely used in wiring and electrical infrastructure, the recycling rate is high at around 60% in Europe. However, not all collected copper is recycled within the EU, and much scrap is exported for recycling. For indium (recovery and recycling of indium – used in electronic goods such as smartphones and flat-screen televisions – the recycling rate is non-existent. If the urban mines of indium were collected, the rare metal separated and the waste metal recycled, almost the entire European demand for the metal could be met. Another example is neodymium (used in permanent magnets in wind turbines, laptops and electric vehicles), the EU relies entirely on imported materials, making recycling even more important. About 80% of end-of-life products containing neodymium are collected for recycling, but the metal is not recovered during product sorting and separation processes. If neodymium in urban mines was collected and recycled, it could meet 60% of European demand at current levels. Likewise, europium, which is used in fluorescent lamps, LEDs and electronic goods provides another good example. Today there are no recycling facilities, but recovery and recycling of this metal currently in urban mines could meet the entire EU demand.

These materials are either relatively scarce, or Europe is almost entirely dependent on imports. To help prevent shortages in the future and make the production and use of these metals more sustainable, studies on the potential for recycling them in Europe shows promising results (JRC, 2017).

Although several critical raw materials (CRMs) have a high technical and real economic recycling potential, and despite the encouragement from governments to move towards a circular economy, the recycling input rate (a measure of the share of secondary sources in raw material supply) of CRMs is generally low (see Figure 2-19). This can be explained by several factors: sorting and recycling

technologies for many CRMs are not available yet at competitive costs; the supply of many CRMs is currently locked up in long-life assets, hence implying delays between manufacturing and scrapping which negatively influences present recycling input rates; demand for many CRMs is growing in various sectors and the contribution from recycling is largely insufficient to meet the demand[74].

Figure 2-19 Current contribution of recycling to meet EU demand of CRMs: End-Of-Life recycling



Source: (JRC, 2017)

A few CRMs, namely Vanadium, Tungsten, Cobalt and Antimony have a high recycling input rate. Other CRMs have a good rate of recycling at end-of-life (e.g. recycling rates for PGMs reaches up to 95% for industrial catalysts and 50-60% for automotive catalysts) but this gives a contribution that is largely insufficient to meet the growing demand and thus the recycling input rate is low (e.g. 14% for PGMs).

Several examples of good practice in recycling of CRM have been identified in the NWE countries. The main ones are presented below.

- France: The *Comité pour les Métaux Stratégiques (COMES)* seeks to strengthen the security of supply of strategic metals. Its activities include work on specific recycling targets for strategic metals as part of certain extended producer responsibility (EPR) schemes.[75] The French agency *ADEME* also commissioned and published a study on research and development priorities for the recycling of critical metals (ADEME, 2017).

[74] See Input Rate (EOL-RIR) (JRC elaboration based on the 2017 CRM study and on the MSA study 2015).
[75] http://www.mineralinfo.fr/page/comite-metaux-strategiques.

- The Netherlands: A Government-wide Programme for a Circular Economy (Government of the Netherlands, 2015) addresses critical mineral raw materials by promoting their substitution, efficient use, re-use and recycling. The Ministry of Economic Affairs has also commissioned the development of a “resource scanner”, a method and IT tool to map out business risks.

- The ERA-MIN 2 project, involving from the NWE organisations from Belgium, France, Germany, and Ireland. Through the Horizon 2020 programme, the Commission is co-funding ERA-MIN 2 which is the largest network of R&I funding organisations in the mineral resources field[76].

The main barriers to the development of rare metal recycling facilities include the cost of establishing recycling facilities, intricate product design that complicates the separation of materials, a lack of information on how to extract the material, limited knowledge of which products contain crucial metals and a lack of end-of-life collection processes.

As a summary, the circular use of CRMs depends on many parameters and there is a need to adopt a sectorial analysis of flows of CRMs, including circularity elements to determine the potential of investment in the specific solutions[77]. It should be pointed out that circularity is very much influenced by the sectors in which CRMs are used: the demand and the duration of the use of the CRMs is strictly dependant on the products that the CRMs are embodied in, recycling rates usually depend on the nature of the end-of-life products the CRMs are embodied in; moreover, circularity of several CRMs strongly benefits from take back-scheme that are implemented in various sectors.

3 PO 3 – A more connected Europe

The territorial analysis for PO 3 differentiates three themes, namely the integration of digital technologies, mobility and connectivity at different levels and scales and multimodality of transport infrastructure.

3.1 Digital Economy and Society Index and integration of digital technology

The analysis on digital connectivity and the integration of digital technology into business sectors and public services is based on the Digital Economy and Society Index (DESI)[78] referring to the year 2018.

According to DESI, countries of the NWE cooperation area show the highest digital performances at EU level, registering, in most cases, higher values than the EU average (52,5%). With a DESI score of 72,6%, the Netherlands ranked in the third position out of the 28 Member States followed by the United Kingdom (fifth position with a score of 63,6%), Luxembourg (sixth position with 61,8%) and Ireland (seventh position with 61,4%). Also Belgium (59,4%) and Germany (54,4%) are performing well,

[76] The partners are Finland (Tekes), France (ANR and ADEME), Germany (Juelich/BMBF), Ireland (GSI), Italy (MIUR), Poland (NCBR), Portugal (FCT), Romania (UEFISCDI), Slovenia (MIZS), Spain (CDTI and MINECO) and Sweden (Vinnova); Flanders (FWO and Hermesfonds) and Castille y Léon (ADE); Turkey (TUBITAK), Argentina (MINCyT), Brazil (Finep), Chile (CONICYT) and South Africa (DST).

[77] The need to adopt a sectorial analysis for the analysis of flows of CRMs, including considering circularity aspects, was confirmed by a recent report of the SCRREEN project. http://scrreen.eu/.

[78] The Digital Economy and Society Index (DESI) is a composite index summarising relevant indicators on Europe’s digital performance, which track the progress of EU Member State in digital competitiveness. The five components of DESI are: 1. Connectivity (fixed broadband, mobile broadband, fast and ultrafast broadband and prices); 2. Human capital (internet users skills and advanced skills); 3. Use of internet (citizens’ use of internet services and online transaction); 4. Integration of digital technology (business digitization and e-commerce); 5. Digital public services (e-Government and e-health).

covering, respectively, the 9th and 12th position in the EU ranking, while France (51%) is the only country in the NWE cooperation area showing a DESI score below the EU average (European Commission, 2019d).

Generally speaking, these positive digital performances are due to a combination of factors, such as the availability of fast fixed and mobile broadband networks, the improvement of digital skills as well as the level of digitization of economy and public services, although some differences among NWE countries and the divide between urban and rural areas persist.

Based on the DESI components relating to connectivity, the following table shows data on the percentage of households covered by fast and ultrafast broadband networks at national level. Available data show quite homogeneous values relating to both fixed broadband and 4G networks coverage throughout the NWE cooperation area (all of them higher than in the EU), while next-generation access (NGA) fast broadband reaches the highest value in the Netherlands, covering 99,5% of households, and the lowest in France (58%). Similarly, ultra-fast broadband coverage in the most member states of the NWE cooperation area is higher than the EU average (60%), except for France (49%) and United Kingdom (52%) (Table 3-1).

Table 3-1 Connectivity per type of network (% of covered households), 2018

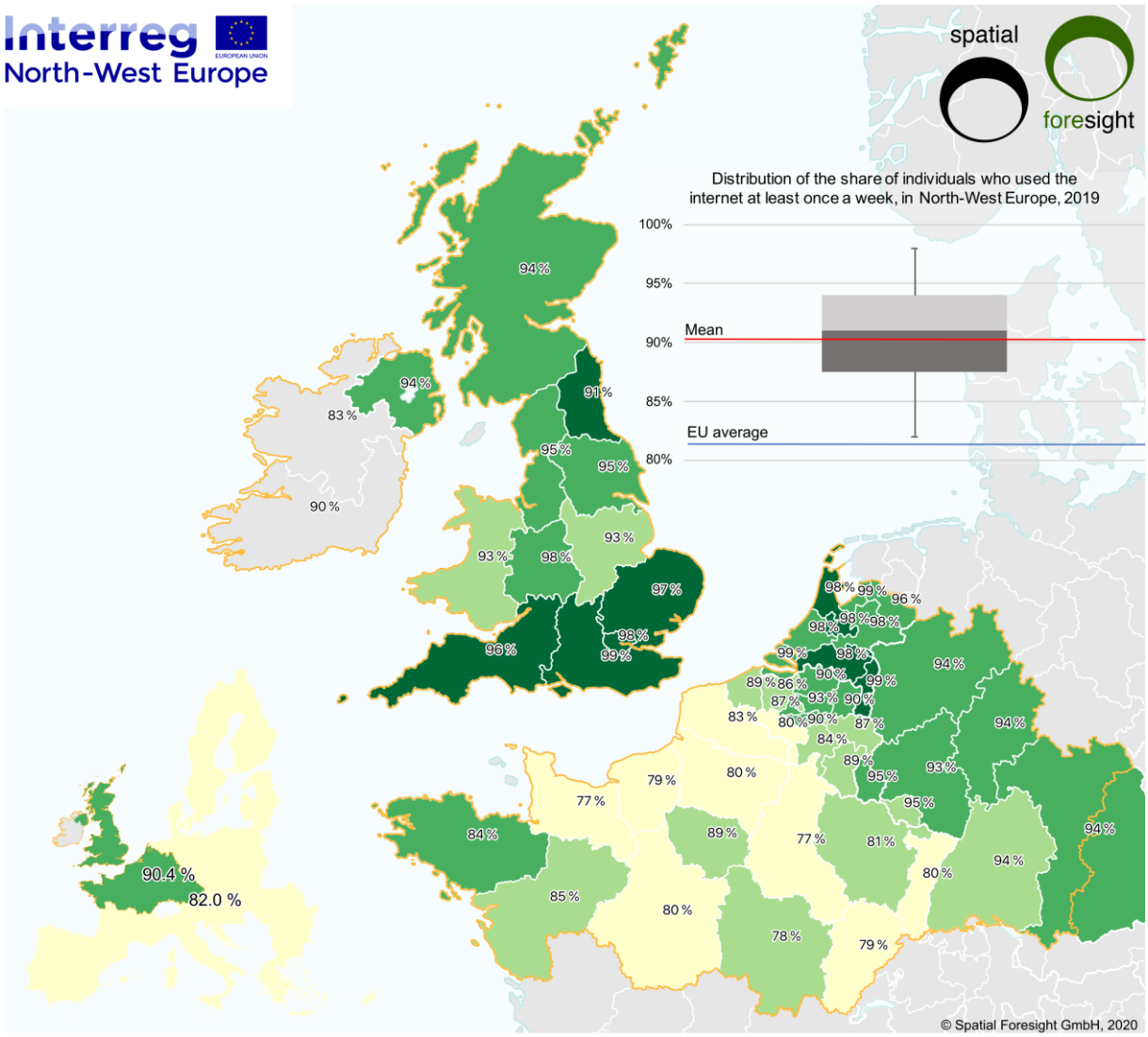
Type of network	BE	FR	DE	IE	LU	NL	UK	EU
Fixed broadband coverage	99,5%	99,5%	98%	98%	100%	100%	100%	97%
4G coverage	99,5%	95%	90%	96%	99%	99,5%	98%	94%
Fast broadband (NGA) coverage	99%	58%	88%	96%	98%	99,5%	95%	83%
Ultrafast broadband coverage	96%	49%	66%	56%	92%	97%	52%	60%

Source: (European Commission, 2019d)

Information on 5G readiness[79] is still partial, but it is worth stressing that debates about coverage and access obligations in the 5G auction are in the political agenda of NWE countries and debate on the regulatory implementation of obligations is expected to continue in the future, foreseeing a synergy of both EU and national funds.

[79] The European Commission defines 5G readiness as the assigned spectrum as a % of total harmonised 5G spectrum, (European Commission, 2019d).

Map 3-1 Individuals who used the internet at least once a week (share of total), 2019



Administrative boundaries: Spatial Foresight and University of Geneva based on material from Eurostat GISCO, the GADM database and the EEA.
Data: based on Eurostat [isoc_r_iuse_i] and [isoc_r_broad], extracted 13.03.2020. Figures for IE (internet use) not available and excluded from calculation, figures for UK and DE: NUTS1.

Individuals who used the internet and broadband access

Individuals who used the internet at least once a week, share of total individuals and share of households with access to broadband, 2019

- < 85 %
- 85 - 90 %
- 90 - 95 %
- > 95 %
- 94 % Share of households with broadband access
- Programme area
- no data / no NWE territory

Source: own representation, 2020

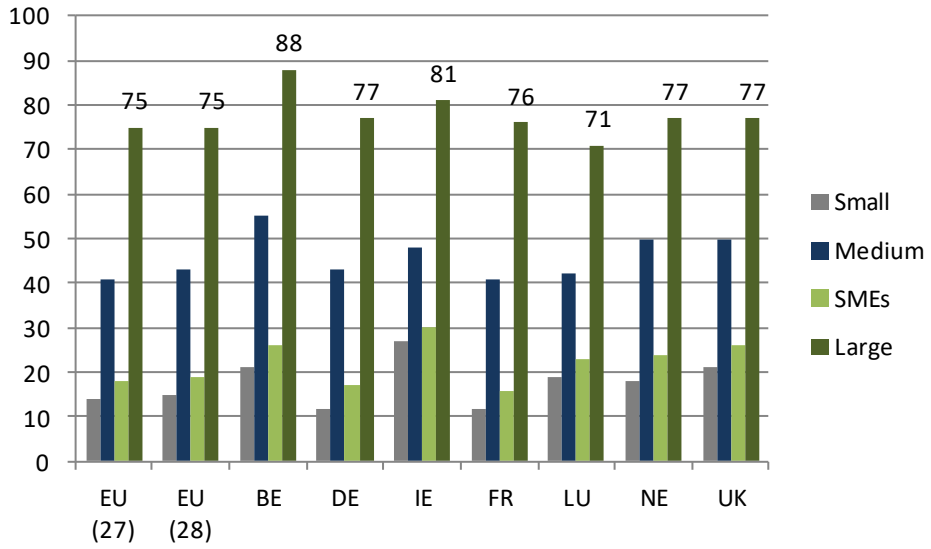
All in all, the availability of fast and ultra-fast broadband networks enabled to increase both digital skills and the use of web-based services like home-banking, online shopping and social networking. In 2019, the percentage of individuals living in NWE cooperation area regularly using the internet at least once a week represented 91% of the whole population[80] and most people aged between 16 and 74 declared to have at least basic digital skills with values varying between 85% in Luxembourg and 48% in Ireland

[80] Elaboration on EUROSTAT database “Individuals regularly using the internet by NUTS 2 regions [TGS00050]

(57% in the EU) (European Commission, 2019d). The percentages are slightly lower when considering individuals having above basic digital skills (with values varying between 55% in Luxembourg and 28% in Ireland against 31% in the EU) and ICT graduates, even if most countries reach higher values than the EU (3,5%)[81]. Map 3-1 also shows visually that individuals in the majority of the regions in the NWE cooperation area have used the internet at least once a week.

At the same time, the percentage of enterprises employing ICT specialists to develop their business are above the EU average in relation to almost all kinds of enterprises. This is particularly true for large and medium enterprises: the percentage of large enterprises that employ ICT specialists varies between 88% in Belgium and 71% in Luxembourg (against the European average of 75%), while values relating to medium-sized enterprises vary between 55% in Belgium and 41% in France, which is a bit lower than the average at EU level (43% for EU-28 countries)[82] (Figure 3-1).

Figure 3-1 Employment of ICT specialists per typology of enterprise (%), 2019



Source: Own elaboration based on Eurostat 2020 data (isoc_ske_itspen2)

SMEs and small-sized enterprises are lagging behind in the employment of ICT personnel in line with European trends, but they are doing efforts to exploit internet potentials, especially by increasing their online sales (the percentage of SMEs selling online in the NWE area vary between 30% in Ireland and 12% in Luxembourg against 17% in the EU). Nonetheless, raising awareness on the relevance of digitalisation among SMEs and their investment in new technologies are of pivotal importance for most countries in the NWE cooperation area.

As far as the integration of digital technologies into business sectors is concerned, enterprises are mostly taking advantage of electronic information sharing and the use of social media to promote their

[81] Data on ICT graduates according to DESI figures are the following: Belgium 1,6%, France 3%, Germany 4,5%, Ireland 7%, Luxembourg 5,8%, UK 3,6%. Data relating to the Netherlands are not available for the year 2019.
[82] EUROSTAT database “Enterprises that employ ICT specialists” [isoc_ske_itspen2]

business. As shown in the table below, enterprise in the NWE cooperation area also rank relatively high in the use of big data and cloud services compared to EU average values (see Table 3-2).

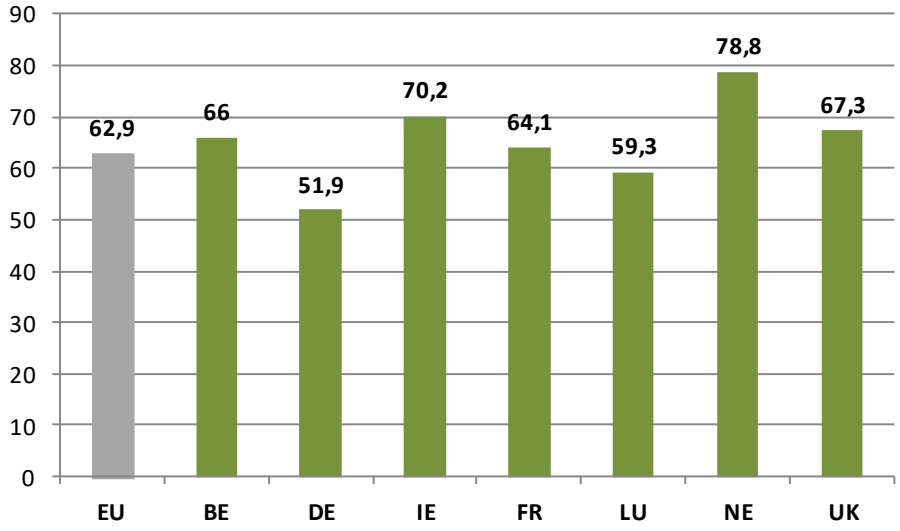
Table 3-2 Use of digital technologies in enterprises, 2018

Digital technologies *(% of enterprises)*	**BE**	**FR**	**DE**	**IE**	**LU**	**NL**	**UK**	**EU**
Electronic information sharing	54%	38%	38%	28%	41%	48%	19%	34%
Social media	24%	16%	16%	36%	20%	39%	42%	21%
Big data	20%	16%	15%	20%	16%	22%	NA	12%
Cloud	31%	15%	12%	33%	16%	42%	30%	18%

Source: (European Commission, 2019d)

In relation to the development of digital public services (which, among other parameters, include e-Government tools, open data, e-health services and medical data exchange), NWE countries are well above EU value (62,9) except for Luxembourg (59,3) and Germany (51,9) as shown in Figure 3-2.

Figure 3-2 Digital public services, 2018



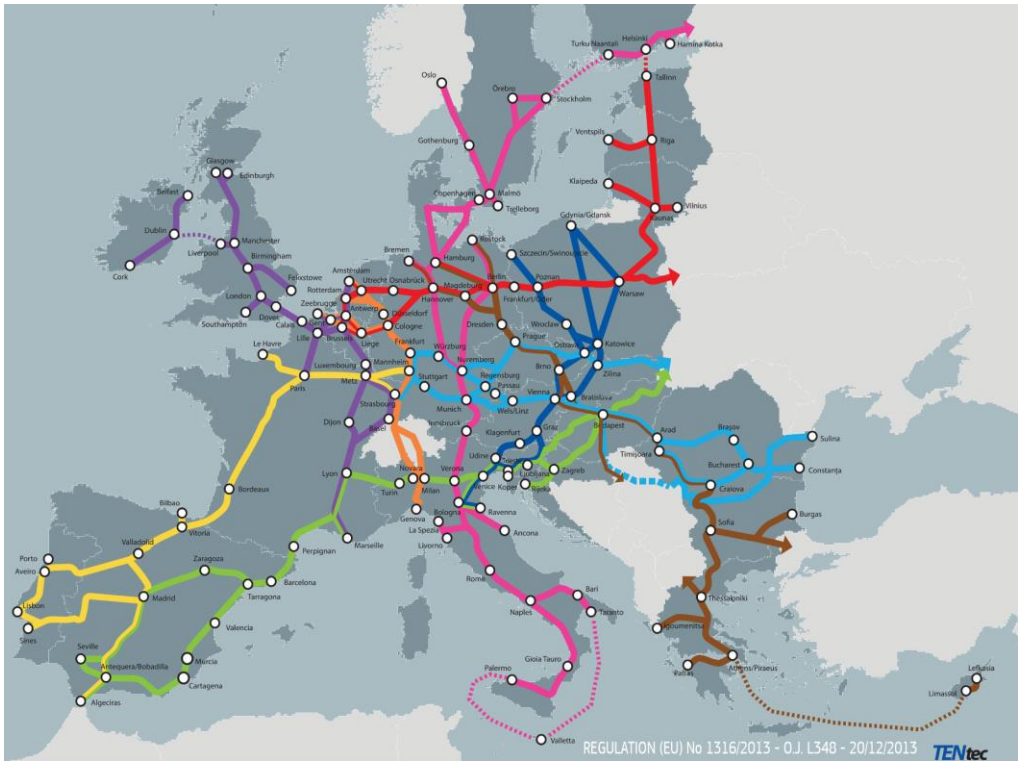
Source: (European Commission, 2019d)

As for investments in the digitalisation of business processes, in addition to national initiatives, member states of the NWE cooperation area are committed to the development of innovative digital technologies by means of strategic programmes coordinated at EU level, such as the European High-Performance Computing Joint Undertaking (EuroHPC) (European Commission, 2020i), the European Blockchain Partnership Declaration (European Commission, 2020j) and the Declaration of Cooperation on Artificial Intelligence (JRC, 2018), representing the policy framework for upcoming research and innovation activities aimed to support a more smart and sustainable economic growth based on the efficient and secure use of digital technologies.

3.2 Mobility and connectivity at different scales (local to TEN-T)

The NWE Programme area is crossed by seven TEN-T core network corridors[83] and involves some of the best connected areas in the EU, with widespread road and railway connections as well as ports and international airports of pivotal importance for both cargo and passengers transport to the main European and global destinations (Map 3-2).

Map 3-2 TEN-T Core Network corridors

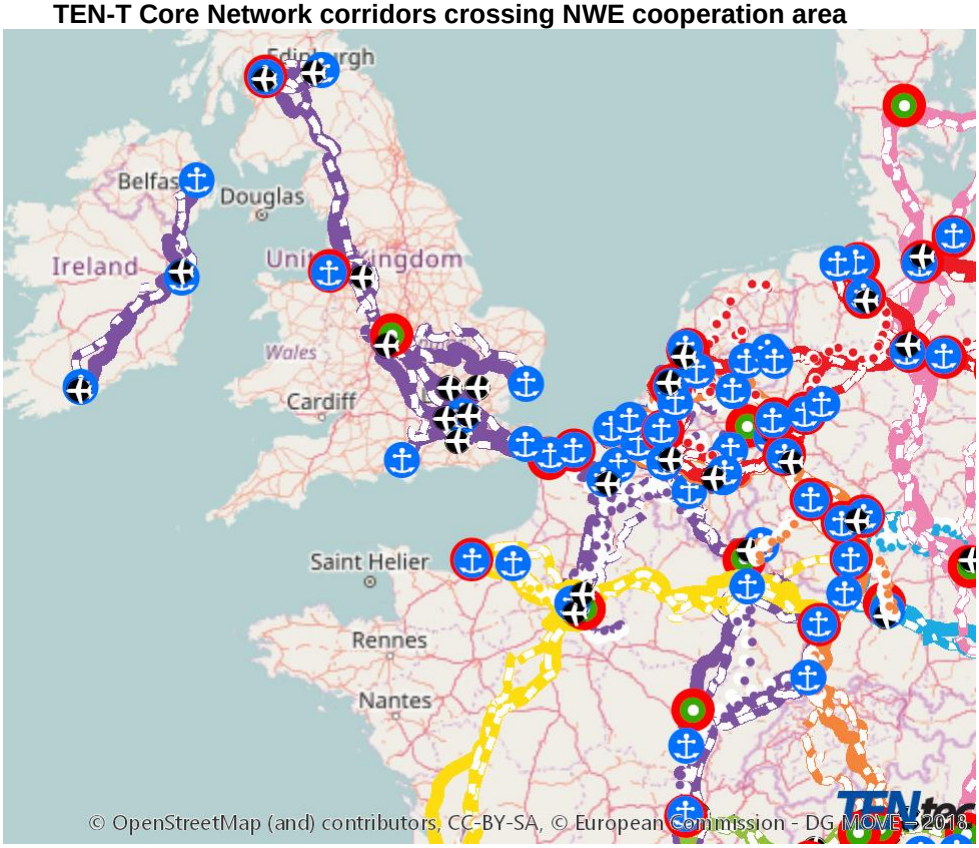


Source: TENtec portal, 2020

The availability of a variety of transport infrastructures reflects the geographical features, population trends and economic conditions in the NWE cooperation area, ranking it among the most advanced regions in the EU in relation to transport facilities, technology and economy performances. Though, it also highlights the existence of gaps between capital regions/urban agglomerations, benefiting more from the proximity to TEN-T networks, and the rural regions, which benefit less. As a matter of fact, for a few members states of the NWE cooperation area (like France and Ireland) the overall accessibility remains a big challenge (European Commission, 2020k).

[83] TEN-T core network corridors involving, at different degrees, territories in the NWE area are: North Sea- Baltic, Mediterranean, Scandinavian – Mediterranean, Rhine-Alpine, Atlantic, North Sea – Mediterranean, Rhine – Danube. For more information, please visit https://ec.europa.eu/transport/infrastructure/tentec/tentec-portal/map/maps.html

Map 3-3 TEN-T Core Network corridors crossing NWE cooperation area



Source: TENtec portal - Interactive Map Viewer, 2020

All in all, data on accessibility by type of transport confirm that countries involved in the Programme are among the most connected areas in Europe, showing values relating to road, rail and air accessibility higher than the European average.

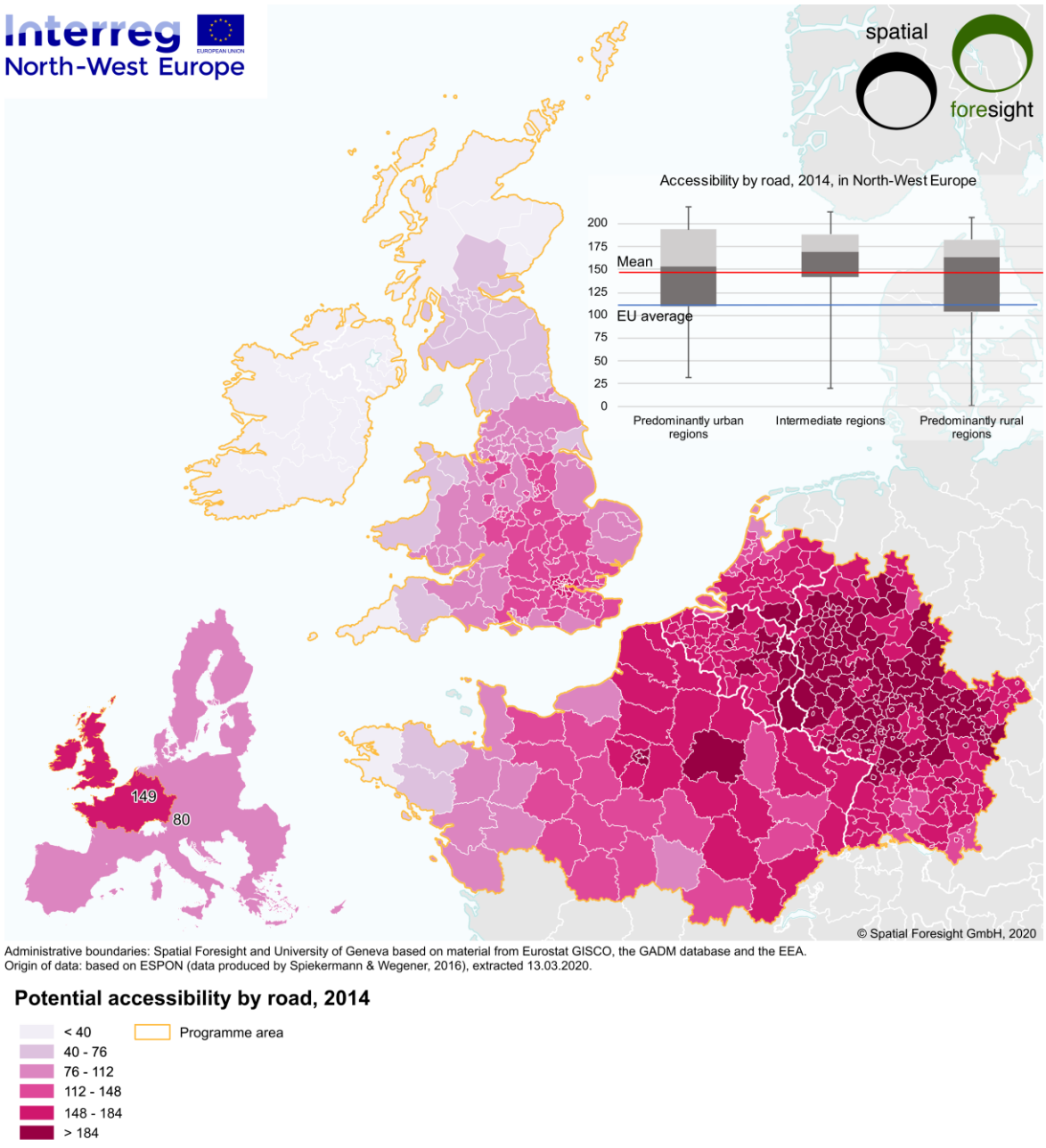
As for road connections, accessibility in NWE intermediate and rural regions is higher than in predominantly urban areas probably due to the high density of motorways, the lack of alternative strategic infrastructures and possible weaknesses in public transport services, especially across borders.

Map 3-4 shows that most eligible NUTS 2 regions in Germany (e.g. Saarland, Trier Rheinhessen-Pfalz, etc.), Luxembourg (whole territory), Belgium (e.g. Liége, Luxembourg, Limburg), the Netherlands (e.g. Limburg, Noord-Bramant, Gerderland) and France (e,g. Île de France, Nord-Pas-de-Calais and Champagne-Ardenne) record higher road accessibility rates than the European average mainly due to the presence of good motorways networks.

This evidence is confirmed by studies on potential accessibility scenarios highlighting that southern regions of the Netherlands, all regions in Belgium, regions in northern and eastern France and in the western parts of Germany have the highest accessibility potential by road in Europe thanks to the combination of well-developed road infrastructure (especially dense motorway networks) and a high concentration of population (ESPON, 2017a, pg.9).

On the other hand, the development of road networks also produces negative externalities, such as air pollution and road congestion, which represent the major problems tackled by several countries in the NWE area. This is particularly the case for Belgium, which has the most congested roads in Europe, the Netherlands, Germany, Luxembourg and Ireland where greenhouse gas emissions from road transport have been increasing in the last years.[84]

Map 3-4 Accessibility by road in North-West Europe, 2014



Source: own representation, 2020

[84] EC, Commission Staff Working Documents, Country Reports, 2019

These negative side-effects are particularly evident in urban areas where population and business opportunities are mainly located. Especially road congestion affects travel time, air quality and accessibility to jobs, services and resources.

Many cities in the cooperation area have tackled the need to guarantee a more sustainable and multimodal urban mobility system, considering the combined use of different means (e.g., walking paths, car sharing, renting bikes, etc.), especially by improving the network of bike lanes to further enhance the use of bicycles for private movements. Due to the lack of homogeneous data relating to urban mobility and particularly to bike as a transport modality at European (Eurostat) and NWE area levels, it was not possible to develop a comprehensive analysis on sustainable urban mobility, which will surely be on top of urban planning priorities in the next post COVID-19 period.

Nonetheless, on this subject, it is worth stressing that, following the EU Transport White Paper, in 2011, and the publication of the first guidelines for developing and implementing the Sustainable Urban Mobility Plans (SUMPs), in 2013, the EC has been supporting the uptake of an integrated urban mobility approach by EU urban areas, also taking into consideration that the transport of goods and people through TEN-T networks starts and ends in cities.

The reduction of traffic congestion through SUMPs in urban areas is expected to develop TEN-T logistics, by improving access to motorways, to better linkages with main transport hubs (ports, airports) located in urban areas and better organization of city logistics in general (European Commission, 2013c). Moreover, cities that adopted SUMPs have experienced an increasing engagement of local authorities and stakeholders, through the use of participatory methods leading to the cooperation among institutions and the active participation of citizens in long-term integrated urban mobility planning. It is also worth stressing that a number of cities in the NWE cooperation area represent good practice examples in the implementation of SUMPs, such as, for instance, London, Brussels Capital Region and Groningen as for the management of SUMPs characterised by the full support of key political figure (e.g. mayor or vice-mayor) or in the example of Kassel where both a city and a regional mobility plans were drafted so as to ensure the efficiency of transport planning across city boundaries[85].

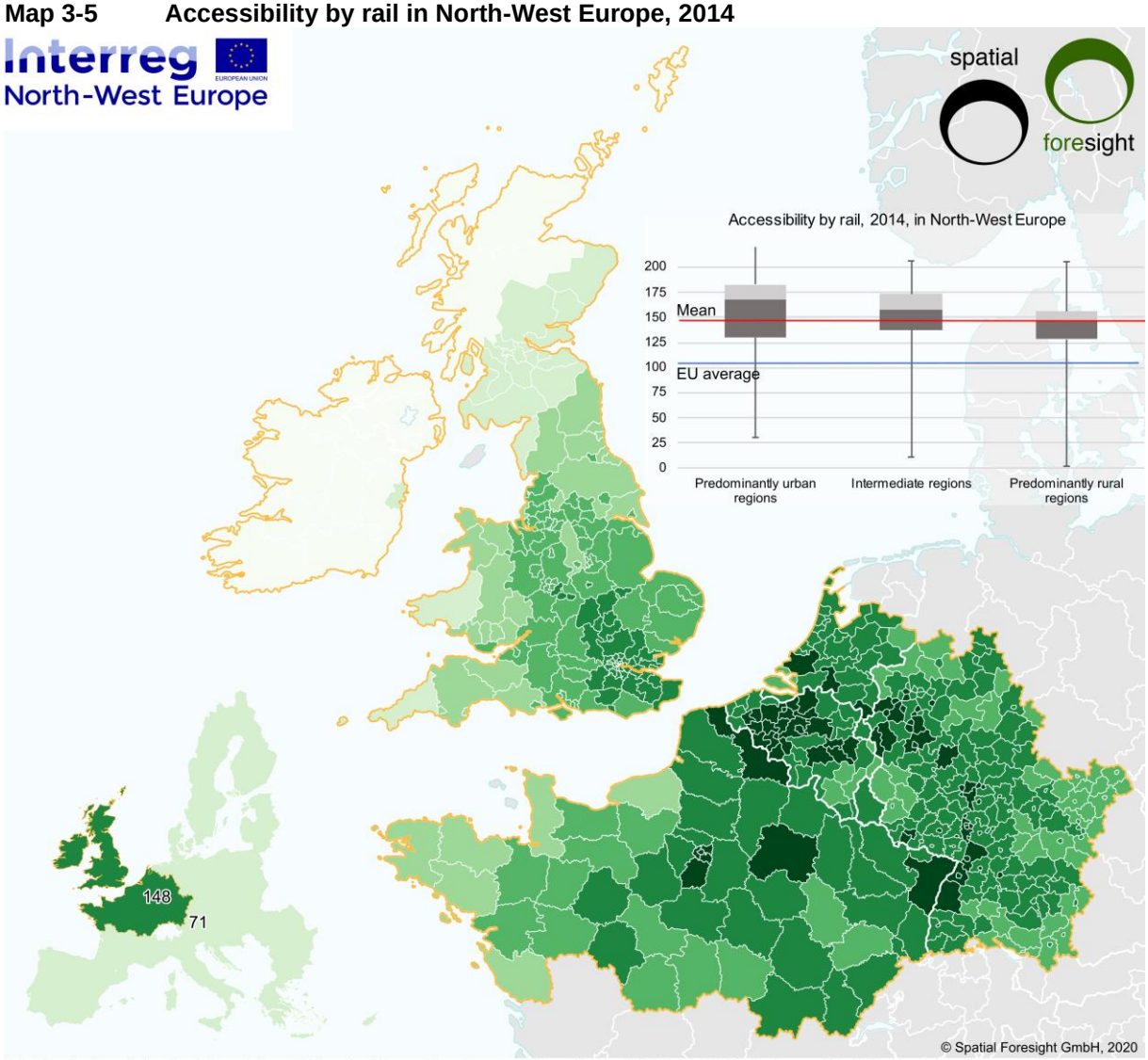
The overall NWE cooperation area shows higher rates than the European average also in relation to railway accessibility. Unlike road networks, predominantly urban regions record the highest values on rail accessibility compared to both intermediate and rural areas mainly due to their proximity to high-speed railway networks, which are expected to enhance accessibility also in areas with high accessibility potentials by road. On this topic, it is worth mentioning corridors in France towards the Atlantic and, via Lyon, to the Mediterranean regions or in Germany towards Hannover and Berlin. Moreover, all regions in the Benelux countries, England, France and Germany have an accessibility potential by rail above the European average, while Ireland ranks below this value (ESPON, 2017a).

Map 3-5 also shows potential developments in railway accessibility at cross-border level (for instance, between Nord-Pas-de-Calais, in France, and West-Vlaanderen, in Belgium, or between France and Germany considering links between Alsace and Freiburg and/or Karlsruhe), notwithstanding the need

[85] European Platform on Sustainable Urban Mobility Plans, Annex to the guidelines for developing and implementing a SUMP (2nd edition), https://ec.europa.eu/transport/themes/urban/urban-mobility/urban-mobility-actions/sustainable-urban_en

for additional investments to improve existing connections (Commission Européenne, 2019; European Commission, 2019e, n.d.).

Map 3-5 Accessibility by rail in North-West Europe, 2014



Administrative boundaries: Spatial Foresight and University of Geneva based on material from Eurostat GISCO, the GADM database and the EEA.
Origin of data: based on ESPON (data produced by Spiekermann & Wegener, 2016), extracted 13.03.2020.

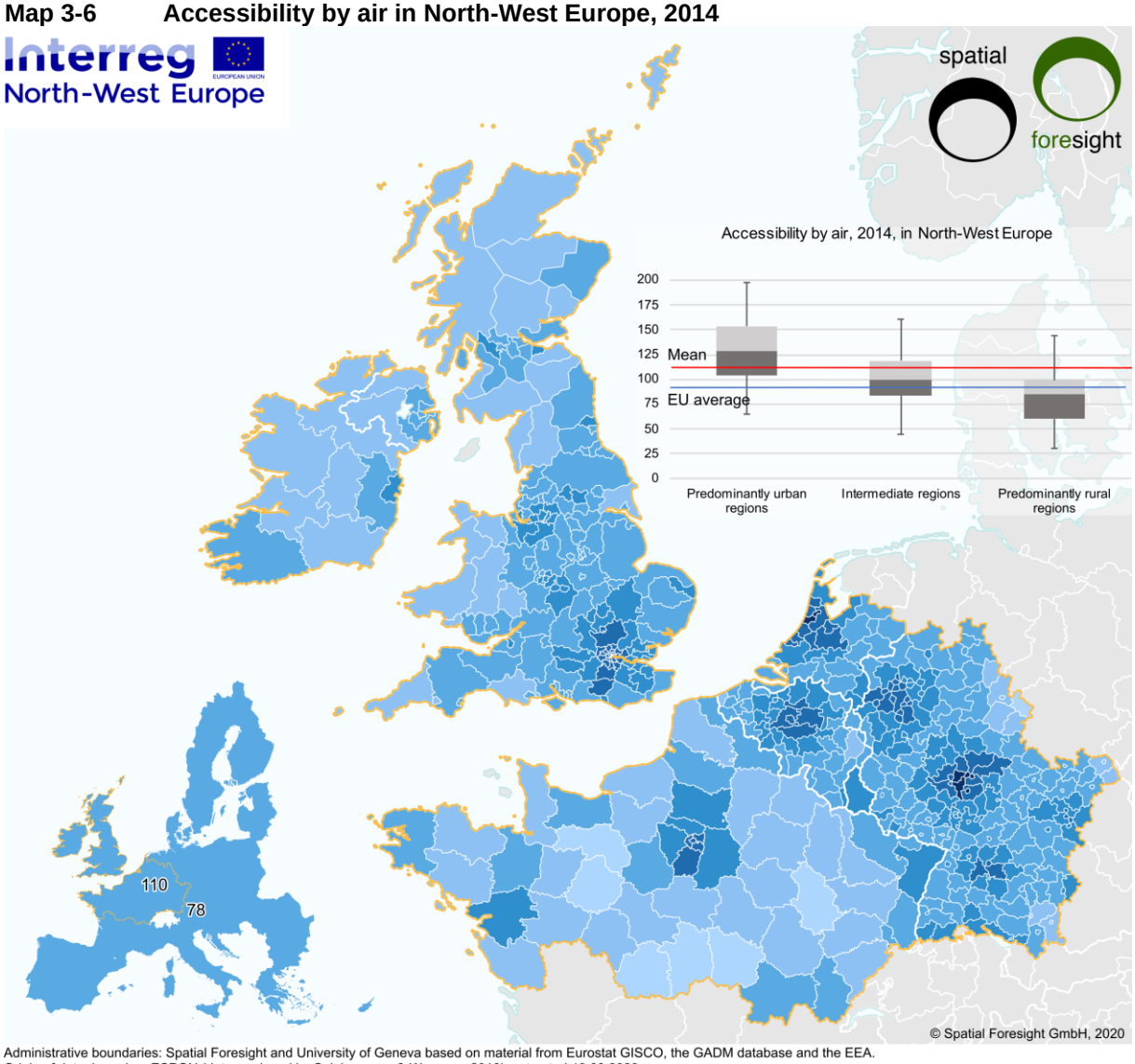
Potential accessibility by rail, 2014

- < 40
- 40 - 76
- 76 - 112
- 112 - 148
- 148 - 184
- > 184
- Programme area

Source: own representation, 2020

As for air accessibility, Map 3-6 highlights that urban regions are far more connected than intermediate and rural areas with the highest rates coinciding with the major international airports in Europe, namely London, Paris, Brussels, Amsterdam, Düsseldorf, Frankfurt and Munich.

Map 3-6 Accessibility by air in North-West Europe, 2014



Administrative boundaries: Spatial Foresight and University of Geneva based on material from Eurostat GISCO, the GADM database and the EEA.
Origin of data: based on ESPON (data produced by Spiekermann & Wegener, 2016), extracted 13.03.2020.

Potential accessibility by air, 2014

- < 40
- 40 - 76
- 76 - 112
- 112 - 148
- 148 - 184
- > 184
- Programme area

Source: own representation, 2020

Moreover, data relating to the air transport of passengers by NUTS 2 regions highlight that, in the year 2018, the highest number of travelers passed by Paris (with over 105,000 passengers) followed by London (over 80,000) and Frankfurt (more than 69,000 passengers)[86].

3.2.1 Multimodal infrastructures and use of intermodal transport

Multimodal accessibility stands for the combined use of different types of infrastructures and intermodal transport systems aiming to reduce the road leg of freight transportation and to limit its negative side effects on both traffic flows and the environment.

As far as the transport of goods is concerned, the NWE cooperation area can count on a variety of transport modes given the mentioned proximity to the main European TEN-T corridors and the availability of road, rail, air, sea and inland waterways, although with some differences among involved countries.

Table 3-3 shows data on the transport of goods by mode of transport at national level to guarantee as much complete and homogenous information as possible and to enable comparisons among member states of the NWE cooperation area and between them and to the European average. Air transport is the most frequently used mode of transport for goods throughout the cooperation area, also at a higher rate than the EU average (46%), except for Ireland where goods transported by air represent 45% of the total volume of transported goods. Luxembourg shows the highest rate of air transport of goods (94%) followed by Belgium (62%) and the United Kingdom (58%).

Table 3-3 Transport of goods by mode of transport (year 2017)

NWE Countries	Sea	Air	Road	Rail	Inland waters
EU – 28 countries	**11%**	**46%**	**41%**	**NA**	**2%**
EU – 27 countries (by 2020)	**10%**	**47%**	**42%**	**NA**	**2%**
Belgium	13%	62%	15%	NA	10%
Germany	3%	54%	36%	4%	3%
Ireland	15%	45%	40%	0%	NA
France	7%	53%	37%	2%	1%
Luxembourg	NA	94%	5%	0%	1%
Netherlands	17%	53%	19%	1%	10%
United Kingdom	10%	58%	30%	2%	NA

Source: Own elaboration on Eurostat data on goods transport by sea [TTR00009], air [TTR00011], road [TTR00005], rail [TTR00006] and inland waterways [TTR00007][87], 2020

Road transport is the second-best choice in all countries, but always at a lower rate than the European average (40%) with values varying between 5% in Luxembourg and 40% in Ireland.

[86] EUROSTAT, Air transport of passengers by NUTS 2 regions [TGS00077]

[87] Values showed in the table represent the ratio of goods transported by mode of transport on the total of transported goods.

Sea transport of goods is still an option in the Netherlands (17%) and Ireland (15%) while France (7%) and Germany (3%) lag behind. Inland waterways are used for the transport of goods in Belgium and in the Netherlands where they represent 10% of transported goods in both cases.

On the other hand, values relating to railway transport of goods are quite low, varying between 4% in Germany and 1% in the Netherlands.

As for possible developments in freight transport, according to the ESPON study on scenarios for accessibility, by 2030 multimodality rates will be highest in urban regions followed by intermediate and rural areas (ESPON, 2017a).

Although multimodal transport concerns mainly goods, the availability of different kinds of infrastructures influences also people behaviour and produces unavoidable externalities. As a matter of fact, accessibility levels by car are in general higher at regional and local level than those for public transport. As pointed out by the European Commission, overcoming road congestion and air pollution are the main challenges for most countries in the NWE area.

For instance, in Belgium increasing congestion is partly explained by the continuous increase of passenger cars, incentivized by toll-free roads, the company car deduction and low environmental taxation. At the same time, the quality of rail services has decreased, and the supply of urban and urban-rural public transport has room for improvement, notably in Wallonia, where access to employment is a major constraint to job seekers. According to its National Reform Programme, important investments and reforms are underway in all regions, while at federal level, and in cooperation with the Regions, the completion of the network of suburban railways around Brussels is progressing. Belgium has also adopted a specific law to open domestic railway services to private suppliers, but the share of passenger transport provided under public service obligations with a directly awarded contract remains very high (European Commission, 2019f).

Similarly, in Germany cars remain by far the most commonly used means of transport for daily commuting and the average time spent in traffic jams is about 30 hours per year so that congestion and looking for parking spaces has been estimated to cost EUR 110 billion per year, or about 4% of Germany's GDP. Although vehicles running on alternative fuels have seen the steepest increase in new registrations, numbers remain low and car and ridesharing are still heavily underexploited (European Commission, 2019g).

Air pollution and road congestion are an overriding concern also for Luxembourg and the Netherlands from both a competitiveness and environmental point of view. Particularly in Luxembourg, the number of cross-border workers (45% of the labour force), the low taxation of transport fuel and the high house prices stimulate increased car use and are an obstacle to improving air quality and traffic conditions. Nonetheless, the use of alternative fuels in new passenger cars sold in Luxembourg has increased over the past few years (European Commission, 2019h).

As pointed out in the previous section on mobility and connectivity at different scales, cities are addressing the above mentioned negative externalities through urban transport planning instruments, such as SUMPs, to promote a shift towards more sustainable modes of transport, which encompasses not only a balanced development and better integration of different transport means (public transport,

car-sharing, cycling, etc.), but also a more efficient planning (including monitoring and assessment) of transport systems efficiency through the involvement of different levels of public authorities, stakeholders and citizens.

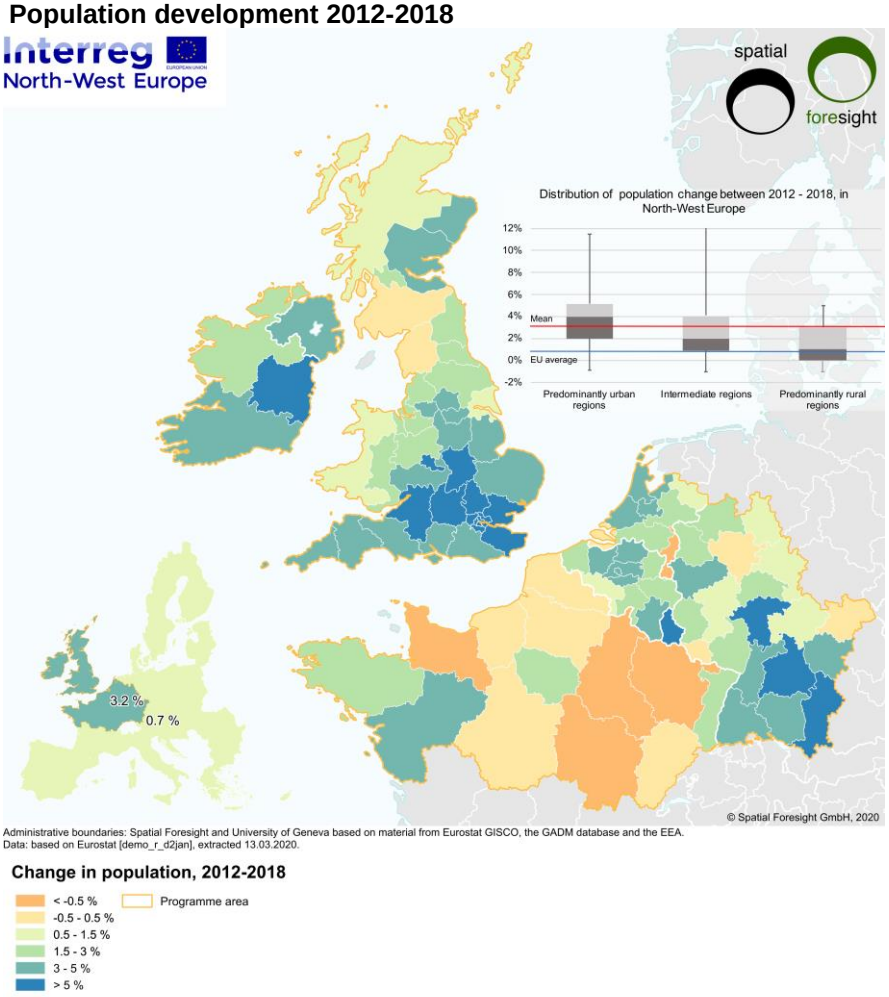
4 PO 4 – A more social Europe

The territorial analysis for PO 4 differentiates four themes, namely population development, labour market, healthcare and social inclusion.

4.1 Population development

Population development is central not only in view of a more social Europe but affects also many other regional development potentials, e.g. the labour force, achieving critical mass or cost-efficiency of public services. In the NWE cooperation area, the overall population development has been above EU average, i.e. growing more than elsewhere in Europe. However, the territorial picture is very divers with regions gaining population by several percentage points (up to nearly 15%) and other regions experiencing population shrinkage of up to more than -1% (Map 4-1).

Map 4-1 Population development 2012-2018



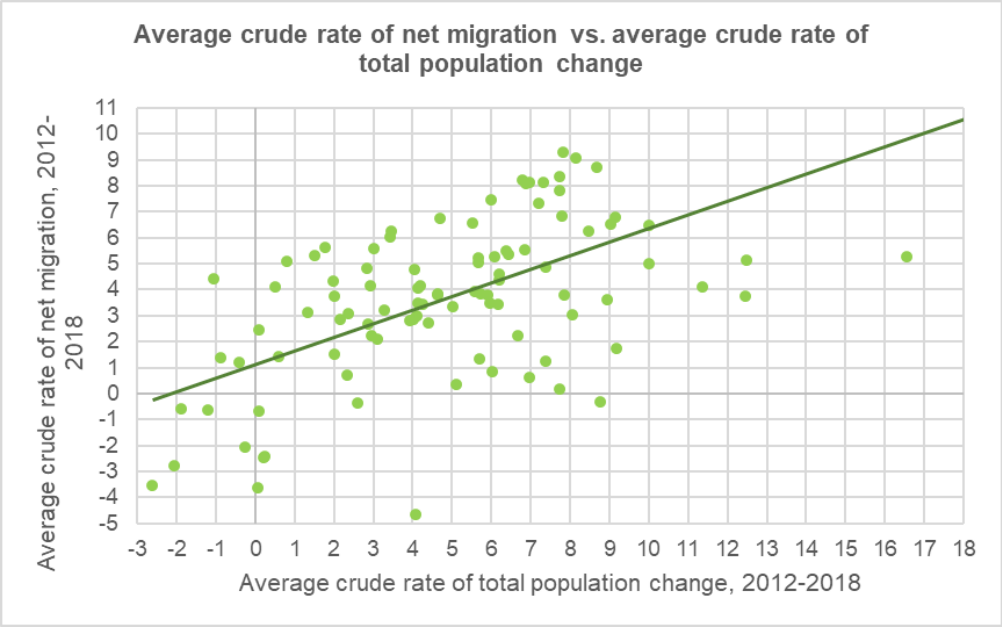
Source: own representation, 2020

Map 4-1 shows the extent to which the population grew in 2012-2018. The NWE cooperation area performs particularly well (+3.2%) in terms of population development, compared to the European growth (0.7%). However, rural regions (mainly the French ones) experienced significant demographic decline. Conversely, the pathways in intermediate and urban areas are on an upward trend (specially in London and Dublin regions, and Stuttgart and Darmstadt).

This pattern is driven by national differences among member states in the NWE cooperation are, as well as urban-rural patterns. It is mostly the French predominantly rural regions are hit the most by population shrinkage; the Dutch Province of Limburg is the only predominantly urban region in the NWE area with a shrinkage of more than 0,5%. Overall, population shrinkage and stagnation concentrate in the French regions of the NWE area. In all other NWE countries population growth occurs more frequently in all types of territories from predominantly urban to rural, though it is more pronounced in predominantly urban areas such as London and Southern English regions, and the German regions Darmstadt and Stuttgart. An outstanding exception is Luxembourg as predominantly intermediate area with the highest population growth of all NWE regions.

Population development in the NWE cooperation area is driven by population ageing and migration. Population development and migration rates between 2010 and 2018 are highly correlated (correlation coefficient 0,61). With the exception of Île de France, no region in NWE cooperation area experienced significant population growth (about 4%) and similarly high net out-migration (-4.6%) during this period. This exception can be explained by a high share of young population (below 35 years of age) and high fertility rates of young migrant families, which outweighs the out-migration of elder inhabitants from Île de France to other French regions (see also Figure 4-1).

Figure 4-1 Average migration in relation to total population change, 2012-2018*

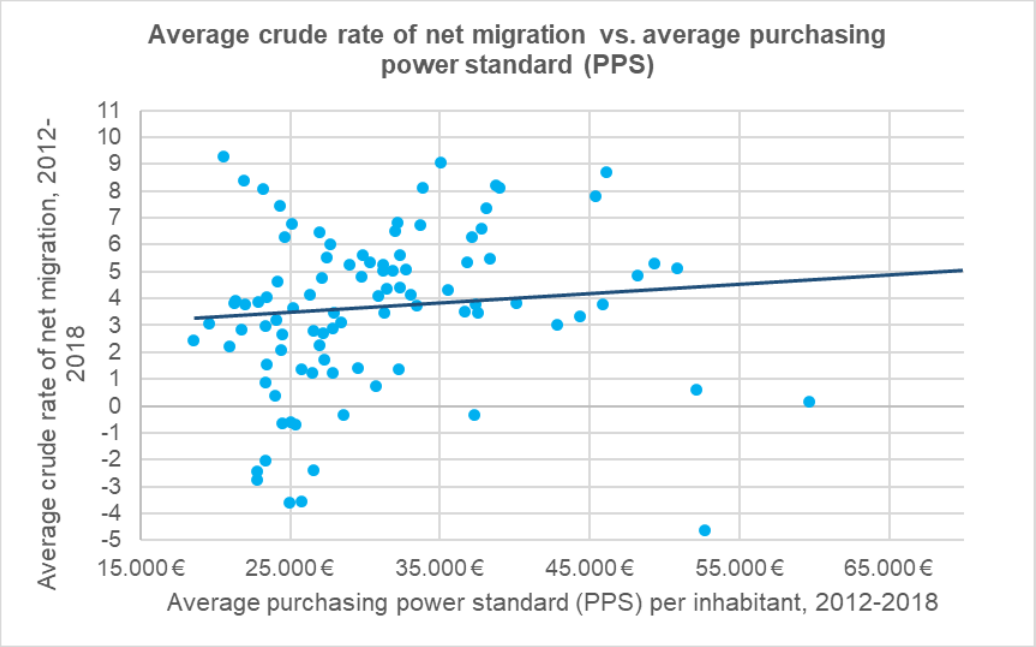


* Please note that values for LU00 lay outside of the chart area (average net migration rate: 18.0).

Source: Spatial Foresight, 2020, based on Eurostat [demo_r_gind3], accessed on 13.05.2020

Relating migration with GDP per capita in purchasing power standards (PPS) reveals some positive relation, which is however not significant, despite the attractiveness of regions with high GDP per capita for migrants. For example, especially the migration inflow in 2015 and 2016 may have affected the territorial migration pattern and relation to GDP per capita.

Figure 4-2 Average migration in relation to average GDP in PPS, 2012-2018*

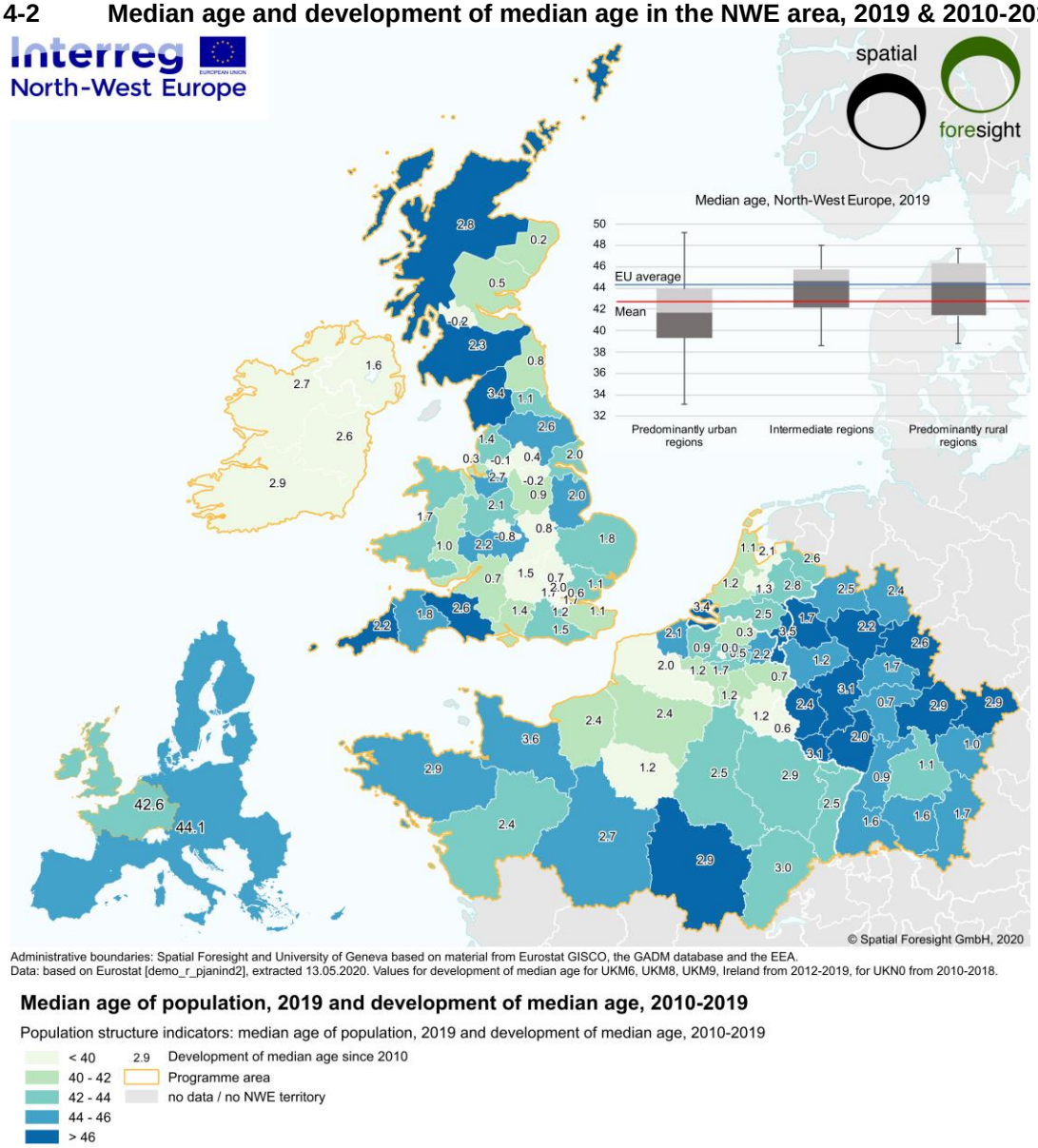


* Please note that values for LU00 lay outside of the chart area (average net migration rate: 18.0).

Source: Spatial Foresight, 2020, based on Eurostat [demo_r_gind3] and [nama_10r_gdp], accessed on 13.05.2020

The population in the NWE area is ageing. While the average median age is still about 1.5 years below the EU average, the median age has been increasing between 2010 and 2019 in nearly all regions of the NWE cooperation area. The British regions West Midlands, South Yorkshire, West Central Scotland and Greater Manchester are the sole exceptions to the rule, with slight decreasing median age values between -0.1 and -0.8. At the same time these regions are among the NWE regions with the overall lowest median age. Regional differences are considerable in most NWE countries other than Ireland, where median age is well below NWE average, but ageing is relatively strong. Country specific patterns tend to dominate territorial patterns. Only predominantly urban regions have a lower median age than other regions in the NWE cooperation area. However, regions with population growth are more often among the regions – within their country context – with a lower median age and slower aging than the regions with stable or shrinking population (see also Map 4-2).

Map 4-2 Median age and development of median age in the NWE area, 2019 & 2010-2019



Administrative boundaries: Spatial Foresight and University of Geneva based on material from Eurostat GISCO, the GADM database and the EEA.
Data: based on Eurostat [demo_r_pjanind2], extracted 13.05.2020. Values for development of median age for UKM6, UKM8, UKM9, Ireland from 2012-2019, for UKN0 from 2010-2018.

Source: own representation, 2020

4.2 Labour market

In comparison with the European context, labour market conditions in the NWE cooperation area can be considered positive. The unemployment rate of the NWE space is below the European average, both in the 15-24 and the 20-64 age groups. The situation is quite homogeneous in all territories of the NWE area, showing unemployment rates lower than the EU average. The only exceptions are the French regions of the NWE cooperation area -for both the age groups mentioned above- and Belgium, as a whole, for the 15-24 age group. These countries, indeed, are currently focused on strengthening the labour market by renovating the education and training system (European Commission, 2019i, 2019f).

In the French regions of the NWE cooperation area, for instance, some relevant differences can be observed within the regions in the age group 15-24 years: Pays-de-la-Loire, Bretagne and Basse-

Normandie show unemployment rates around 16%, while they remain higher in Nord-Pas-de-Calais and Picardie (about 27%). Disparities in the Belgian regions persist, ranging between 30.6% in Brussels Capital Region and 8.1% in Flanders in 2018 for younger people.

The average unemployment rate for the NWE space has decreased over time (in the 2010-2018 period) showing the capacity of the NWE area to recover from the crisis, as shown by the significant decrease of the unemployment rate in Ireland in both age groups (-51% for the 15-24 age group and -61% for the 20-64 age group). This progress could be particularly observed starting from 2013, after the launch of activation reforms to reinforce the Irish labour market (European Commission, 2019j) which are contributing to return the unemployment rate to its pre-crisis level.

Luxembourg is the only country showing an upward trend in the unemployment, with the 20-64 years age group growing at a pace of +26% in 2010-2018 period. However, it has to be noted that Luxembourg experienced high level of youth unemployment in 2014 (23%) that fell progressively in the following years. To this also helped a deceleration in active population, largely driven by inflows of new residents (especially from border countries).

Table 4-1 shows the unemployment rate in the NWE space and within the partner countries. The NWE calculation results from the average of all the eligible NUTS 2 regions.

The unemployment rates per partner country refer to data at NUTS 0 level for all the states, excluding France and Germany. In these countries, where only some territories are concerned by the programme, the value reported is the average only of the eligible NUTS 2 regions.

Table 4-1 Unemployment in the NWE cooperation area, 2010-2018

Unemployment	From 15 to 24 years		From 20 to 64 years	
	2018	% growth 2010-2018	2018	% growth 2010-2018
NWE area	11,9%	-31%	4,4%	-35%
NWE average without UK	12,2%	-25%	4,9%	-28%
EU - 28 countries	15,2%	-29%	6,7%	-28%
Belgium	15,8%	-27%	5,8%	-28%
Germany*	6,3%	-29%	2,9%	-49%
Ireland	13,8%	-51%	5,4%	-61%
France*	20,6%	-7%	8,4%	-1%
Luxembourg	14,2%	0%	5,3%	26%
Netherlands	7,2%	-35%	3,4%	-23%
United Kingdom	11,3%	-43%	3,6%	-47%

* Regards the NWE cooperation area regions

Source: Own elaboration on Eurostat's dataset lfst_r_lfu3rt, 2020

The box plot in Figure 4-3 illustrates how the unemployment rate of the 15-24 age group is distributed across the different types of areas (with reference to the Eurostat typologies of territory). The red line

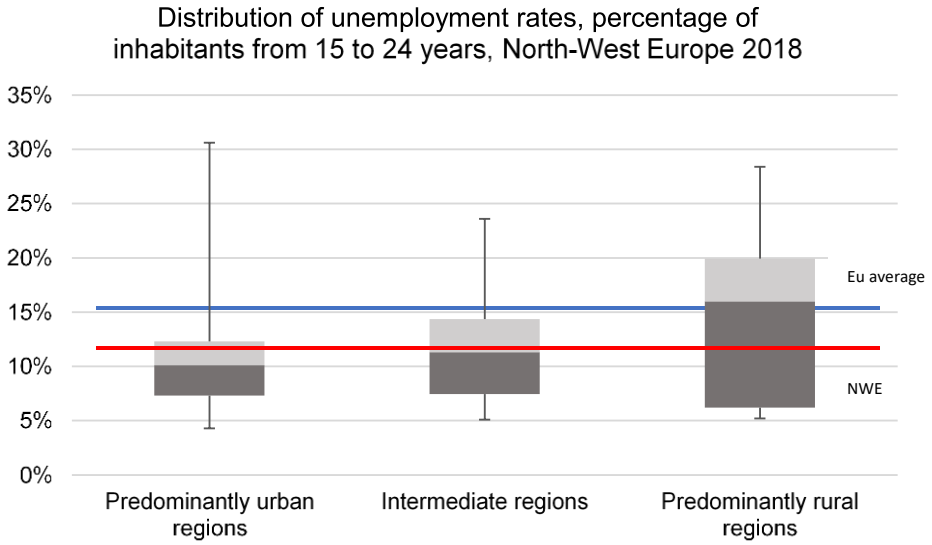
represents the average unemployment rate for the NWE area, while the blue line represents the EU average.

Without prejudice to the positive general picture described above, the box plot shows that unemployment rate for young people (from 15 to 24 years) tends to be higher in rural areas - where the median unemployment rate is close to the 15% EU average. The regions mainly contributing to this result are Picardie (28%) and Val de Loire (21%) in France, and Namur in Wallonia region (21%). Whereas, in urban areas, which are the majority in the NWE cooperation area, the median unemployment rate is even lower than the NWE average and, the distribution is balanced (the maximum refers to Brussels Capital Region).

This picture is confirmed by the distribution of the unemployment rate for people from 20 to 64 years. As the box plot in Figure 4-4 shows, also in this case, unemployment rate is higher in rural areas (with a median value close to the EU average of 6.7%) and the population shows significant dispersion. Intermediate regions and urban regions perform well comparing to the EU average and NWE area (median unemployment rates are lower than 3%) and, still, the variability is lower within the group.

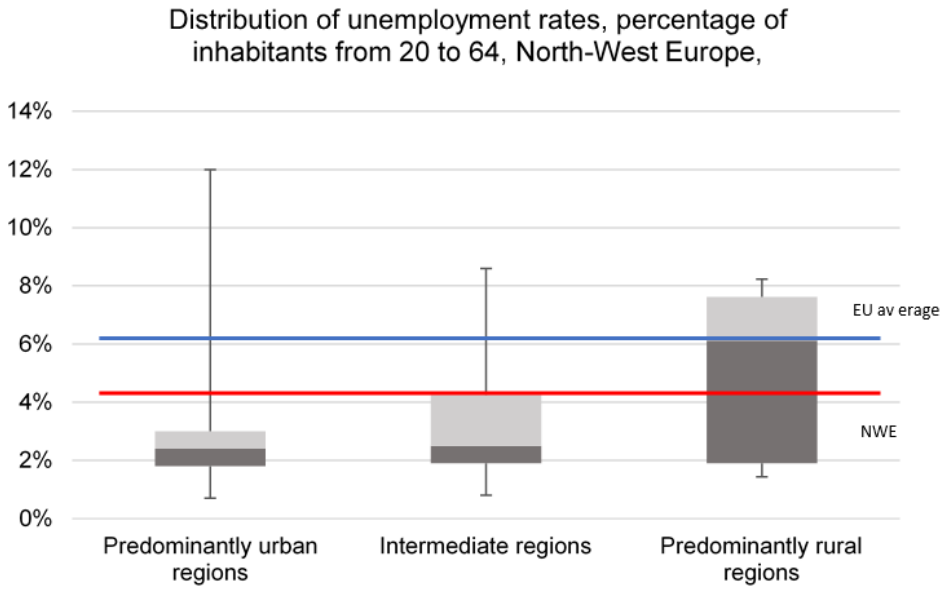
For what concerns the participation in the labour market, the economic activity rate of the NWE area is higher than the EU average (i.e. 81%, 2 points above the EU average). The activity rates are similar across the different countries, going from 77% in Belgium to 84% in the German regions of the NWE cooperation area.

Figure 4-3 Unemployment rate for age 15-24 years by types of regions in NWE, 2018



Source: own presentation based on EUROSTAT, 2020

Figure 4-4 Unemployment rate for age 20-64 years by types of regions in NWE, 2018



Source: own presentation based on EUROSTAT, 2020

German and Dutch regions of the NWE cooperation area show high degrees of economic activity in all their territories, while, significant inter-regional disparities feature the other NWE countries (United Kingdom, Belgium and France, in particular). BREXIT should not affect the NWE space.

The participation of the population in the labour market has increased by 3% over the 2010-2018 period. Ireland and the Netherlands are the countries recording the most significant improvement. In the Netherlands, job creation continued in the second half of 2018, driving down the unemployment rate to pre-crisis levels[88]. In Ireland, instead, the activity rate continues to increase since 2012 even though, according to recent research (OECD, 2018), employment barriers persist (such as limited work experience, low levels of skills, and scarce job opportunities).

Table 4-2 shows the economic activity rate in the NWE cooperation area and within the respective member states. The NWE calculation result from the average of all the eligible NUTS 2 regions.

The economic activity rates per respective member state refer to data at NUTS 0 level for all the states, excluding France and Germany. In these countries, indeed, there were only some territories are concerned by the programme, the value reported is the average only of the NWE cooperation area regions.

[88] SWD (2019) 1018 final, 2019. Country Report The Netherlands 2019 Including an In-Depth Review on the prevention and correction of macroeconomic imbalances

Table 4-2 Economic activity in the NWE area, 2010-2018

Economic activity	From 25 to 64 years	
	2018	% growth 2010-2018
NWE cooperation area	81%	3%
NWE average without United Kingdom	81%	3%
EU - 28 countries	79%	4%
Belgium	77%	2%
Germany*	84%	3%
Ireland	79%	4%
France*	79%	3%
Luxembourg	79%	2%
Netherlands	83%	4%
United Kingdom	82%	4%

* Regards the NWE cooperation area regions

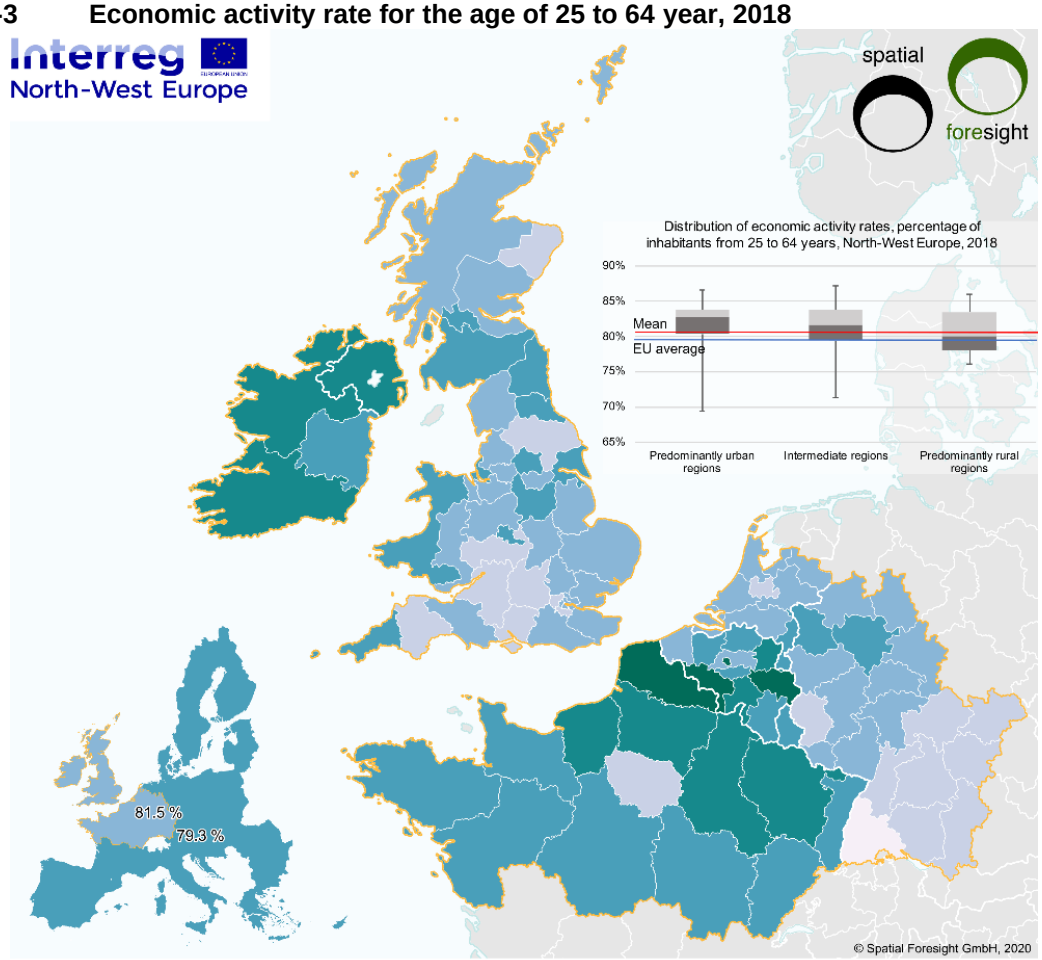
Source: Own elaboration on Eurostat's dataset lfst_r_lfp2actrt, 2020

Map 4-3 illustrates the distribution of the economic activity rates in 2018 at NUTS 2 level. As for the unemployment rate, also the activity rate tends to vary according to the type of territories. This is particularly evident in the case of Ireland and France where the regions of Dublin and Paris have activity rates significantly higher than the other NUTS 2 regions.

In the boxplot, top right of the map we can observe that, while the median activity for NWE urban areas is 83%, in rural areas it is almost 3 points lower (close to 80%) which confirms, as for the unemployment rate, that labour conditions are more difficult in rural regions than in urban areas.

For what concerns the urban regions, high levels of economic activity are observed in Stuttgart (87%) and in the British west country (Bristol and Gloucester). Lower participation is, instead, recorded in Nord-Pas-de-Calais in France and in Hainaut, in Belgium. Rural areas are mainly in France, Germany and Belgium, but the weaker economic activity rates refer to France and Belgium, while in Germany the figures reach, on average, 85%.

Map 4-3 Economic activity rate for the age of 25 to 64 year, 2018



Source: own representation, 2020

The current COVID-19 pandemic calls for a deep reflection on how the socio-dimension will be affected in the coming months and years. First estimates, indeed, show that the COVID-19 crisis is causing the most severe reduction in economic activity and working time since the Second World War (International Labour Organization, 2020). The effects of this crisis show certain asymmetries across European regions: this depends, indeed, on the intensity of infections and death in a certain area, as well as the specificity of its economic system.

The COVID-19 crisis also has a territorial dimension, and thus, the characteristics of regions in terms of structural business and employment represent a starting point to determine how regional development will be affected due to their specific endowment (Böhme and Besana, 2020). Which sectors effectively have been locked down varies considerably among countries and, because of that, employment has been impacted in a very different way across sectors and regions.

Bearing in mind the sectoral focus of the regions in NWE cooperation area in 2020, a preliminary assessment on the economic implications has been carried out, according to the degree of risk assigned to the economic sectors contributing to regional economies.

Table 4-3 illustrates the exposure to the COVID-19 risk of the economic sectors relevant for NWE area and, indicates the economic implications in the short and long period. Strong economic impacts concern the manufacturing industry, wholesale/retail trade and accommodation and food services, where the labour market is likely to suffer in both the short and long term. The risk in construction, transportation and the financial/insurance sectors has been assessed as medium, while the high demand of ICT services during the lockdown restriction is expected to be consolidate in the long term as an effect of a new organisational approach to work.

Table 4-3 Economic implication of COVID19 crisis to NWE regional economies

Economic sectors contributing to regional economies in NWE area[89]	Category assigned	Economic Implications
Agriculture, forestry and fishing	Neutral	The demand can be considered stable compared to other goods
Manufacturing	high	The demand will suffer both in the short and long term by value chains disruption
Construction	Medium	Demand can be negatively affected in the long term
Wholesale and retail trade	High	Very strong disruption in short term and social distancing in the long term
Transportation	Medium	Strong impact on air and water transport demand in short and long period but stable or rising for postal and courier service
Accommodation and food services	High	Very strong disruption in the demand
Information and communication	Positive	Demand of services has sharply increased in the short terms and is suspected to consolidate in medium-long terms

Source: Böhme and Besana, 2020

4.3 Access to healthcare

The outbreak of the coronavirus pandemic in early 2020 is putting healthcare systems under increasing pressure and governments across the EU will be asked to take actions and address these challenges accordingly in the coming months and years.

With that in mind, the following analysis on the accessibility to healthcare services might only partially reflect the needs of the territories in the NWE area over the next programming period.

The European Commission has recently issued a practical guide to Member States stressing the importance for national, regional and local authorities to cooperate in the healthcare field to respond to

[89] See section 1.1.1 Sectoral focus of regions where the Gross added value per sector was used to assess the regional economic profiles and competitiveness levels.

the COVID-19 crisis. Cross-border cooperation, in particular, has proven to be a concrete and prompt response to the emergency from the very early stage of the crisis.

However, transnational programmes may also offer the possibility to improve the resilience of healthcare systems. In particular, the new regulatory framework is based on the concept of territoriality according to which the geographical dimension plays an important role in the development of cooperation strategies. In this sense, the existing regional disparities in the NWE cooperation area should be taken into account as functional areas where challenges in the healthcare sector can be addressed.

According to the 2018 study of the European Commission on the Inequalities in access to healthcare (European Commission, 2018b), (intended as share of covered population, supplied range of services and costs charged to users). However, substantial disparities in the supply of health services across urban and rural areas are frequently reported. Demographic changes such as growing population or rising urbanisation can exacerbate such difference. These developments also concern the NWE cooperation area.

If we look at the number of beds per inhabitant (which represent an important indicator of the health care system's efficiency) we observe that in the NWE cooperation area, there are on average 574 hospital beds per one hundred thousand inhabitants, higher than the European average of 498 hospital beds. The countries with greater availability are Germany, France and Belgium.

In Germany, the healthcare facilities are concentrated mostly in urban settings, pointing towards a significant oversupply in some urban areas, while access to primary healthcare may soon become challenging for certain rural and remote areas[90].

In the French regions of the NWE cooperation area, there are no significant differences within, with all the figures remaining above the EU average. This picture is expected to further improve due to a new reform announced in 2018 (i.e. the plan *'Ma santé 2022')* to boost the shift from the traditionally hospital-centred healthcare systems towards strengthened primary care and to facilitate the access to care in underserved regions (mainly rural zones).

The United Kingdom and Ireland have a lower hospital bed availability. Over the 2015-2017 time period, the amount of hospital beds decreased, in particular in Netherlands (-6%) and in Luxemburg (-5%), where the reduction was significantly greater than the European average (-2%). In Ireland, the cost-effectiveness of public hospitals is still challenging, even though an increase by 6% occurred over the last years, which confirms the effort made by the government in reforming the health and social care system[91].

The distribution in the territories (see Map 4-4) within each partner country is quite balanced. Table 4-4 shows the number of hospital beds per inhabitants in the NWE space and within the partner countries.

[90] For more details see: SWD (2019) 1004 final, 2019. Country Report Germany 2019 Including an In-Depth Review on the prevention and correction of macroeconomic imbalances

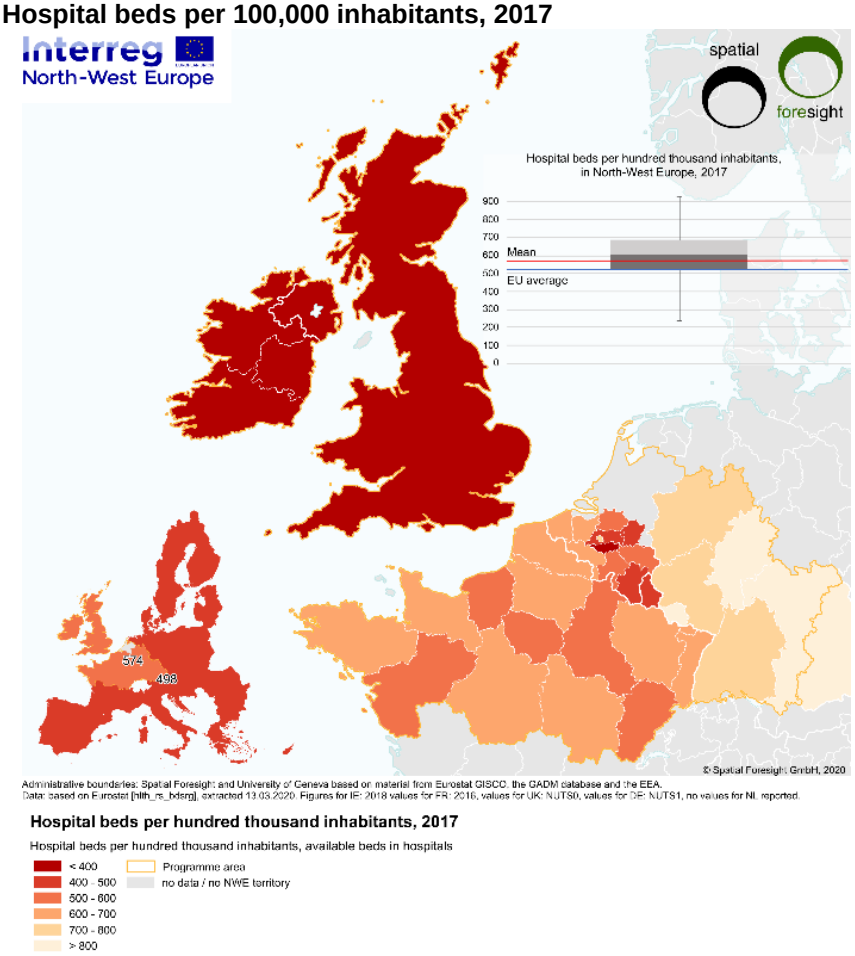
[91] For more details see: COM (2019) 507 final, 2019. Council Recommendation on the 2019 National Reform Programme of Ireland and delivering a Council opinion on the 2019 Stability Programme of Ireland

Table 4-4 Hospital bed per inhabitants in the NWE area, 2015-2017

Hospital beds per 100 000 inhabitants*	2017	% growth 2015-2017
NWE cooperation area	574	-2%
NWE average without UK	585	-2%
EU - 28 countries	498	-2%
Belgium	529	-3%
Germany**	816	-1%
Ireland	267	+6%
France***	602	-2%
Luxembourg	466	-5%
Netherlands	332	-6%
United Kingdom	253	+6%

* Data from national databases are not considered. The NWE calculation results from the average of all the eligible NUTS 2 regions. The rates per partner country refer to data at NUTS 0 level for all the states, excluding France.
** Data available only at national level
*** Regards the NWE cooperation area regions
Source: Own elaboration on Eurostat's dataset hlth_rs_bdsrg, 2020

Map 4-4 Hospital beds per 100,000 inhabitants, 2017



Source: own representation, 2020

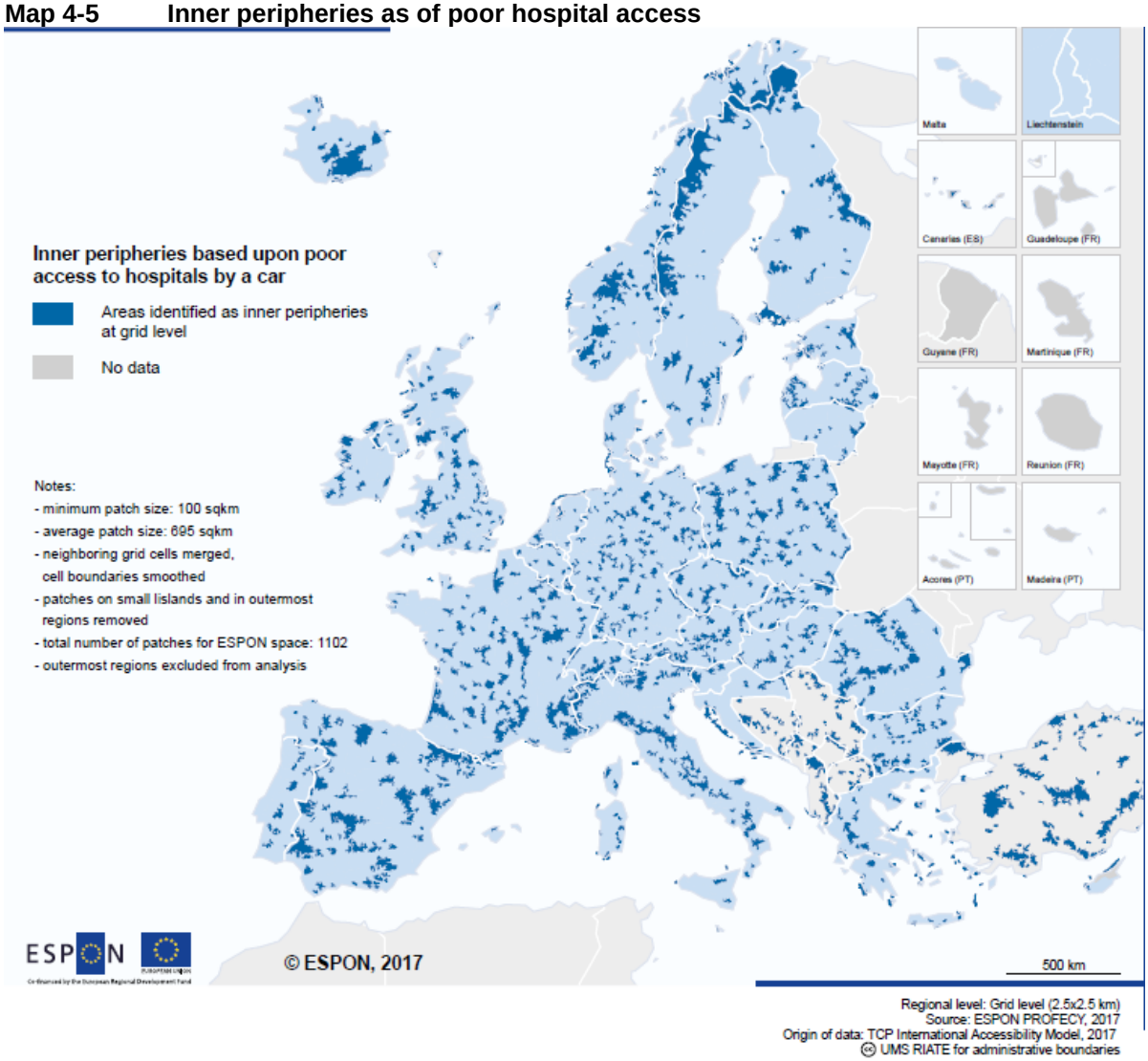
Looking at the average travel time needed to reach the closest regional centres (Table 4-5), a slightly lower timing can be observed in the NWE regions compared to the European average (i.e. 91 minutes while the European average is 93.8)[92]. This suggests a great accessibility to the general urban services, and so to the health care supply, for the programme inhabitants.

Table 4-5 Average travel time to regional centres

Average travel time to regional centres								
NWE area	**EU28**	**UK**	**BE**	**FR**	**DE**	**LU**	**IE**	**NL**
91	93.8	88.4	87	76.8	94.4	136.4	101.7	93

Source: Own elaboration on ESPON's dataset D1_TT_Std

Map 4-5 Inner peripheries as of poor hospital access



Source: (ESPON, 2017b)

[92] The car travel times (in minutes) to the next regional centre have been standardized at the average of the neighbouring NUTS-3 regions, ESPON's dataset, 2019

There is a significant share of inner peripheries in Europe, in the core as well as in the outer regions (ESPON, 2017b) (see also chapter 5 of this report). In particular, cross-border and mountain regions appear to be the areas where this issue is particularly markable. Map 4-5 shows that overall, the NWE cooperation area is not particularly concerned by that risk. However, some territories close to the French borders are marked as inner peripheries at grid level. In the United Kingdom, there are numerous inner peripheries spread all over country, while, in Ireland, they seem to be more concentrated on the western side.

4.4 Social inclusion

Looking at social inclusion, the NWE cooperation area ranks above the EU 28 average, although with a clear divide between less performing regions, e.g. in France and the south of Belgium and the more developed regions, as e.g. in the Netherlands (European Commission, 2020k)[93].

Important evidence on the social dimension can be observed in the share of NEET population (Not in Education, Employment or Training); in 2018 the regions in the NWE cooperation area had average rates significantly lower than the European level in the age groups 15-24 and 18-24. More specifically, 8.7% for people from 15 to 24 (the EU average is 11.5%) and 11% for people from 18 to 24, with an EU average of 14%.

Map 4-6 shows the NEET share in the NWE cooperation area and within the respective member states. The NWE calculation results from the average of all the eligible NUTS 2 regions.

Table 4-6 NEET share in the NWE area, 2010-2018

NEET (not Employment, education and training)*	From 15 to 24 years		From 18 to 24 years	
	2018	% growth 2010-2018	2018	% growth 2010-2018
NWE cooperation area	8.7%	-23%	11%	-20%
NWE average without UK	7.5%	-22%	10%	-18%
EU - 28 countries	11.5%	-18%	14%	-17%
Belgium	9%	-16%	11%	-20%
Germany**	7%	-24%	8%	-25%
Ireland	10%	-48%	13%	-47%
France**	11%	-8%	15%	-6%
Luxembourg	4%	4%	8%	16%
Netherlands	4%	-13%	6%	-17%
United Kingdom	10%	-24%	13%	-25%

* The NEET shares per respective member state refer to data at NUTS 0 level for all the states, excluding France and Germany.

** Regards NWE cooperation area regions.

Source: Own elaboration on Eurostat's dataset edat_lfse_22, 2020

[93] The reference for that evidence is the Social progress index, an indicator which measures the capacity of a society to meet three main dimensions: basic human needs, foundations of well-being and opportunity.

The country with the best performance is the Netherlands, while France and the United Kingdom are more in line with the European average. Within the French programme regions, disparities were quite significant 2018, especially if we compare the Pays de la Loire region (8.4%) with the upper Normandie (14%).However, improvements over the coming years are expected in the whole country, due to a set of actions introduced by the government in 2018 and specifically targeting the NEET (i.e. *Plan d'investissement dans les compétences 2018-2022*). Due to BREXIT, the share of NEET would slightly decrease in the programme space (i.e. by 1%).

Looking at the trends over the 2010-2018 period, the percentage of NEET significantly decreased (i.e. average reduction of 23% in the 15-24 age group and of 20% in the 18-24 age group) and a general improvement is observable in almost all NWE regions.

Progress has been experienced in Ireland, where the NEET percentage decreased by approximately 48% for both age groups. Overall, Ireland is in line with the Pillar principle on education, training and lifelong learning[94]. Significant improvement occurred in Germany, as a whole, in many of the indicators of social scoreboard supporting the European Pillar of Social rights, and it is among the best performers as regards the youth NEET rate in Europe[95]. The picture within the eligible regions is confirmed, with the only exception of a growing pace in lower Franconia.

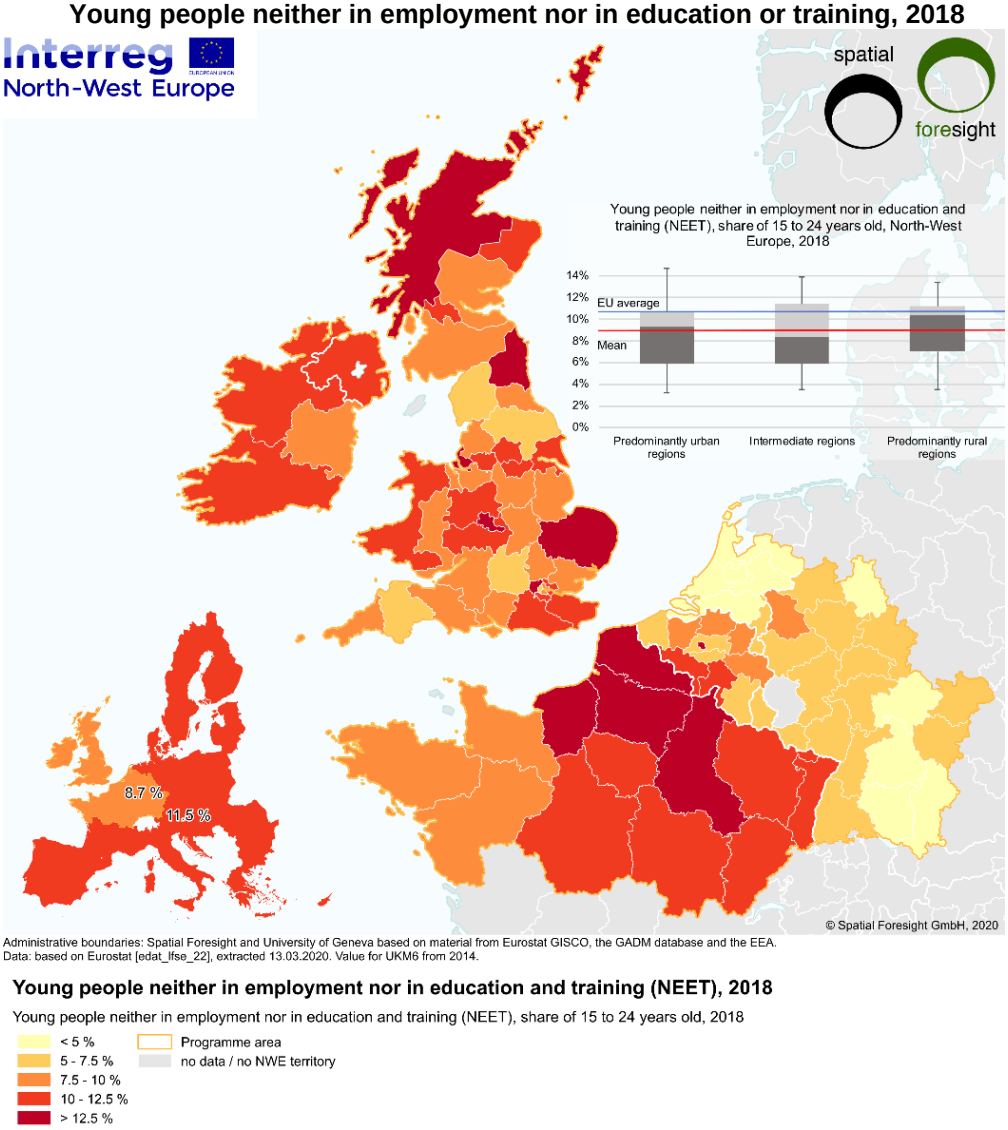
The NEET growth rates are particularly high for the 18-24 age group in Luxemburg (+16%), confirming the need to increase investment in skills, employability, education and training, stressed in the Country recommendations of 2019. High concentration of NEET can be observed in the French border regions (Map 4-6), in Belgium, as a whole, and in Scotland.

The boxplot on the right top of the map shows the NEET distribution according to the type of territory. Intermediate regions have a lower share of NEET compared to other areas, as well as the European average, while urban regions present a median value close to the programme average and lower than the European average. As for the unemployment rates, the highest concentration of NEETs can be observed in rural areas, with 10% as median value and a greater variability under that values. Targeted actions would be needed, in particular, in Picardy and Champagne-Ardenne regions, where the share of NEET reach 13%.

[94] For more details see: SWD (2019) 1006 final,2019. Country Report Ireland 2019 Including an In-Depth Review on the prevention and correction of macroeconomic imbalances

[95] For more details see: SWD (2019) 1004 final, 2019. Country Report Germany 2019 Including an In-Depth Review on the prevention and correction of macroeconomic imbalances

Map 4-6 Young people neither in employment nor in education or training, 2018



Source: own representation, 2020

Early leavers from education and training may face considerable difficulties accessing the labour market and are therefore more at risk of social exclusion[96]. In the NWE cooperation area, they represent 10% of the population in 15 to 24 years, which is slightly below the European average (11%).

French regions of the NWE cooperation are close to the EU average but experienced a significant decrease over the 2010-2018 period (-2%). This can be linked to the set of reforms introduced by the government to improve basic skills and reduce inequalities in education (as lowering the compulsory school entry age, halving the class size and strengthening teacher training to deliver differentiated teaching)[97].

[96] Eurostat Glossary : https://ec.europa.eu/eurostat/statistics

[97] For more details see: SWD (2019) 1009 final, 2019. Country Report France 2019 Including an In-Depth Review on the prevention and correction of macroeconomic imbalances

BREXIT would lead to a slight decrease of 1 percentage point. Regardless of the improvement in recent years (the average rate dropped from 15% in 2011 to 11% in 2017), rates at regional level in the United Kingdom range from 6% in London to 14% in Yorkshire and the Humber and the East of England.

The education system in Ireland shows overall positive outcomes, with a 5% average rate of early leavers, the lowest not only among the programme countries, but also in comparison to other EU countries. This data, along with the 58% decrease recorded in the 2010-2018 period, confirm the effectiveness of the Irish literacy and numeracy strategy and other policy instruments addressing educational disadvantage (i.e. DEIS)[98].

Table 4-7 below shows the share of early leavers in the NWE cooperation area and the respective member states.

Table 4-7 Early leavers in the NWE area, 2010-2018

Early leavers*	From 18 to 24 years	
	2018	% growth 2010-2018
NWE cooperation area	10%	-21%
NWE average without UK	9%	-20%
EU - 28 countries	11%	-16%
Belgium	8%	-28%
Germany**	10%	-12%
Ireland	5%	-58%
France**	9%	-24%
Luxembourg	6%	-11%
Netherlands	7%	-28%
United Kingdom	11%	-28%

* The NWE calculation results from the average of all the eligible NUTS 2 regions. The early leavers rates per partner country refer to data at NUTS 0 level for all the states, excluding France and Germany. In these countries, where only some territories are concerned, the value reported is the average only of the eligible NUTS 2 regions.

**Regards NWE cooperation area regions.

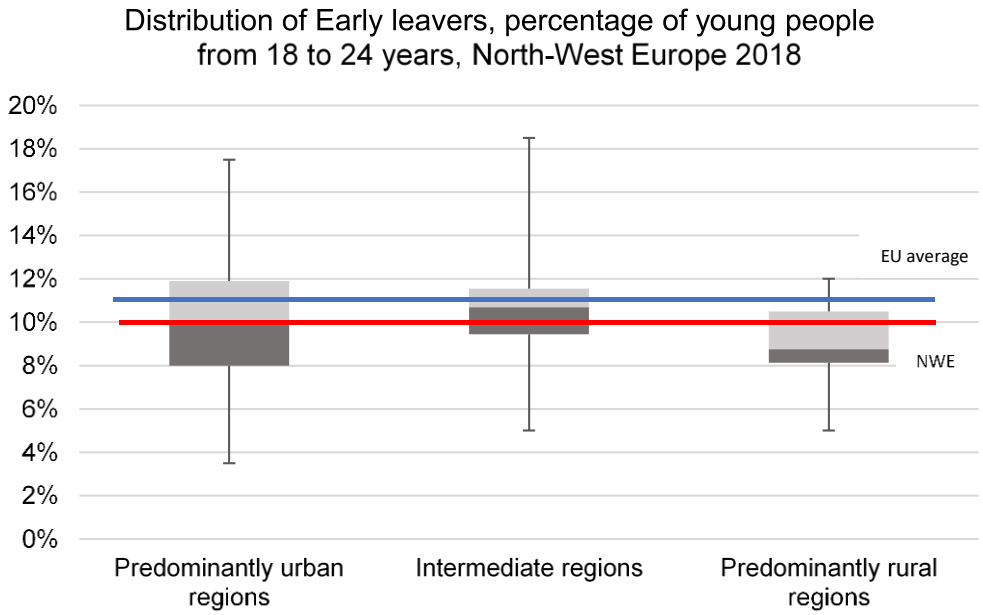
Source: Own elaboration on Eurostat's dataset edat_lfse_16, 2020

The boxplot in Figure 4-5 illustrates how early leavers are distributed in the three types of territory. Interestingly, rural areas show the lowest median value comparing to the urban and intermediate ones. In urban regions, the median value equals the programme average, with a significant variability within the group, especially in United Kingdom (where, only in London region, the range goes from 4% to 12%).

[98] DEIS (Delivering Equality of Opportunity in Schools) is the national programme launched in 2005 by the government, aimed at addressing the educational needs of children and young people from disadvantaged communities.

Intermediate regions are closer to the European average with a distribution more concentrated around the median value (the maximum of 18% refers to East Yorkshire and Northern Lincolnshire).

Figure 4-5 Early school leavers by types of regions in NWE, 2018



Source: own presentation based on EUROSTAT, 2020

With regard to social exclusion, the Eurostat definition includes all people at risk of poverty, or severely materially deprived or living in a household with a very low work intensity. In the NWE cooperation area, the average rate of people at risk of poverty or social exclusion was 18% in 2018, 5 points below the European average. The United Kingdom, Luxemburg and Ireland (all ranking 22% in 2018) present higher values than the NWE average. When looking at poverty for young people (age group 20-29 years), the figures indicate a higher risk of social exclusion in NWE cooperation area (23%), 3 points below the European average. At risk of poverty and social exclusion issues remain a point of attention in particular in Luxemburg and in Netherlands (both 27%). Ireland, instead, is the best performer among the member states of the NWE cooperation area, with 20% of young people at risk of poverty and with a decrease by 30% between 2016 and 2018. This confirms the effectiveness of social policies (tax and benefits system) in reducing poverty and inequalities[99].

Table 4-8 shows the share of people at risk of poverty, (total population and young population) in the NEW cooperation area and within the respective member states.

The risk of poverty's rate (whole population) per partner country refer to data at NUTS 0 level for all the states, excluding France and Germany. In these countries indeed, where only some territories are concerned by the programme, the value reported is the average only of the eligible NUTS 2 regions.

[99] For more details see: SWD(2019) 1006 final, 2019. Country Report Ireland 2019 Including an In-Depth Review on the prevention and correction of macroeconomic imbalances

For the young population (20-29 years) date were only available at NUTS0 level, thus Germany and France were considered as whole*.

Table 4-8 People at risk of poverty or social exclusion in the NWE area, 2016-2018

People at risk of poverty or social exclusion	Share of population*		Share of young population (20-29 years)**	
	2018	% growth 2016-2018	2018	% growth 2016-2018
NWE cooperation area	18%	-3%	23%	-7
NWE average without UK	18%	-3%	23%	-8%
EU - 28 countries	23%	-7%	26%	-10%
Belgium	20%	-4%	20%	-7%
Germany**	18%	-3%	26%*	-1%
Ireland	22%	-14%	20%	-30%
France**	17%	-4%	21%*	-20%
Luxembourg	22%	+11%	27%	+12%
Netherlands	16%	0%	27%	-3%
United Kingdom	22%	+6%	24%	-1%

* The risk of poverty's rate (total population) per member state country refers to data at NUTS 0 level for all the states, excluding France and Germany. In these countries, where only some territories are concerned, the value reported is the average only of the eligible NUTS 2 regions.

**For the young population (20-29 years) data were only available at NUTS0 level, thus Germany and France were considered as whole.

*** Regards NWE cooperation are regions.

Source: Own elaboration on Eurostat dataset's ilc_peps11 and ilc_peps01, 2020

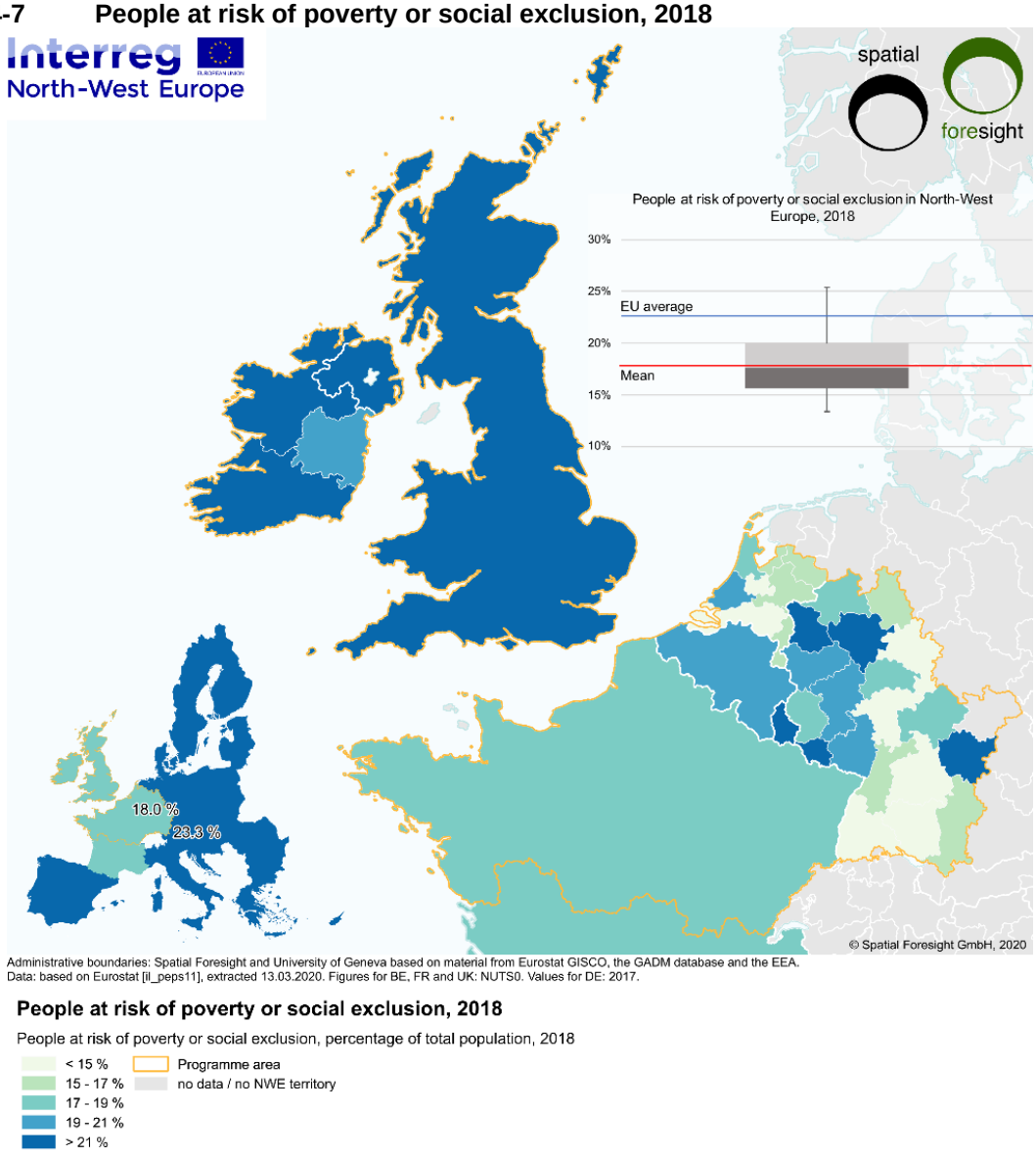
The dimensions of poverty and social exclusion across these countries are different. In Luxemburg, for instance, the main issue regards the insufficient supply of social housing: recent studies show that building land is concentrated in the hands of very few persons and companies and the current government programme implemented initiatives in the housing sector to make residences more affordable and to review existing laws (European Social Policy Network (ESPN), 2020). The housing supply shortages are also affecting social housing and homelessness in Ireland because of inadequate investments over the last decade[100]. Moreover, more investments are needed in order to promote social integration of children at risk of poverty a social exclusion and provide food and basic material assistance to the most deprived people.

[100] For more details see: COM(2019) 507 final, 2019. Council Recommendation on the 2019 National Reform Programme of Ireland and delivering a Council opinion on the 2019 Stability Programme of Ireland

The Netherlands have the lowest percentage of population at risk poverty or social exclusion (16%), followed by the French programme areas (17%) (Table 4-8). More in detail, the French figures confirm the good performance of the social protection system (taxes and social transfers) and further improvement are expected in the coming years due to the strategy, launched in September 2018, to prevent and fight against poverty.

The 2016-2018 period shows an average decrease of social exclusion rate of 3% (while in Europe was 7%), although some countries experienced a reverse trend (Luxemburg +11% and United Kingdom +6%). Ireland shows the most remarkable improvement, with a decrease of 14%. The distribution of people at risk of poverty and social exclusion in 2018 among the NWE cooperation area is shown in Map 4-7.

Map 4-7 People at risk of poverty or social exclusion, 2018

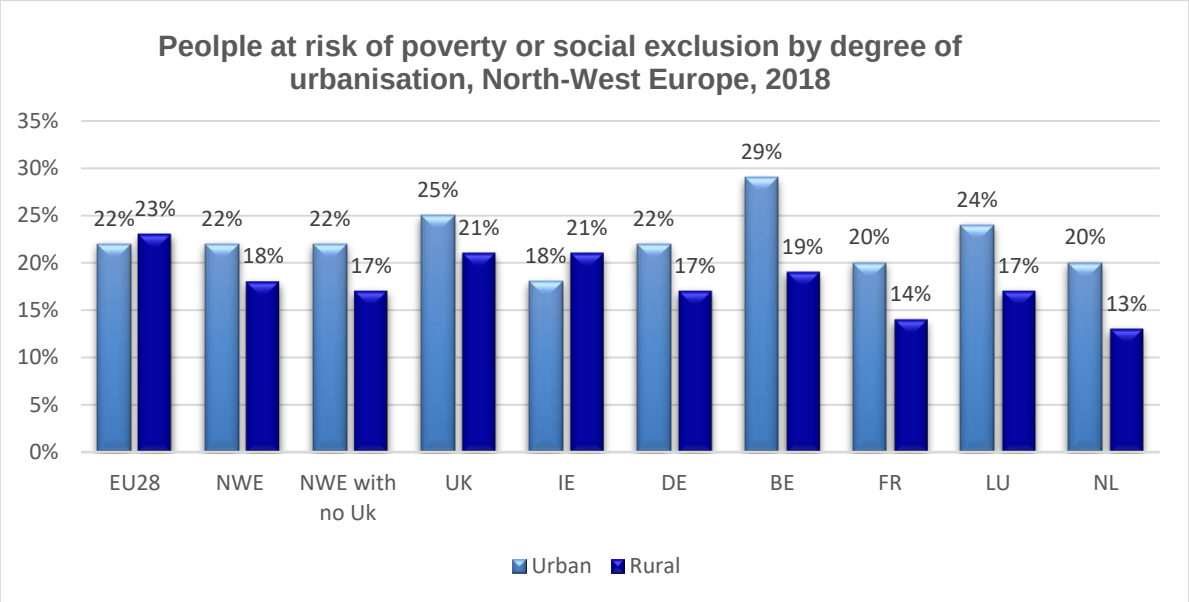


Source: own representation, 2020

The median value is very close to the NWE cooperation area average and the distribution is balanced. According to the EC (European Commission, 2020k) in most countries, poverty and social exclusion is visible in larger urban areas than in rural zones and, as shown in Figure 4-6, the gap in the programme area is quite significant if compared to the European picture: the difference between the share of people at risk living in urban and rural areas is 4% while, in Europe as a whole, only 1%. The risk of social exclusion is a concern in particular in Belgian urban areas (29%) while it is more limited in rural areas (19%).
In general, both in France and Belgium, socio-economic disparities at sub-regional level, contribute to create pocket of poverty across the counties, thus additional measures are needed to reduce the territorial gaps. Significant is also the urban-rural gap in Luxemburg and the Netherlands.

Ireland represents the only exception among the member states in the NWE cooperation area, where social issues are more relevant in rural areas, with a share of 3% of people at risk of poverty or social exclusion above the ones living in urban centres. Specific disadvantages in Irish rural areas as compared to urban areas are issues relating to migration/urbanisation, changing population/age; poor infrastructures in more remote areas, poor condition of the housing stock, lower ICT / broadband coverage (O'Donoghue et al., 2014).

Figure 4-6 People at risk of poverty or social exclusion, 2018



Source: Own elaboration on Eurostat dataset's ilc_peps13, 2020

The social performance can also be assessed through the percentage of people materially deprived or being in an economic strain, unable to pay unexpected expenses, afford a one-week annual holiday away from home, a meal involving meat, chicken or fish every second day, the adequate heating of a dwelling, durable goods like a washing machine, colour television, telephone or car, being confronted with payment arrears (mortgage or rent, utility bills, hire purchase instalments or other loan payments).

In the NWE cooperation area, in 2018, 9% of population was suffering from material deprivation, which is 4% below the European figure. The highest value is recorded in Ireland (12%) even though, between

2014 and 2018, a significant decrease (-40%) has been observed. Luxemburg and the Netherlands show the lowest rates and remarkable is the improvement, in particular, by Netherlands (-46%).

Figure 4-7 shows the share of people in condition of material deprivation, in the NWE cooperation are and the respective member states.

Figure 4-7 People suffering from material deprivation, 2014-2018

Material deprivation rate*	2018	% growth 2014-2018
NWE cooperation area	9%	-27%
NWE average without UK	9%	-24%
EU - 28 countries	13%	-34%
Belgium	11%	-10%
Germany	7%	-38%
Ireland	12%	-40%
France	9%	-9%
Luxembourg	4%	-24%
Netherlands	4%	-46%
United Kingdom	10%	-42%

* Data available only at NUTS0 level.

Source: Source: Own elaboration on Eurostat dataset's ilc_mdsd08, 2020

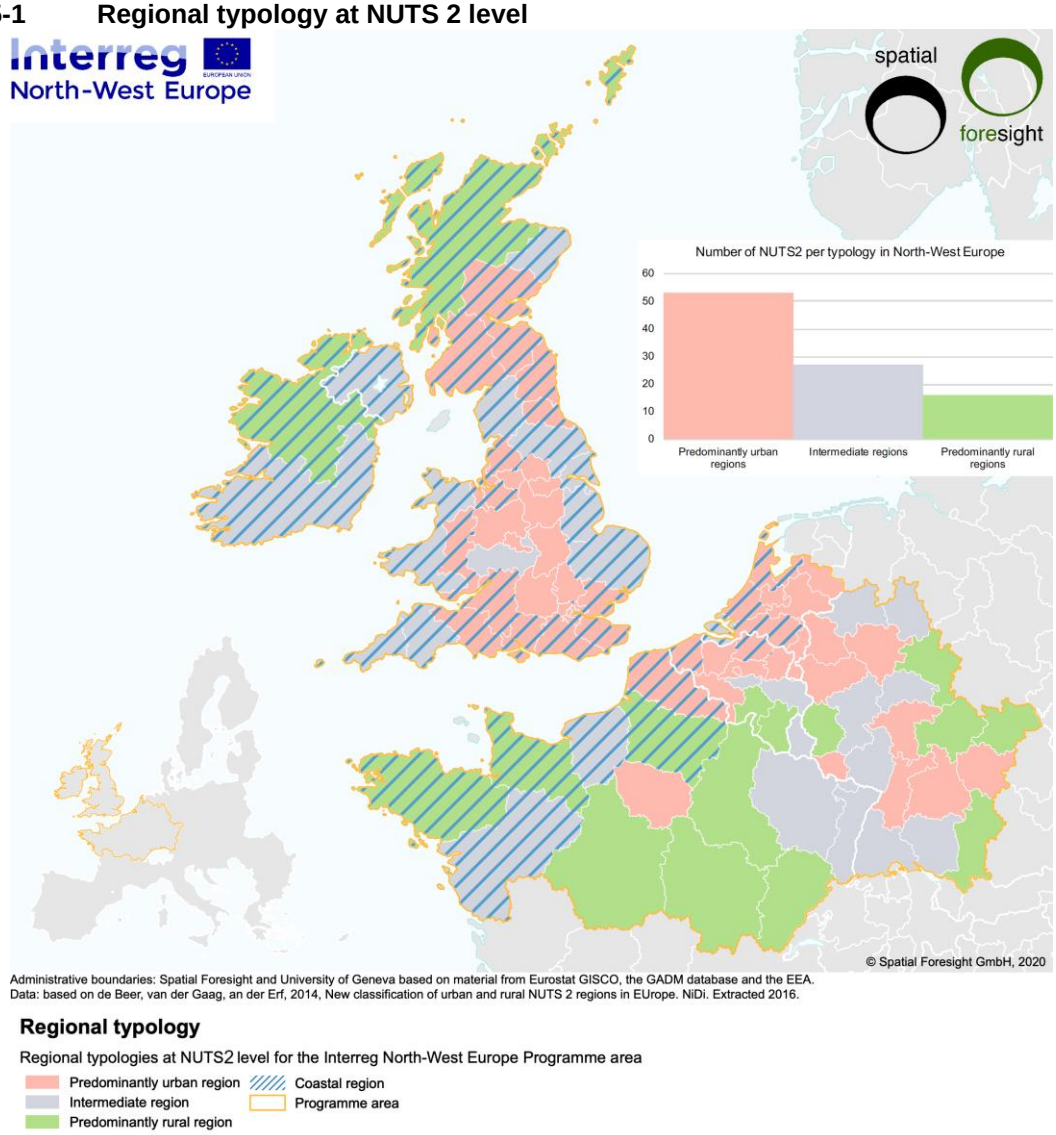
5 PO 5 – A Europe closer to citizens

The territorial analysis for PO 5 differentiates four themes, namely urban-rural disparities and links, rural and coastal area development, urban development and Sustainable Development Goals.

5.1 Urban-rural disparities and functional links

The NWE cooperation area is a predominately urbanised region, home to the biggest urban areas of the European Union. The several urbanised areas also include some cross-border regions, e.g. Lille-Tournai and densely populated metropolitan agglomerations, as London and Paris (European Commission, 2020k). There is no doubt that the region forms the largest part of Europe's 'blue banana', comprising a set of metropoles in the area, as Manchester, Birmingham, London, Rotterdam, Hague, Amsterdam, Antwerp, Ghent, Brussels, Düsseldorf, Dortmund, Frankfurt, Stuttgart, with some more remote rural areas, mainly in Belgium, France and Germany (European Commission, 2020k). As Map 5-1 shows, the majority of NUTS 2 regions in the NWE cooperation area are predominately urban regions, in most of the Netherlands, west Belgium, the Ruhr area in Germany, around Paris and most parts of the United Kingdom. Irish regions are an exception, as most of its territories are either intermediate urban or rural areas. Intermediate urban areas are to be found in the surroundings of these urban areas, and beyond. Vast rural areas are to be found particularly in France, beyond Île de France, and in Ireland, as well as Scotland and some areas in west Germany.

Map 5-1 Regional typology at NUTS 2 level



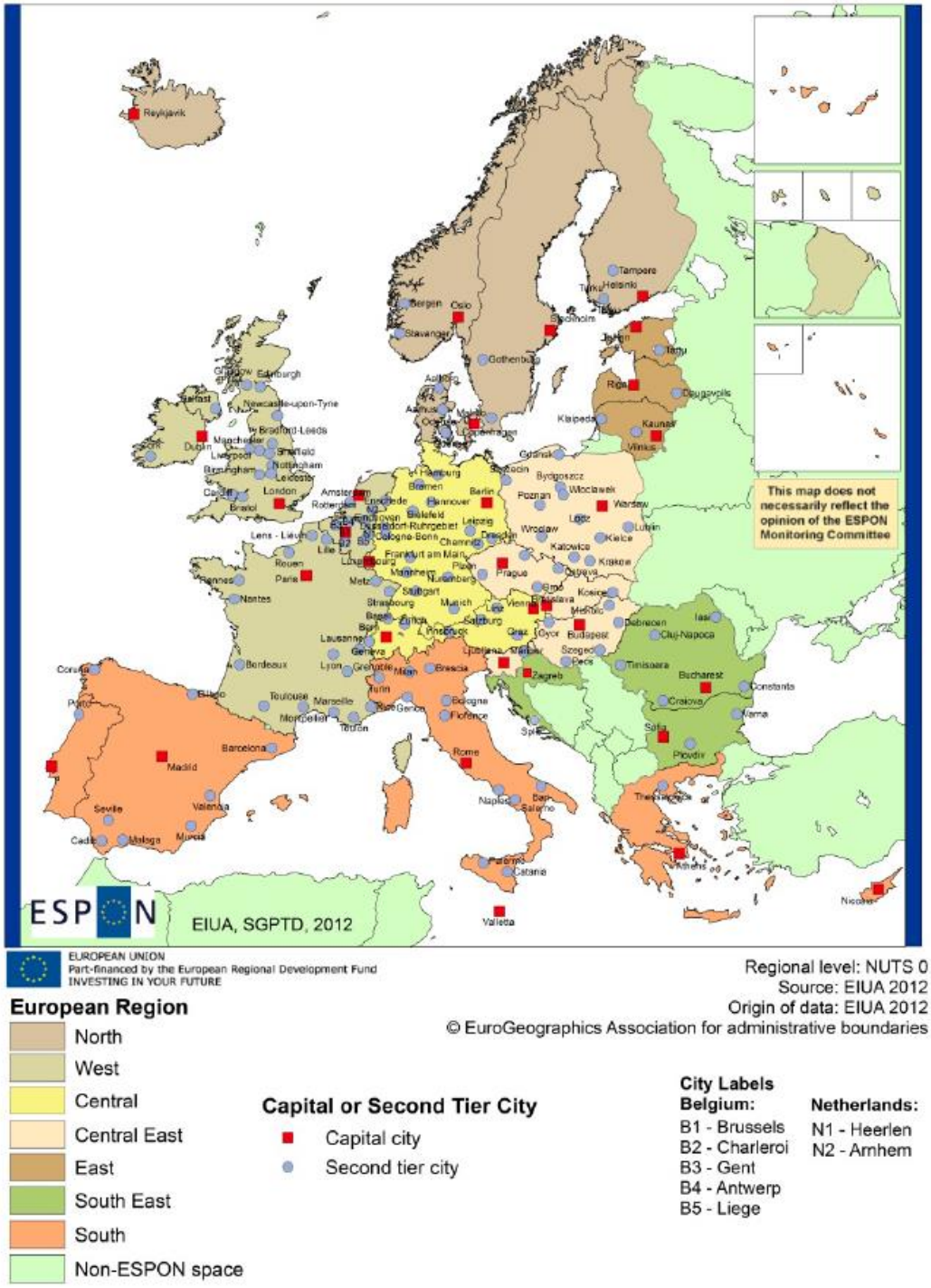
Source: own representation, 2020

The capital cities in the NWE cooperation area largely shape the national economies. Capital cities bring high gains to their national economies, as thanks to their agglomeration advantages, they have a strong private sector, are well networked at a global scale, they have advanced producer services and financial institutions, as well as they are innovation, research and transport hubs (ESPON, 2013a). The NWE cooperation area, as also mentioned above, is home to many and among the most economically strong EU capital cities, each sharing several but also having different gateway functions and characteristics. For instance, London is the only global business hub in the EU, while Paris follows a major global gateway. Amsterdam is a transport, innovation and tourism hub, Brussels is an innovation and transport hub, Dublin is an economic gateway, while Luxembourg is a gateway for international trade, attracting foreign issuers (ESPON, 2013b).

Despite their benefits, capital cities may also face negative externalities due to unregulated urban growth (ESPON, 2013a). Furthermore, large metropolitan areas face a number of challenges, which are

frequent across most, such as efficient transport infrastructure, multilevel collaboration, shared vision on strategic plans, traffic congestion and political reluctance to address issues at a metropolitan scale (ESPON, 2018e).

Map 5-2 The 31 capitals and 124 second tier cities

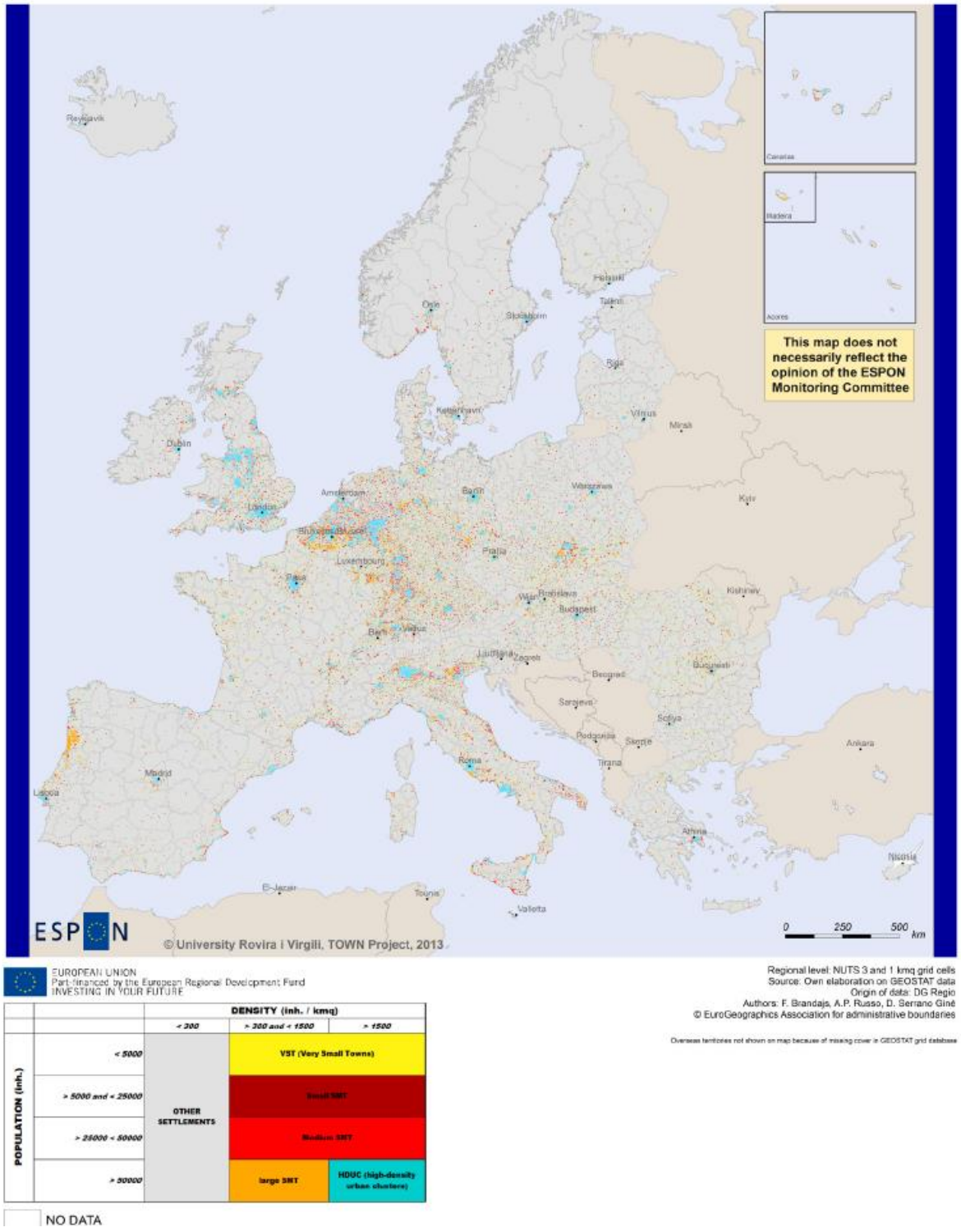


Source: (ESPON, 2013a)

The second-tier cities in the NWE cooperation area are also of great importance**.** Nevertheless, the NWE cooperation area is not only home to vibrant and economically strong capital cities. It is also home to smaller second-tier cities which play an important role in its economic and local governance character. Second-tier cities have economic, wealth and human capital potential, can offer firms better local access to different services, while with the right infrastructure, facility and capacity, they can increase their regional economic capacity and reduce inter-regional inequalities by promoting territorial and social cohesion (ESPON, 2013a). Hence, second-tier cities are non-capital cities that have economic and social performance which can affect the performance of the national economy, while in some cases they can even outperform their capitals (ESPON, 2013a). Map 5-2 shows the second-tier cities in Europe. A very high concentration of second-tier cities is observed in the North West Europe cooperation area, particularly in regions in the United Kingdom, such as Liverpool, Manchester, Birmingham, Edinburgh and Glasgow, in Belgium, such as Namur, in the Netherlands, such as Rotterdam and Eindhoven, as well as in the western part of Germany, as Düsseldorf and Cologne.

As a highly urbanised region, the NWE cooperation area has also a high density of small and medium-sized cities, as Map 5-3 shows. Although the area is characterised by high density urban clusters, there is also a large number of small and medium sized towns, particularly in the Netherlands, in Flanders and central and south United Kingdom, with very small towns observed in south Belgium and north France (ESPON, 2014). Small and medium-sized towns play an important role in the economic development of functional urban areas, mainly through daily migration patterns, as well as when it comes to the deconcentrating and concentration of firms and residents (ESPON, 2014). Despite them not profiting from agglomeration economies, they benefit from being a more affordable place to live and work compared to larger urban areas, while although networks of small and medium sized cities may not be able to substitute larger urban areas, they have the potential through this cooperation to achieve a territorial critical mass and a shared vision which can lead to more development (ESPON, 2014). Certainly national and regional policies play a crucial role in the development of small and medium sized cities and hence well thought policies and strategies to attract and maintain population in these towns to avoid depopulation and ageing, but also to enhance the attractiveness of the place in general for touristic reasons and develop further and diversify the local productive economy and small businesses would be of benefit to support territorial cohesion and integrated development (ESPON, 2014).

Map 5-3 Small- and Medium-sized town settlements, ESPON space



Source: (ESPON, 2014)

The urban-rural linkages in the NWE cooperation area show some first functionalities. Urban-rural relations and linkages are inevitable, as they integrate urban and rural areas in a more functional way. Urban and rural linkages can inspire a more balanced territorial development, as they enhance the

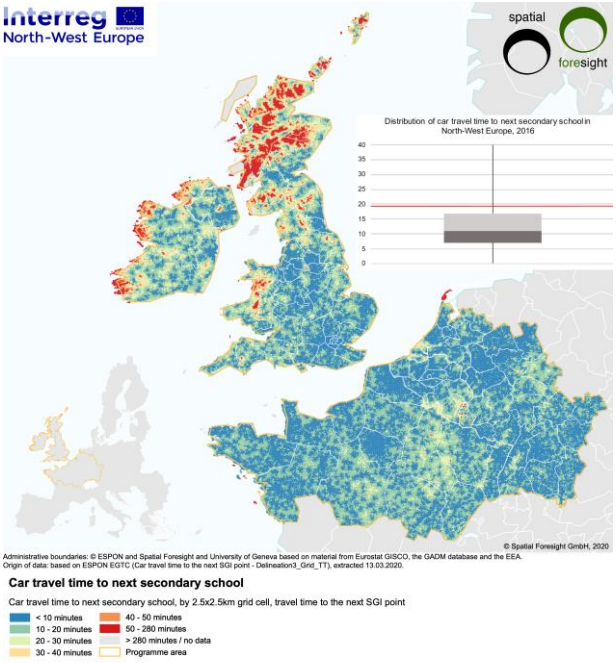
existing complementarities between the urban and rural regions, they can improve access to services and increase the economic attractiveness of rural areas. There are different types of linkages between urban and rural areas (ESPON, 2019b). These are for instance demographic linkages, such as rural-urban migration and commuting and counter-urbanisation, economic transactions and innovation activities, delivery of public services, including public transport, amenities and environmental goods exchanges, such as leisure, recreation, water supplies and renewable energies (ESPON, 2019b). Some of these functionalities will be discussed further in the report.

Despite the existing functionalities, urban-rural disparities remain in the NWE cooperation area. The high degree of urbanisation does not exclude an urban-rural divide. This is mainly to be observed when it comes to GDP and economic activities, or green infrastructure, or transport connections and accessibility. GDP is higher in urban areas, while although the urban centres in the region are well connected and the region is one of the best connected regions by rail and air (European Commission, 2017c), accessibility between urban and rural areas can be improved. Furthermore, potential regarding circular economy, or smart energy system can be supported by rural areas, e.g. in the French and Belgian border (European Commission, 2019). All these can definitely describe any disparities between urban and rural regions in NWE cooperation area. Nevertheless, as these themes are rather the focus for other policy objectives, this section will look at urban-rural disparities that can be most relevant for policy objective 5.

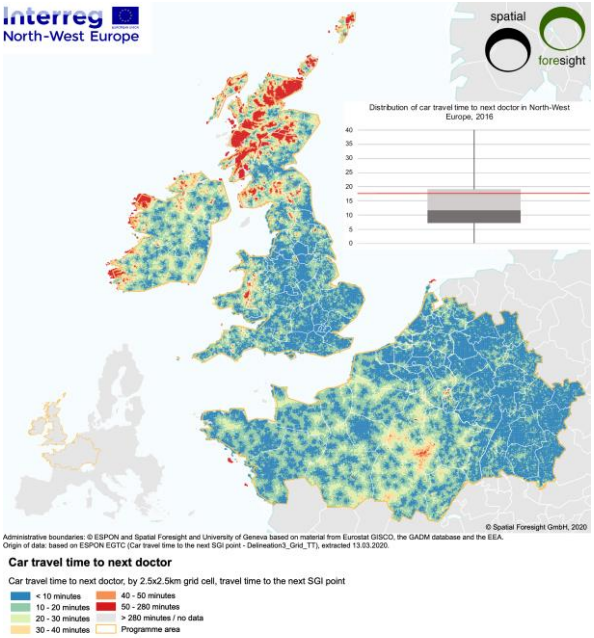
One example is the access to services of general interest in the NWE cooperation area, which shows an urban-rural divide. Rural areas are more vulnerable when it comes to access to services of general interest, however, this differs per area and per service. Map 5-4 - Map 5-7show the car travel time to the next secondary school, next doctor, next hospital and next shop. Rural areas particularly in the north of Scotland and along the west coast of Ireland and Northern Ireland have limited access to these services. Unlike the rural areas of Germany that are part of the NWE cooperation area, which have a moderate access to these services. Overall, it seems that services of general interest that are of everyday use, such as secondary schools or shops are rather more accessible, compared to services that of more rare use. Rural areas in France need more travel time to doctors and hospitals, unlike shops or secondary schools.

Transnational cooperation can play an important role in mediating the needs to access to services. Cooperation has particularly proven vital in periods of crisis, such as the COVID-19 crisis, where hospitals at the border accommodated patients from neighbouring places. Hence, coordinating approaches can cover such needs. The urban-rural partnership between regional urban centres and their surrounding resource-based communities needs to be revitalised so as to achieve a stronger territorial cohesion and more integration in different types of territories (ESPON, 2019c). Urban-rural partnerships could also be a horizontal objective to address any fragmentation risks.

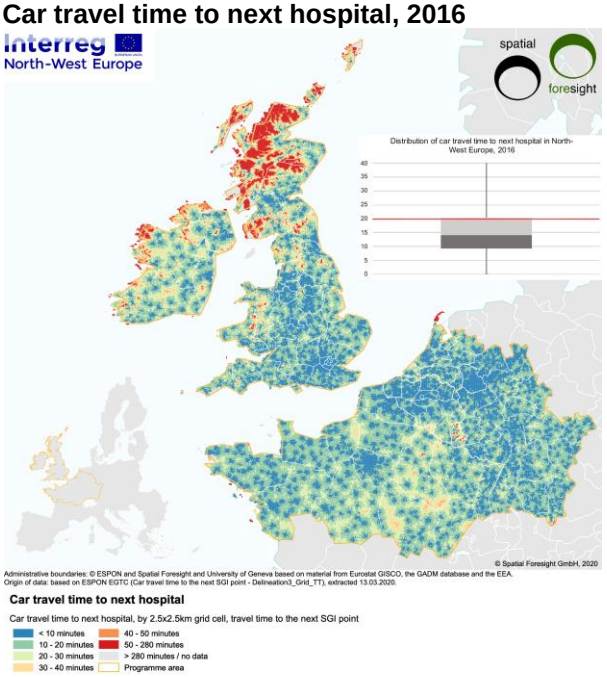
Map 5-4
Car travel time to next secondary school, 2016



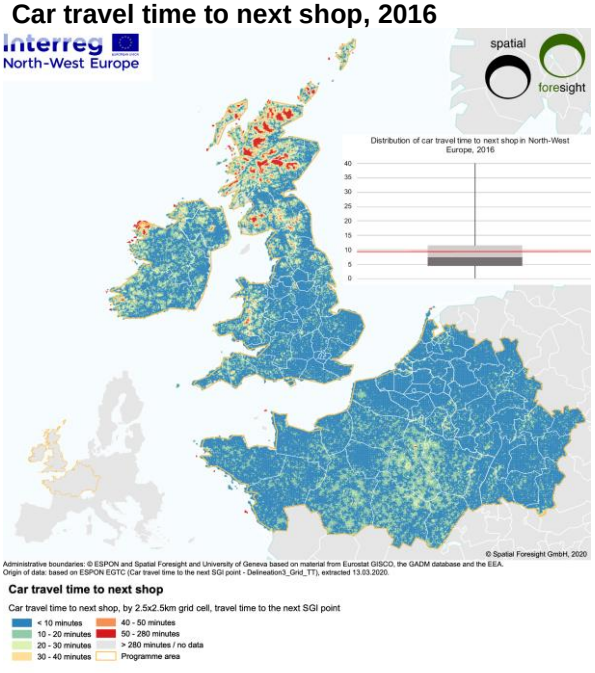
Map 5-5
Car travel time to next doctor, 2016



Map 5-6
Car travel time to next hospital, 2016



Map 5-7
Car travel time to next shop, 2016



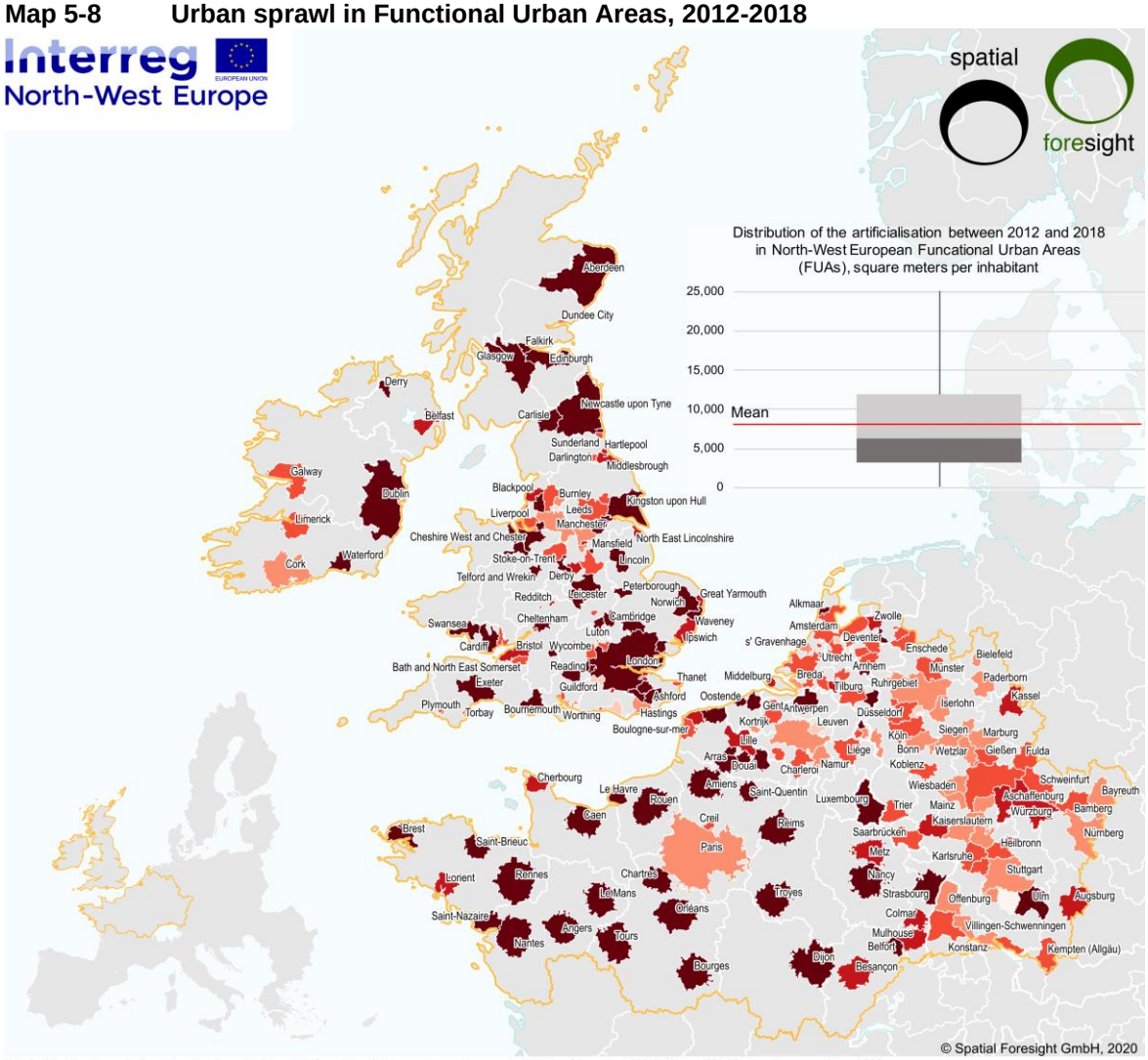
Source: own representation, 2020

Looking at different functionalities in the NWE cooperation area, it can be observed that there is an existing experience in functional areas in the NWE cooperation area, both within the single member states, but also at a transnational level. At single member states' level, this regards for instance functionalities e.g. along large river basins, as the rivers Seine, going through Île de France and Paris before entering into the English Channel and the Havre, and Loire, going through Tours and Nantes, as well as along the 16 river basin districts in the United Kingdom mainly for flood protection, as well as urban-rural functionalities. At a transnational level, there has been a strong cooperation among metropoles in the territory, particularly regarding the river catchment areas of the transnational region. Those rivers do not only serve as inland navigable waterways, but also as important cooperation structures, among the first examples of transnational cooperation, as for example the Rhine/Meuse rivers, going through France, Belgium and the Netherlands (see also chapter 2 of this report for the river catchment areas in the NWE cooperation area).

As stressed by the orientation paper, there are different types of functional areas, e.g. functional urban areas (e.g. Dublin, London, Paris, Amsterdam, Lille Tournai, Luxembourg, Stuttgart), functional rural areas, urban-rural partnerships, potential cross-border areas, transnational urban (e.g. Belgium / the Netherlands / Luxembourg and France / Germany / Switzerland), macro-regions (European Commission, 2020k). Functionalities can also be found in transport related functional links, as for example in the French-Belgian cross-border area (European Commission, 2019). Most of these functionalities have a rather distinct urban character. Map 5-8 shows the urban sprawl in the functional urban areas, between 2012-2018 in the NWE cooperation area. There is a significant urban sprawl in functional urban areas of France beyond Île de France, parts of Scotland and north of England, as well as south of the United Kingdom and around London, as well as Luxembourg, while Ireland, with the exception of Dublin, the Netherlands, Belgium and Germany have a more moderate picture.

Functionalities also play an important role when it comes to urban-rural linkages, as the latter contribute to integrate rural and urban areas into more functional territories and improve access to public services within functional areas, increase the attractiveness of rural areas, enhance complementarities and inspire more balanced territorial development (ESPON, 2019b). Recent analyses indicate a lack of knowledge on spatial trends in functional urban areas. With a focus on metropolitan areas these show that functional urban areas in the NWE cooperation area face partially different development trends and challenges that are influenced e.g. by national policy contexts, regional development and economic prosperity of the urban area (Dembski, Sebastian et al., 2019).

Map 5-8 Urban sprawl in Functional Urban Areas, 2012-2018



Administrative boundaries: Spatial Foresight and University of Geneva based on material from Eurostat GISCO, the GADM database and the EEA.
Data: based on EEA (Corine Land Cover Change (CHA) 2012 - 2018, Version 20) and Eurostat [urb_lpop1], extracted 13.03.2020.

Urban sprawl in Functional Urban Areas, 2012-2018

Change in soil sealing towards artificial surfaces, square meters per 1,000 inhabitants between 2012-2018

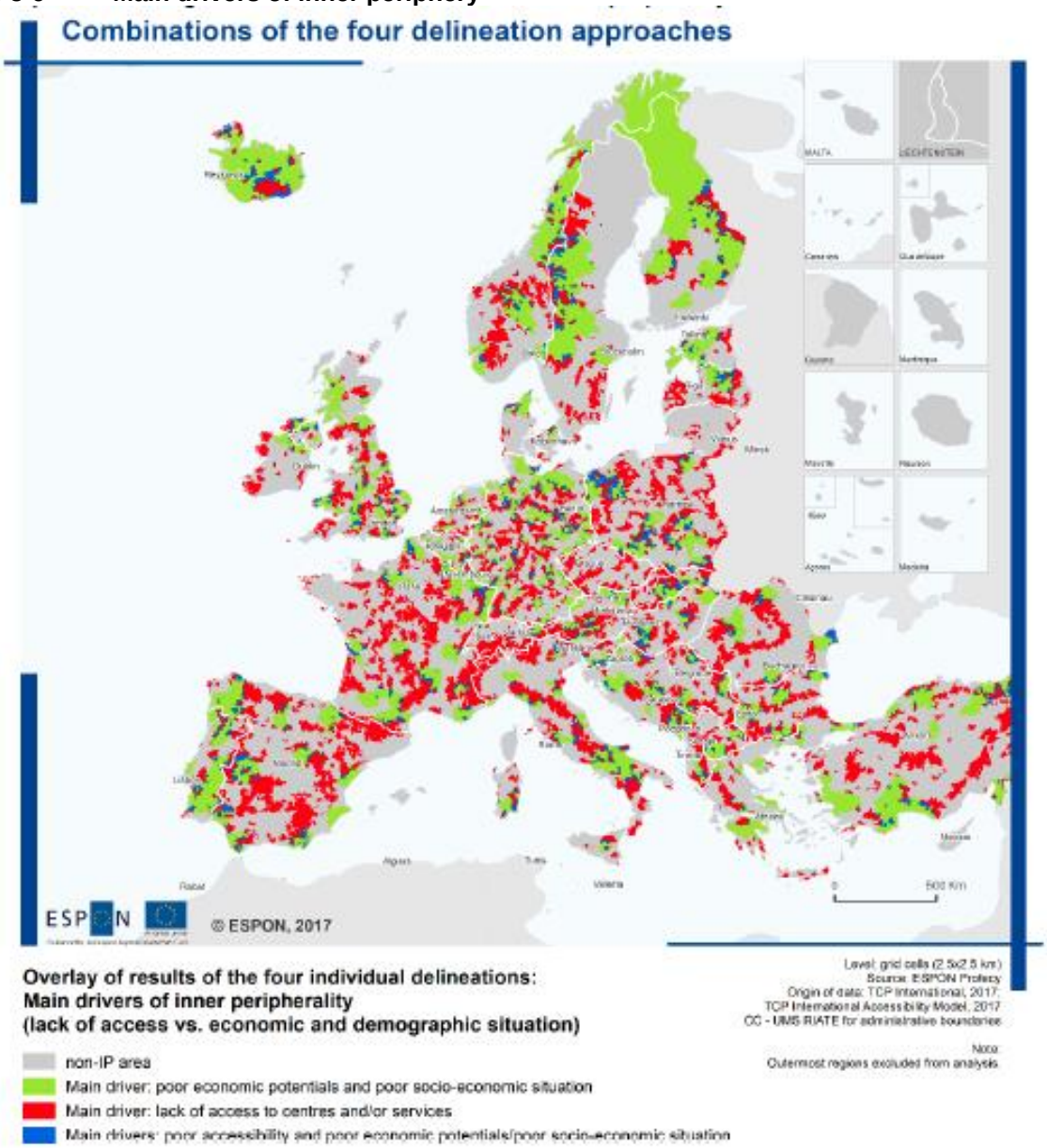
- < 500 square meters
- 500 - 1,000 square meters
- 1,000 - 3,000 square meters
- 3,000 - 6,000 square meters
- 6,000 - 9,000 square meters
- > 9,000 square meters
- Programme area
- no data / no NWE territory

Source: own representation, 2020

Inner peripheries are a rather complex phenomenon which combines various socio-economic processes that result in disconnection from external territories and networks, hence their feature is their disconnection degree, rather than their geographic position to core European areas. Their common characteristic is that they lack in performance, development levels, access to services and worse quality of life than their neighbouring territories (ESPON, 2017c). There are different drivers that may result in inner peripheries. In the cooperation area of NWE cooperation area, these are mainly lack of access to centres and / or services and poor economic potential and poor socio-economic situation, which however also vary and differ in the regions within the different member states. For instance, lack of

access to centres is more visible in Nord region in France, while in the Bassin parisien region, inner peripheries exist rather due poor economic potential. Similar poor economic potential is to be found in the rural areas in Scotland, as well as in parts in Belgium and the Netherlands. On the other hand, inner peripheries in along the west coast of Ireland, Wales and north of England are rather characterised by lack of access to centres / services. The driver of poor accessibility and poor economic potential is to be found to a smaller extend (ESPON, 2017c).

Map 5-9 Main drivers of inner periphery



Source: (ESPON, 2017c)

Zooming in the different delineations of the drivers helps having a clearer picture for the NWE cooperation area cooperation area. Map 5-10 - Map 5-13 show inner peripheralities per delineation. More specifically, one can observe that the travel times to regional centres are high even in

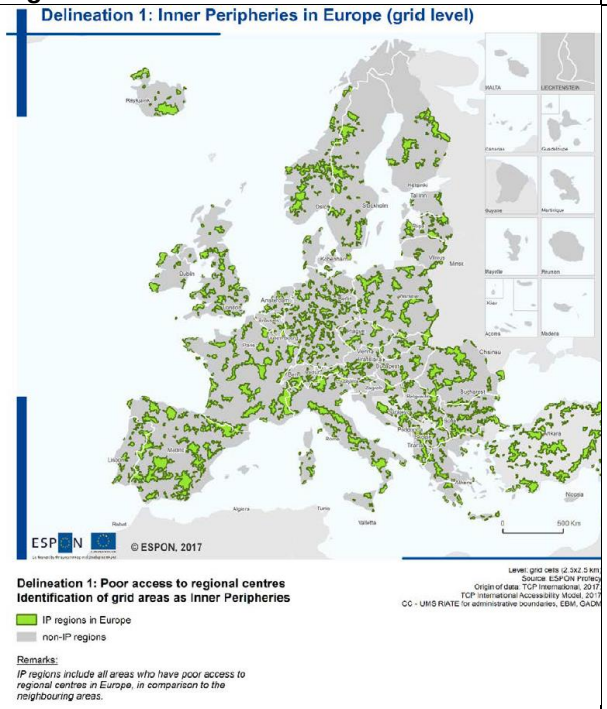
predominantly urban areas, such as the regions around London and regions in the Netherlands. Rural areas are also distanced from regional centres, such as regions in Scotland, north of France, western Germany and the western parts of Ireland (Map 5-10). There are relatively few parts with low economic potential in the region, mainly in the Highlands and Islands in Scotland, south of the United Kingdom, Nord-pas-de-Calais and a few regions in Belgium, the Netherlands and western Germany (Map 5-11). When it comes to access to services of general interest, as also described earlier, the access is lower in many regions outside the big urban areas and agglomerations (Map 5-12). Regarding demographic and economic performance, better performance is to be found in most regions of France and Ireland (Map 5-13). (ESPON, 2017c)

Functionalities and linkages between inner peripheries and other territories can ameliorate the lack of connectedness. For this, different actions can be taken. The identification and implementation of proper strategies could reverse the phenomenon of inner peripheries and places left behind and increase their connectedness with the elements it misses (ESPON, 2017c). For the development of these strategies and intervention logic would need to be built by identify the drivers for inner periphery, extracting their impact and then designing the adequate interventions. For instance, for the concept of low economic potential, possible interventions could regard investments in infrastructure, territorial capital interventions and network brokerage. For areas with poor access to services of general interest, possible interventions may regard the social innovation, governance reform or information technology and enhancements of residential environment. Local interaction, connectedness and use of existing networks and programmes can only be of benefit for areas facing inner peripherality. CLLDs, for example, can enhance this type of cooperation and build locally strong territories and bonds. (ESPON, 2018f)

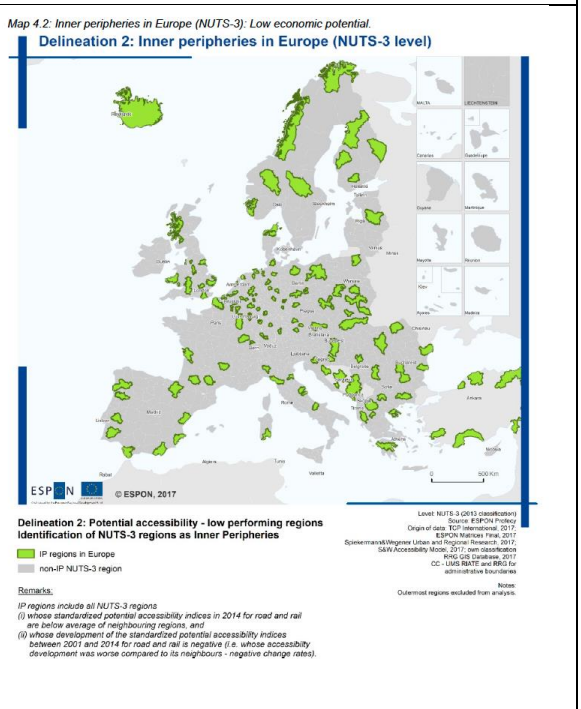
TEN-T networks also show functionality. Besides functional urban links and the functionalities along river catchment areas, other functional characteristics can be found in the different regions of the NWE cooperation area. As shown also in chapter 3 of this report, the TEN-T networks are a functional link. The NWE cooperation area is high densely in transport networks connecting several spots within countries and regions, but also cross-border and eventually transnational. Besides the core network connections there are also several connections through the TEN-T network connecting other places beyond the core poles. These include both high speed connections but also conventional rail, road connections and air and port connections. Given such connections, functionalities can also be found among coastal areas. Hence transport flows show a functionality that spreads throughout the region and can be a topic where local and regional strengthening and involvement can be of benefit for common challenges deriving from the transport connections.

Last but not least, commuting across borders and commuter flows show another functionality. In the NWE cooperation area, people commute for work within a region of a member state, or across regions. Although the commuter flows are most relevant for cross-border territories and would benefit from cross-border cooperation, they can serve as inspiration to show how vibrant these territories are and also inspire future policies. Map 5-14 below shows the total commuter outflows, i.e. people living one region and commute to work to another, be that the same member state or a across a border (Eurostat, 2016). The highest shares of commuting are to be observed in London and in Belgium, particularly around the capital city of Brussels, while a high share is also to be observed in the densely populated Benelux countries, as well as a high number of within region commuters flows into Bochum, Dortmund, Düsseldorf and Cologne (Eurostat, 2016).

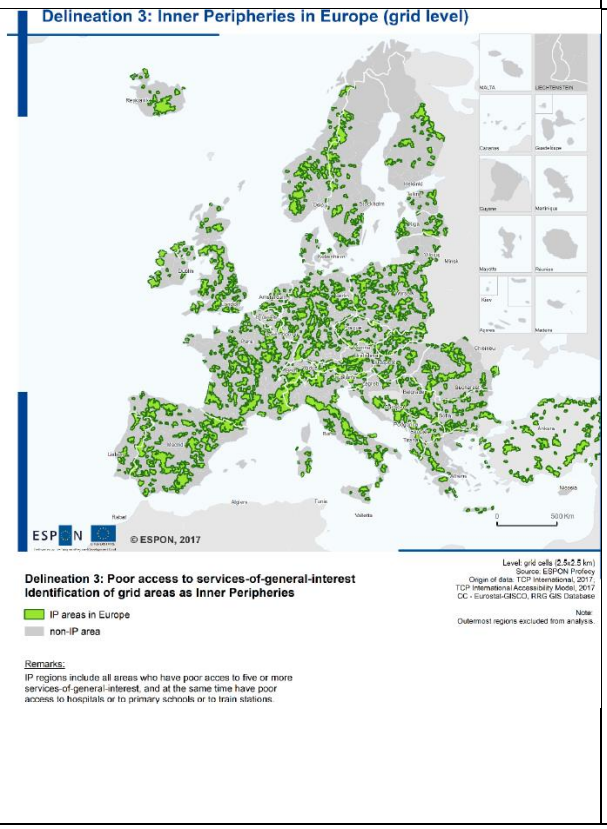
Map 5-10 Areas of high travel times to regional centres



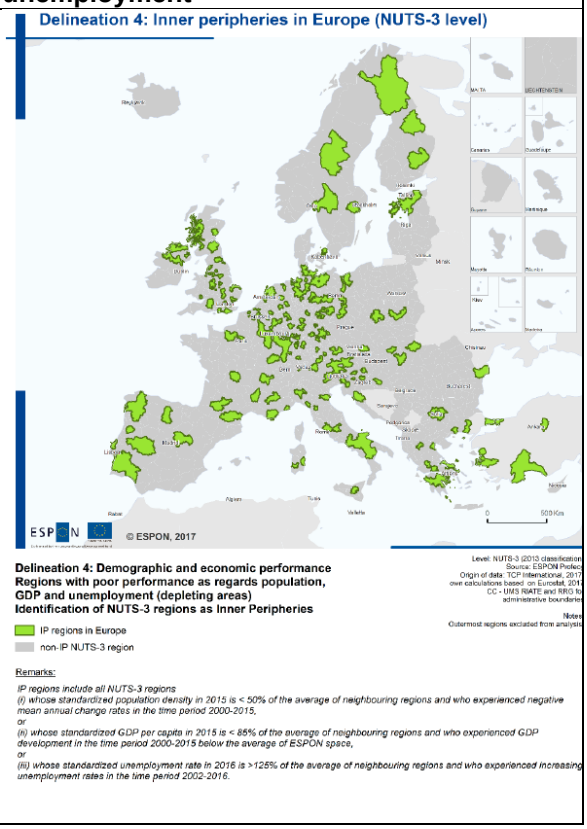
Map 5-11 Low economic potential



Map 5-12 Poor access to services of general interest

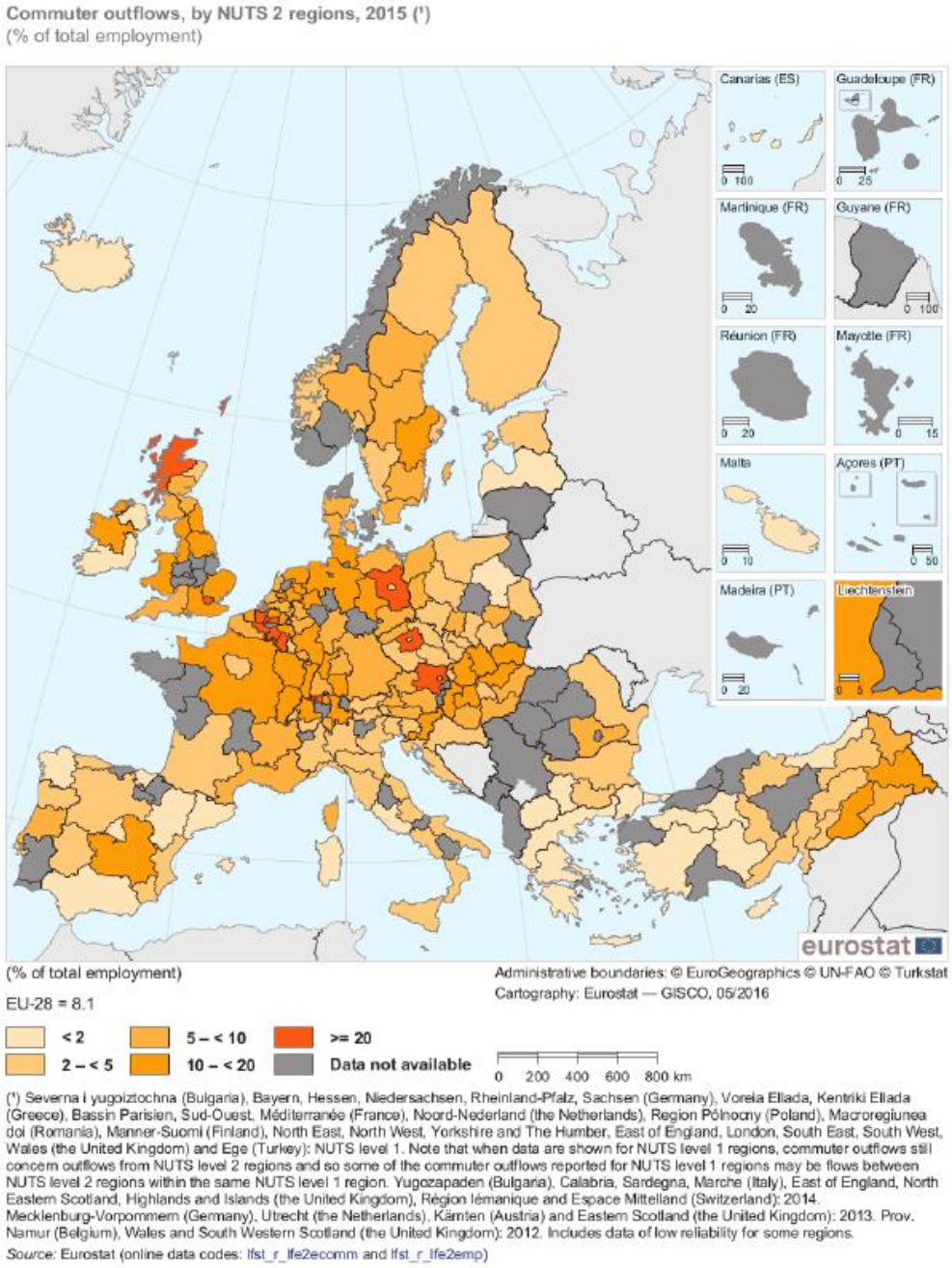


Map 5-13 Regions with poor performance as regards population, GDP and unemployment



Source: (ESPON, 2017c)

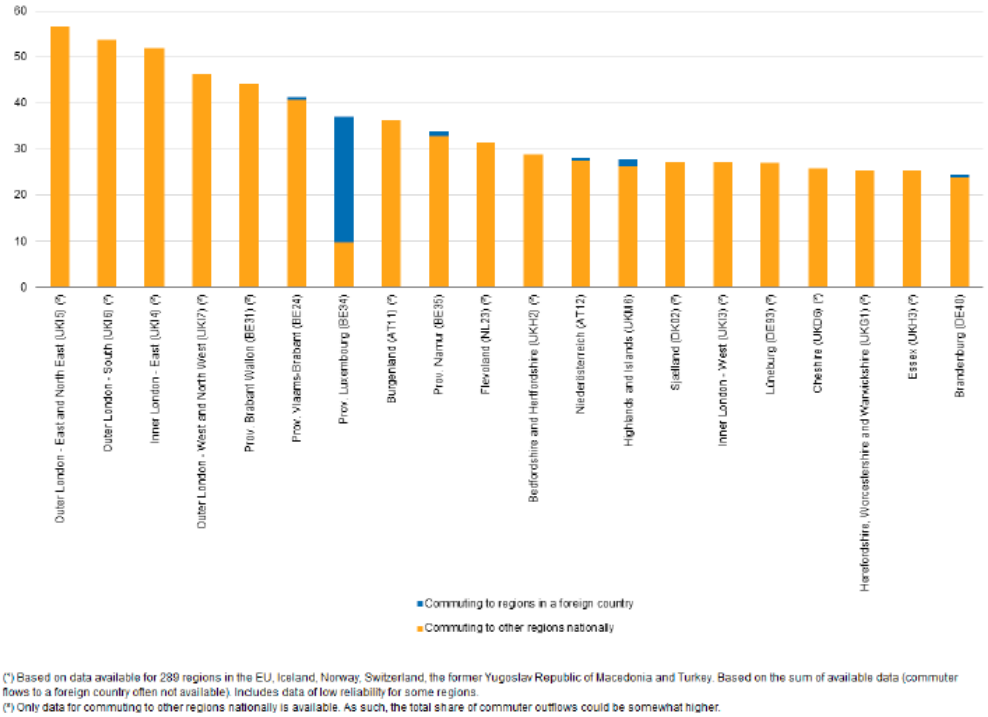
Map 5-14 Commuter outflows by NUTS 2 regions, 2015



Source: (Eurostat, 2016)

Figure 5-1 shows that 17 out of the 20 regions with the highest commuter outflows are part of the NWE cooperation area, with the province of Luxembourg in Belgium having the highest share of commuters to regions in another country, namely Luxembourg.

Figure 5-1 Analysis of commuting destinations for the top 20 regions with the largest shares of commuter outflows by NUTS 2 regions, 2015

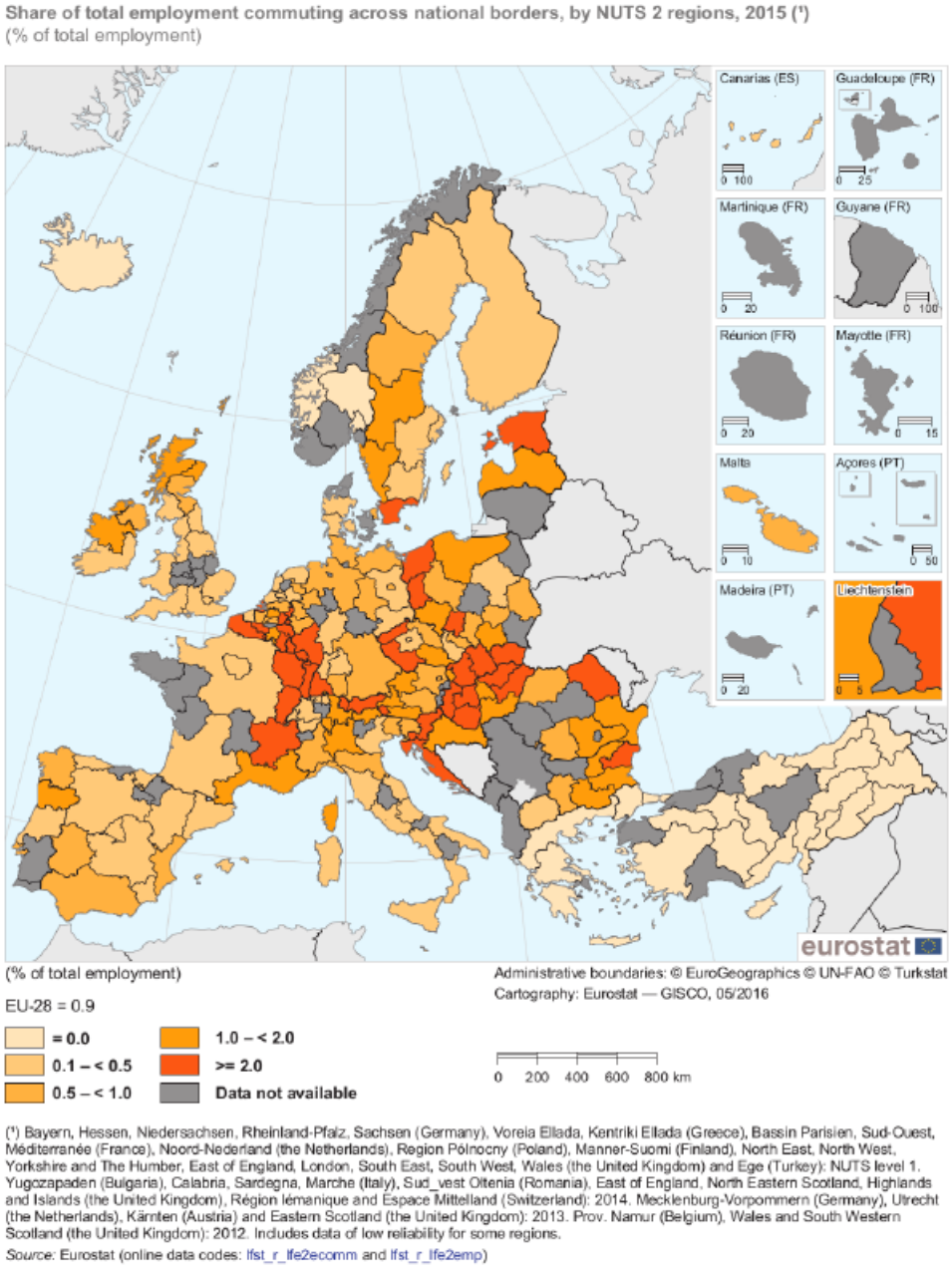


(*) Based on data available for 289 regions in the EU, Iceland, Norway, Switzerland, the former Yugoslav Republic of Macedonia and Turkey. Based on the sum of available data (commuter flows to a foreign country often not available). Includes data of low reliability for some regions.
(*) Only data for commuting to other regions nationally is available. As such, the total share of commuter outflows could be somewhat higher.

Source: (Eurostat, 2016)

Cross-border commuting is highly visible in the region. Among the highest share of cross-border commuters is to be found in Nord-Pas-de-Calais, through Benelux into Rhineland Palatinate, Lorraine and Alsace, as far as the North West Europe cooperation area is concerned. Particularly the south-east border of Belgium, the Luxembourg Province accounts for more than a quarter of outbound commuters and the highest second share of cross-border commuting is to be found in the north-eastern French region of Lorraine (see also Map 5-15) (Eurostat, 2016). Luxembourg is a particular case of cross-border commuting, as it attracts a high number of commuters from its neighbouring countries, reaching up to 42% of its workforce. Although the commuters have a low impact on the flows at their national level, they play an important role in the regional picture (Eurostat, 2016).

Map 5-15 Share of total employment commuting across national borders, by NUTS 2 regions, 2015



(¹) Bayern, Hessen, Niedersachsen, Rheinland-Pfalz, Sachsen (Germany), Voreia Ellada, Kentriki Ellada (Greece), Bassin Parisien, Sud-Ouest, Méditerranée (France), Noord-Nederland (the Netherlands), Region Północny (Poland), Manner-Suomi (Finland), North East, North West, Yorkshire and The Humber, East of England, London, South East, South West, Wales (the United Kingdom) and Ege (Turkey): NUTS level 1. Yugozapaden (Bulgaria), Calabria, Sardegna, Marche (Italy), Sud_vest Oltenia (Romania), East of England, North Eastern Scotland, Highlands and Islands (the United Kingdom), Région lémanique and Espace Mittelland (Switzerland): 2014. Mecklenburg-Vorpommern (Germany), Utrecht (the Netherlands), Kärnten (Austria) and Eastern Scotland (the United Kingdom): 2013. Prov. Namur (Belgium), Wales and South Western Scotland (the United Kingdom): 2012. Includes data of low reliability for some regions.

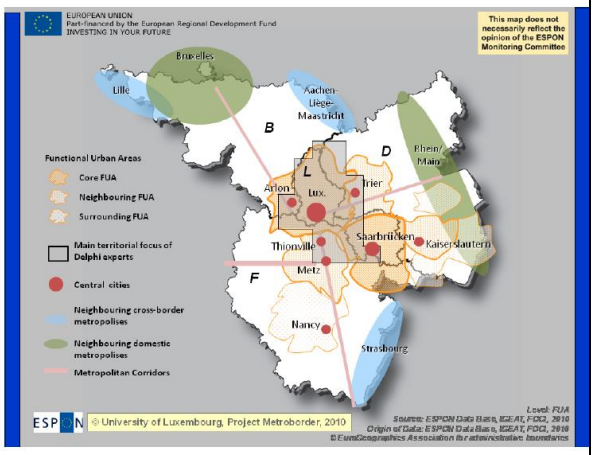
Source: Eurostat (online data codes: lfst_r_lfe2ecomm and lfst_r_lfe2emp)

Source: (Eurostat, 2016)

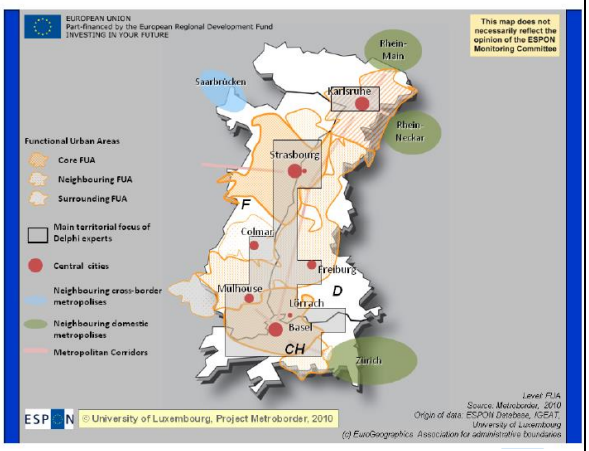
Hence, the Greater Region shows a clear functional polycentricity and functionality highlighting the integration between different regions, complementing each other in a series of structures. Although the sizes of the functional area cannot compete large urban agglomerations, it sufficiently builds a critical mass, which can have spill over effects and lead to more integrated development potential (ESPON, 2010). Similarly, the Upper Rhine region shows a polycentric picture at a cross-border level with functional urban areas at the borders (ESPON, 2010). The maps below show the functionality of these cross-border regions. What can be highlighted is that through cooperation at a functional level, more can be achieved and the dominance of capital cities as growth poles can be counterbalanced,

addressing at the same time common challenges. Transnational cooperation can be inspired by such examples and be a platform for bringing those local actors together through networks and initiatives.

Map 5-16 A cross-border polycentric metropolitan region within the Greater Region



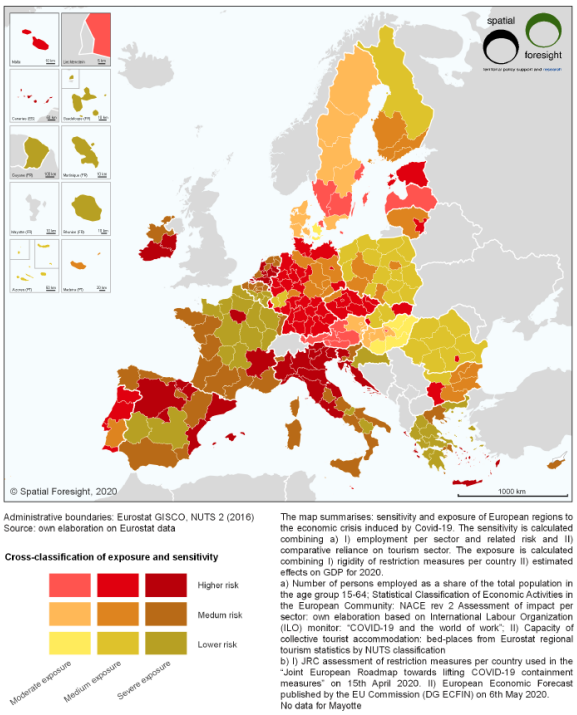
Map 5-17 A cross-border polycentric metropolitan region within the Upper Rhine



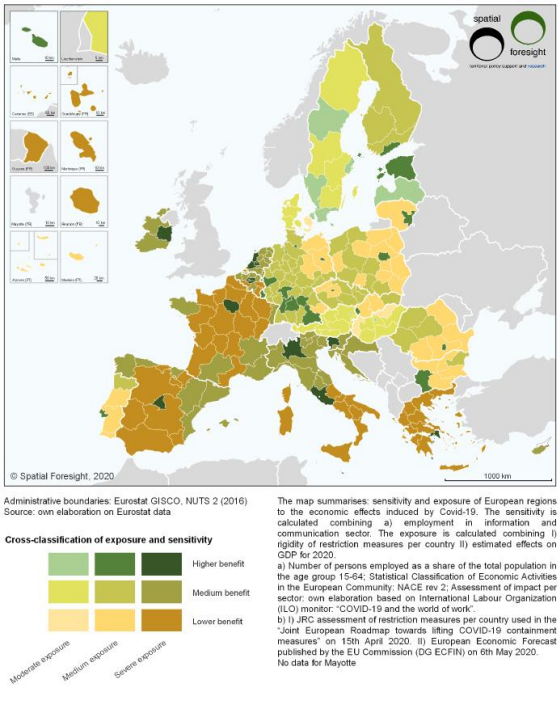
Source: (ESPON, 2010)

Functional links have been shown to a very limited extend when it comes to COVID-19 responses. There have indeed been a few cases where functionalities at cross-border level have played a role in addressing access to services of general interest. Nevertheless, most policy responses were implemented at national level, without necessarily a cooperation across borders. This has had different implications on different regions across Europe. Looking at a number of economic sectors and their risk assessment, the sensitivity (the degree a region may be subject to a policy) and exposure the degree a region is subject to a policy is based on its regional characteristics) has been developed (Böhme & Besana, 2020). Regarding the territorial impacts of the COVID-19 in the NWE cooperation area, based on the policy responses, the south-east of Ireland, east of the Netherlands, Luxembourg and Île de France show a higher risk and severe exposure. Regarding to the positive impacts of the COVID-19 policy responses, capital cities and in general urban areas are in a more favourable position, facing higher benefit, despite the severe exposure (Map 5-18 and Map 5-19, Böhme & Besana, 2020).

Map 5-18 Potential territorial impacts of COVID-19 policy responses – a preliminary assessment



Map 5-19 Possible positive impacts of COVID-19 policy responses – a preliminary assessment



Source: Spatial Foresight (2020), based on Eurostat data and JRC and EU Commission studies[101]

Overall, one of the NWE cooperation area strengths is the existing rich experience with functional areas. Functional areas can be a useful territorial level to address common challenges. The NWE cooperation area can be a platform for reconsidering the match between territories and challenges beyond administrative borders and focus on challenges resulting from the river catchment areas, challenges of metropolitan agglomeration, transport, climate change and others (European Commission, 2020k). The cross-border cooperation potential may be extended to different types of territories, as well as can the topics. Topics like tourism, culture, circular economy, services of general interest can be potential topics for cooperation at a functional level. A more problem-solving focus on functional areas will be important to support territorial strategies to address in an integrated way specific challenges of the area and develop possibilities for joint investments that are most relevant for the NWE cooperation area (based on European Commission, 2019). For example, functionalities can be the starting point for developing local actions coming directly from the citizens, as they will be based on functional issues that are closest to them. Besides on building on the region's comparative advantage, functional cooperation can also address common challenges in a joint way, particularly on issues that cannot be addressed by one region alone and where a larger partnership and participation would be of added value. Challenges as for instance, urban-rural divides in relation to accessibility need more integrated territorial development. For these, the revitalisation of urban-rural partnerships could be a starting point. Last but not least, topics

[101] These are preliminary findings. The study is under development.

that are relevant for cross-border cooperation, such as job opportunities, employment and hence commuting may serve as inspiration for a transnational cooperation level.

5.2 Rural and coastal area development and geographic specificities

The NWE cooperation area is one of the most highly urbanised and most populated regions in Europe. Although larger cities have a higher productivity compared to smaller ones, or rural areas, the later are often concentrated in agricultural production, or the natural resources exploitation, and manufacturing, which, given the small workforce and population, may lead to specialisation in specific activities (European Commission, 2017c). Integrated strategies have supported rural development, as they have improved the governance of functional areas and promoted urban-rural or cross-border links (European Commission, 2017c).

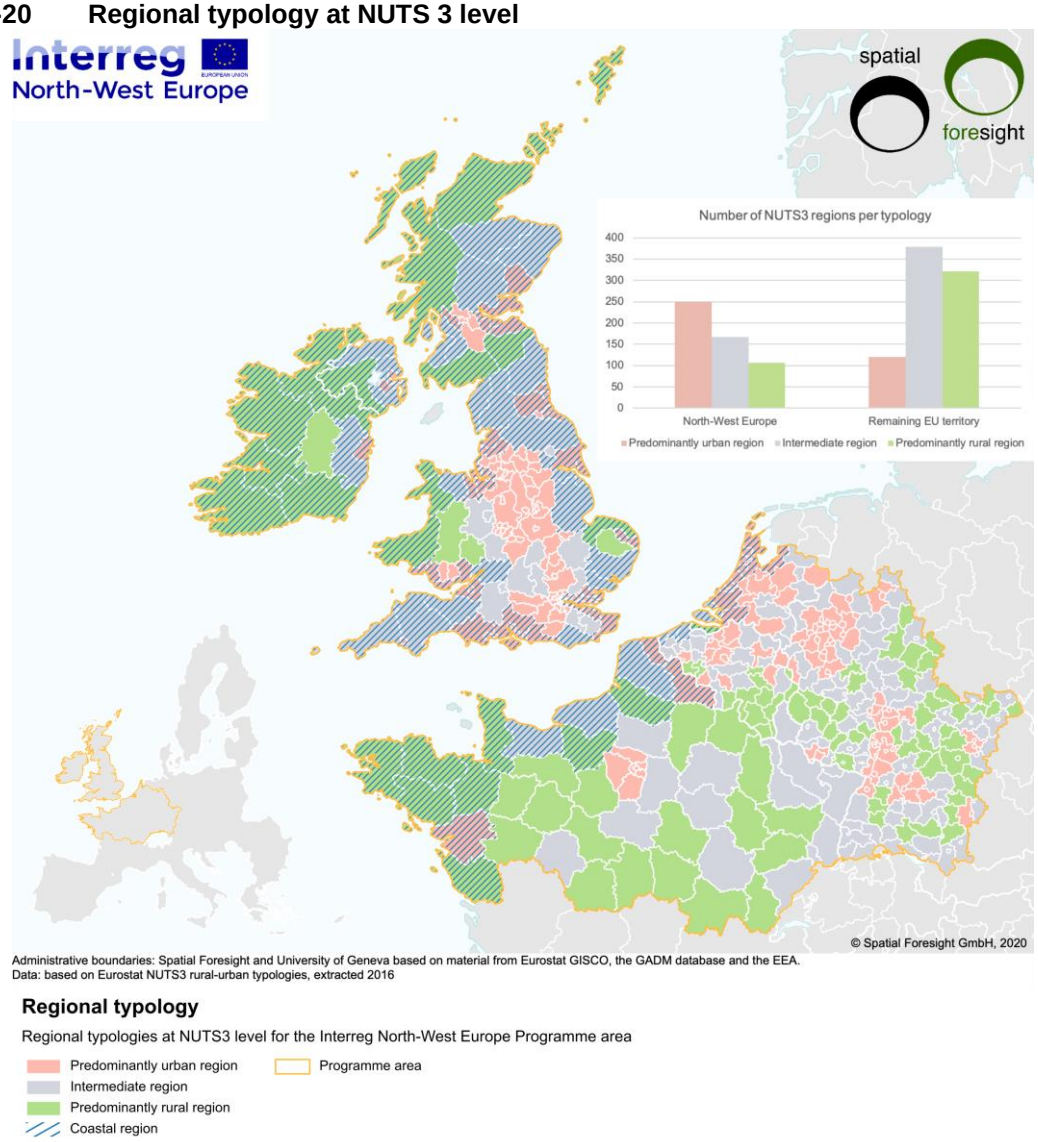
The NWE cooperation area is also home to predominantly rural areas, particularly in France (Ouest and Bassin parisien), most of Ireland, parts in Northern Ireland, Scotland and Wales in the United Kingdom and smaller rural areas in Germany in proximity to intermediate and urban areas (Map 5-20).

As Map 5-20 also highlights, some of these rural areas have at the same time also a territorial specificity, as they are also coastal areas. Ireland and the United Kingdom are large islands, so besides their central regions, all others are also coastal areas, as are the regions along the coasts of the English Channel to the North Sea.

The rural development in the rural areas of the NWE cooperation area can be challenged by a number of factors. These can be depopulation, unemployment, youth unemployment, GDP differences with urban areas, accessibility challenges. Furthermore, rural counties in the United Kingdom that are far from United Kingdom's hotspots and coastal regions suffered from declining tourism and fishing industry (ESPON, 2019c). The analysis of POs 1 and 3 have shown that the rural areas of North West Europe lag behind in these factors compared to the predominantly urban and intermediate regions. At the same time, there is some potential seen in the rural areas of the region. while green infrastructure is another area of potential for rural areas. Wind energy potential is to be seen in coastal (see also later in this chapter) and rural regions in Scotland, coastal areas along the Channel, as well as in the Bassin parisien have a particular installed capacity for electricity generation from wind power (see Map 2-1).

Looking at the coastal areas development, the location and character of coastal areas plays a decisive role in their development. The more remote rural coastal areas are, the more vulnerable they are to unfavourable demographic developments. At the same time, coastal areas that are home to large cities and urban areas show a different picture of development. The ESPON BRIDGES project identifies the variety of the coastal regions based on seven different aspects. Population distribution, to start with, is quite versatile in coastal regions. Coasts are attractive poles for urban development and most populated cities tend to develop on the shoreline, as for example a number of EU capital cities, among Dublin and Amsterdam (ESPON, 2019c). Second comes economic centrality: Some coastal regions are economic hotspots within their national contexts, such as Amsterdam, while others lag behind economically, such as Norfolk in the United Kingdom (ESPON, 2019c).

Map 5-20 Regional typology at NUTS 3 level



Source: own representation, 2020

Economic activities are also quite diverse in coastal areas. Particularly in the North Sea area, which is also the area in focus of this analysis, the coastal areas focus on port activities, fisheries and some sea-related tourism. Hence, urbanised and metropolitan coastal areas do not lack critical mass when it comes to population or economic activities. Ecosystems and climate, as the fourth and fifth aspects respectively, are also very different across the coastal areas, dependent on different geomorphological characteristics and climate zones across Europe. The institutional aspect is related to the security of coastal areas. Last but not least, accessibility is also an important aspect and depends on the remoteness and national population distribution. For instance, the Western European coasts are more accessible compared to the United Kingdom coastal region are more remote. Certainly accessibility is an important factor when it comes to the territorial development, as coastal areas that are also rural areas with small settlements can be challenged by lack of service provision or public transport, while many coastal land strips are inner peripheries between major urban centres in Western and central European coastal states (ESPON, 2019c).

Although coastal or rural areas may be remote and have low accessibility also to energy grids, they also have a potential regarding offshore wind energy and renewables. This depends of course on the regional characteristics, however, shores along the North have a potential or wind energy (European Commission, 2017c).

Summing up, rural areas have the potential to be frontrunners in renewable energies or serve as brand names for sustainable tourism in the region. Coordinated strategies in these fields at a transnational level would be of added value to promote an alternative profile for the region for less inner peripheries and more balanced territorial development where no region is left behind. As sustainable tourism may be more of a challenge for urbanised coastal regions, rural areas can play an important role. Nevertheless, unfavourable demographic conditions remain a challenge and can be a drawback for this development. Coastal areas are dependent on both maritime and land based policies and hence different types of cooperation at different levels is important (ESPON, 2019c). Green infrastructure potential for coastal regions needs also to be taken into account. Urban policies are definitely needed and necessary to be updated for harbour cities and coastal areas, so that they can continue to keep up with international logistics standards and corridors, particularly relevant for example for Rotterdam and Antwerp (ESPON, 2019c), while smart specialisation and blue growth can also be topics for further cooperation.

5.3 Urban development (UIA and URBACT in NWE)

As has already been mentioned earlier in this chapter, the NWE cooperation area is a highly urbanised region. Hence, urban development is an important priority for the development of the regions. The Urban Innovative Actions (UIA) initiative and the URBACT programme are both supporting actions for urban areas to address existing urban challenges and support the territorial development of urban areas, which for URBACT happens through cooperation with other urban areas for UIA in individual cities. Urban areas in the NWE cooperation area participate in a number of urban innovative actions, as well as URBACT networks. These are used in the following to obtain insights in urban challenges possibly not as visible at NUTS 2 and NUTS 3 data level as used for most other analyses of this report. These projects provide inspiration for potential NWE cooperation area measures at urban level.

UIAs supports urban areas in Europe to test new solutions to address urban challenges. In the Benelux area, there in total 14 UIAs, with the Netherlands have the largest participation in UIAs (8 in total), followed by Belgium (6) and France (6) and the United Kingdom (4). Luxembourg and Ireland do not have any actions, while Germany has one but not placed in the cooperation area (see Table 5-1).

The table below groups the different topics, showing the linkages between different themes, urban areas and actions.

Table 5-1 UIA in the NWE area

Topic	City (Country)	Name of Action
Air quality	Breda (the Netherlands)	AirQon - Air Quality through EV Battery Connectivity
Circular economy	Antwerp (Belgium)	Antwerp Circular South - engaging the community in an online and offline circular economy
	Kerkade (the Netherlands)	Super Circular Estate - First Circular Social Housing Estate for 100% Material and Social Circularity
Climate adaptation	Amsterdam (the Netherlands)	RESILIO - Resilience nEtwork of Smart Innovative cLImate-adapative rOoftops
	Greater Manchester (United Kingdom)	IGNITION - Innovative financinG aNd delIvery of naTural clImate sOlutioNs in Greater Manchester
	Paris (France)	OASIS - School yards: Openness, Adaptation, Sensitisation, Innovation and Social ties: Design and transformation of local urban areas adapted to climate change, working jointly with users
Digital transition	Heerlen (the Netherlands)	WESH – We.Service.Heerlen
	Rennes Metropole (France)	RUDI - Rennes Urban Data Interface
Energy transition	Paris (France)	CoRDEES - Co-Responsibility in District Energy Efficiency & Sustainability
Housing	Brussels Capital Region (Belgium)	CALICO - Care and Living in Community
	Ghent (Belgium)	ICCARus (Gent knapt op) - Improving housing Conditions for CAptive Residents in Ghent
	Lyon Metropole (France)	Home Silk Road - Housing toward empowerment
	Antwerp (Belgium)	CURANT - Co-housing and case management for Unaccompanied young adult Refugees in ANTwerp

Topic	City (Country)	Name of Action
Integration of migrants and refugees	Coventry (United Kingdom)	MiFRIENDLY CITIES
	Utrecht (the Netherlands)	U-RLP Utrecht Refugee Launch Pad
Jobs and skills in the local economy	Eindhoven (the Netherlands)	P4W - Passport4Work an intersectoral skills passport with gamified skills assessment and improvement
	Rotterdam (the Netherlands)	BRIDGE - Building the Right Investments for Delivering a Growing Economy
Sustainable use of land and nature based solutions	Breda (the Netherlands)	GreenQuays - Urban River Regeneration through Nature Inclusive Quays
	Plymouth (United Kingdom)	Green Minds - Green Minds - a planning and management system for sustainable land use and nature based solutions
Urban mobility	Ghent (Belgium)	TMaaS - Traffic Management as a Service
	Toulouse Metropole (France)	COMMUTE - Collaborative Mobility Management for Urban Trafic and Emissions reduction
Urban poverty	Birmingham (United Kingdom)	USE-IT! - Unlocking Social and Economic Innovation Together
	Lille (France)	TAST'in FIVES - Transforming Areas with Social Talents: Feed, Include, Value, Educate, Share
	Nantes (France)	5Bridges - Creating bridges between homeless and local communities
	Seraing (Belgium)	A Place to Be-Come

Source: Adjusted from https://uia-initiative.eu/en/uia-cities, 2020

At the same time there are various URBACT networks where urban areas of the region participate. The map below shows the cities in the NWE cooperation area that are part of an URBACT network. Although there are networks also between the urban areas within the NWE cooperation area, it is important to mention that the points in the map do not only show these, but rather cities that may participate also in networks across Europe and beyond the NWE cooperation area. This shows how active urban areas are and how important cooperation is.

The topics of cooperation in UIAs are diverse and cover many aspects of territorial development, namely digital transition, jobs and skills in the local economy, sustainable land use, integration, housing, circular economy, climate adaptation, urban mobility, poverty and integration and energy transition. These actions show primarily two things. First that despite the economic supremacy of urban areas, there are still challenges to be taken into account when developing further policies. Second, that such challenges are best addressed through cooperation, not only between urban areas and the surroundings or their functional areas, but also across larger territories, between places that share the same needs and may have similar potential.

URBACT[102] supports networks of cities focusing on mobility, networks for improving local strategies and developing partnerships between the private sector and relevant stakeholders, education and knowledge economy, health, social inclusion, sustainable energy, networks that promote participatory democracy and local governance, urban security and others. These topics show the already existing experience and cooperation degree of the urban players in the area. Such topics are relevant for PO5 in transnational cooperation. Urban players cannot only capitalise on existing experience, but also exchange learning and knowledge in the NWE programme area for more integrated development.

5.4 United Nations Sustainable Development Goals

The UN Sustainable goals address different aspects of global challenges. Places in the EU plan to localise these goals in their context. PO 5 gives the opportunity of bringing these global goals close to the citizens and the local levels. There are currently no regional data on NWE cooperation area implementation of the SDG, but rather an overall EU picture based on a Eurostat indicator set. Hence it is difficult to extract concrete information on the state of play of implementation. Nevertheless, a number of goals are relevant for the NWE cooperation area also in relation to PO5, where possible links can be made. These can be:

- SGD 7: Affordable and clean energy.
- SDG 9: Industry, innovation and infrastructure
- SDG 10: Reduced inequalities.
- SDG 13: Climate action
- SDG11: Sustainable cities and communities

All these topics are addressed by POs 1-4 in one way or the other. To start with, affordable and clean energy and climate action are addressed under PO2, where the potential of the region in wind power, and hydro power is explained, as well as the transition towards clean energy and reduced greenhouse gas emissions. Furthermore, green infrastructure potential and circular economy are also addressed in PO2, as means for a cleaner territory. Issues around industry, innovation and infrastructure are expressed along PO1, which goes through the regional competitiveness, innovation capacity, employment and growth. Besides these two POs, POs 3 and 4 look at some disparities in the region, e.g. as regards physical and digital accessibility, while the focus on a ‘more social Europe’ focusing on education, health and social inclusion eventually aims at reducing inequalities. All together these POs contribute to more sustainable cities and communities through cooperation. The particular potential of PO5 lies in the fact that all these goals can be tailored to specific territories, be that urban areas,

[102] For more information about the networks, see: https://urbact.eu/

functional urban areas, rural areas, or areas with specificities as coastal areas and therefore achieve greater complementarities and integrated development.

Following the discussions about places left behind, or places that do not matter, bringing policies to the lowest governance levels will lead to better integration and less fragmentation across European regions. Although the NWE is a well-developed area with high GDP, urban challenges and rural obstacles persist. Territorialising and localising the SDG goals a more sustainable development can be foreseen, aiming at a more holistic approach, i.e. through implementing these SDGs throughout all the POs.

Therefore, coordinated actions through PO5 can support local initiatives in urban, rural, coastal territories in related issues where cooperation would be of an added value.

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