Atlas for the Territorial Agenda 2030

Maps on European Territorial Development

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Maps on European Territorial Development

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ESPON

EUROPEAN UNION

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Foreword

The Atlas for the Territorial Agenda 2030 illustrates selected aspects of spatial development in Europe.

With the Atlas, the Federal Ministry of the Interior, Building and Community is updating the compact, science-based presentation of information of the 2007 Territorial Agenda and contributing to the discussion of current challenges in the European Union. This comprehensive graphic representation of trends and existing potential, which differ greatly across Europe, lays the groundwork for an exploration of the strengths and weaknesses of European cities and regions.

The Atlas focuses on the most important areas of action in the Territorial Agenda 2030: the overarching spatial objectives of a Just Europe and a Green Europe; differences in demographic change and migration; the competitiveness of cities and regions; and trends related to the environment and natural resources. The Atlas also contains a wealth of further information on spatial features and structures.

The Atlas is the result of collaboration between the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR) and the European Observation Network for Territorial Development and Cohesion (ESPON). The maps were scientifically reviewed using data from all European Union member states and present complex, multifaceted information in a visual format that is easy to understand.

The Territorial Agenda 2030 is intended to promote economic, social and environmental progress in Europe. It will help create stable and predictable conditions for investment, strengthen social cohesion within Europe and promote the sustainable and efficient use of natural resources. However, to achieve the Agenda's ambitious goals, all stakeholders and all levels of government administration must work together across sectoral boundaries and on the basis of shared data to discuss and implement the measures relevant for spatial development.

This Atlas offers the necessary science-based support to do so, thereby making a significant contribution to managing spatial challenges in Europe.

Horst Seehofer
Federal Minister of the Interior,
Building and Community

Contents

The settlement areas

In the countries of the EU, the European Free Trade Association and the United Kingdom, half of the population lives on 15% of the surface area and 80% of the population lives on half of the surface area.

The territorial division in urban and rural areas is one of the most important spatial distinctions, which is characteristic for living conditions, economic activities and culture.

The settlement concentrations and bands indicated by the population density at local level alone make the differences obvious not only between the densely populated urban areas and less and sparsely populated rural regions, but also between different countries.

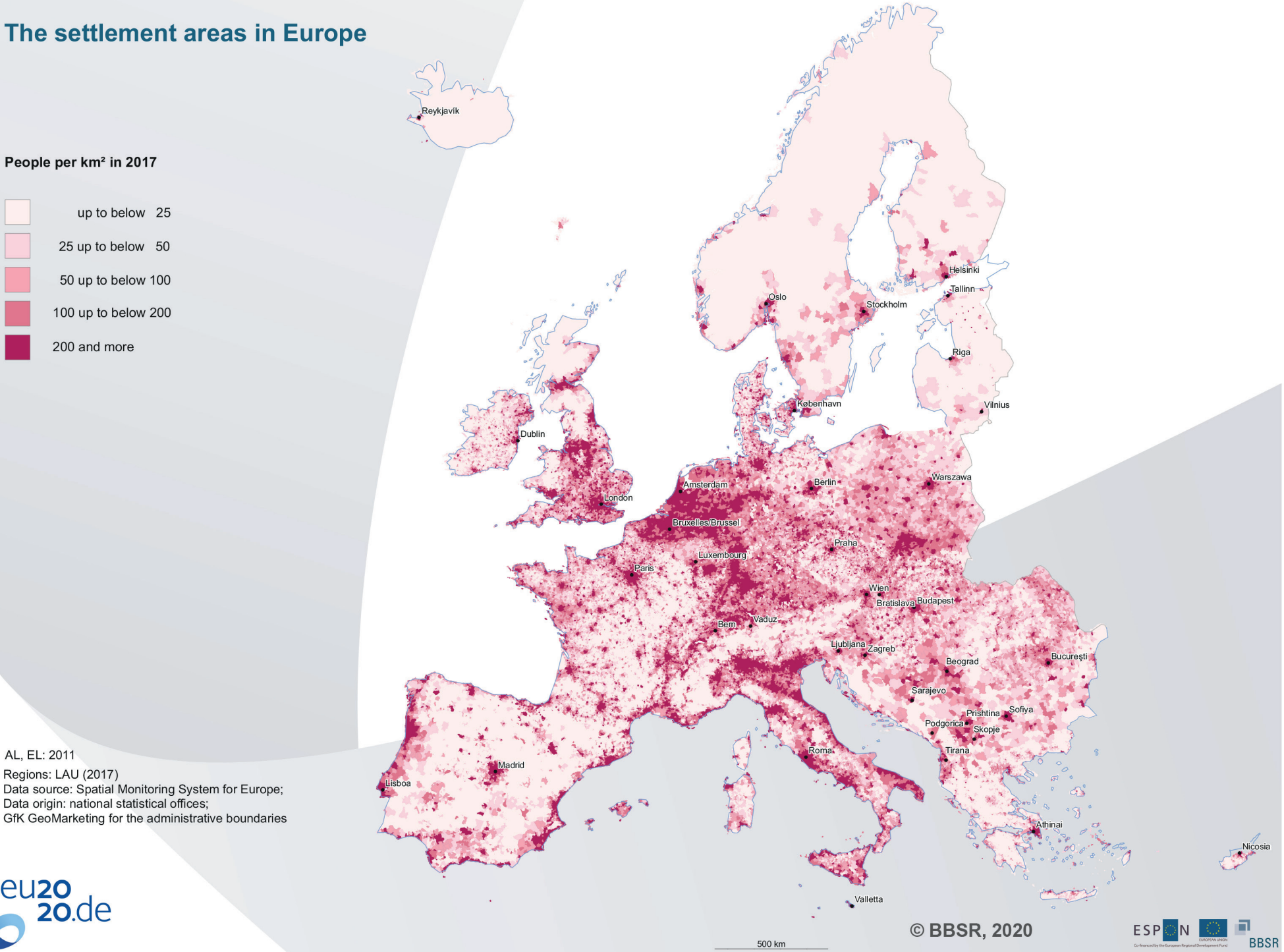
Different spatial patterns are apparent, ranging from solitary municipalities, smaller and medium-sized cities, as well as larger cities and urban regions through to conjoined urban and metro regions and large-scale multi-regional and cross-border settlement areas.

In less populated rural areas, municipalities and smaller cities constitute cores of concentrated settlement and reference points for urban life in the broader rural area. In some areas, they serve as the transition from urban and rural to peripheral rural regions.

Larger, stand-alone densely populated cities and urban regions concentrate urban functions in a larger spatial context as regiopolises, regional population centres between rural regions and metropolitan areas.

The major cities and metropolitan areas are connected with their surroundings and with each other via lines following the topography and transport arteries in the form of densely populated corridors.

The settlement areas in Europe



AL, EL: 2011
Regions: LAU (2017)
Data source: Spatial Monitoring System for Europe;
Data origin: national statistical offices;
GfK GeoMarketing for the administrative boundaries

The transport network

The road and rail network in the European Union covers some 376,000 km of motorways and major roads as well as 156,000 km of main railway lines.

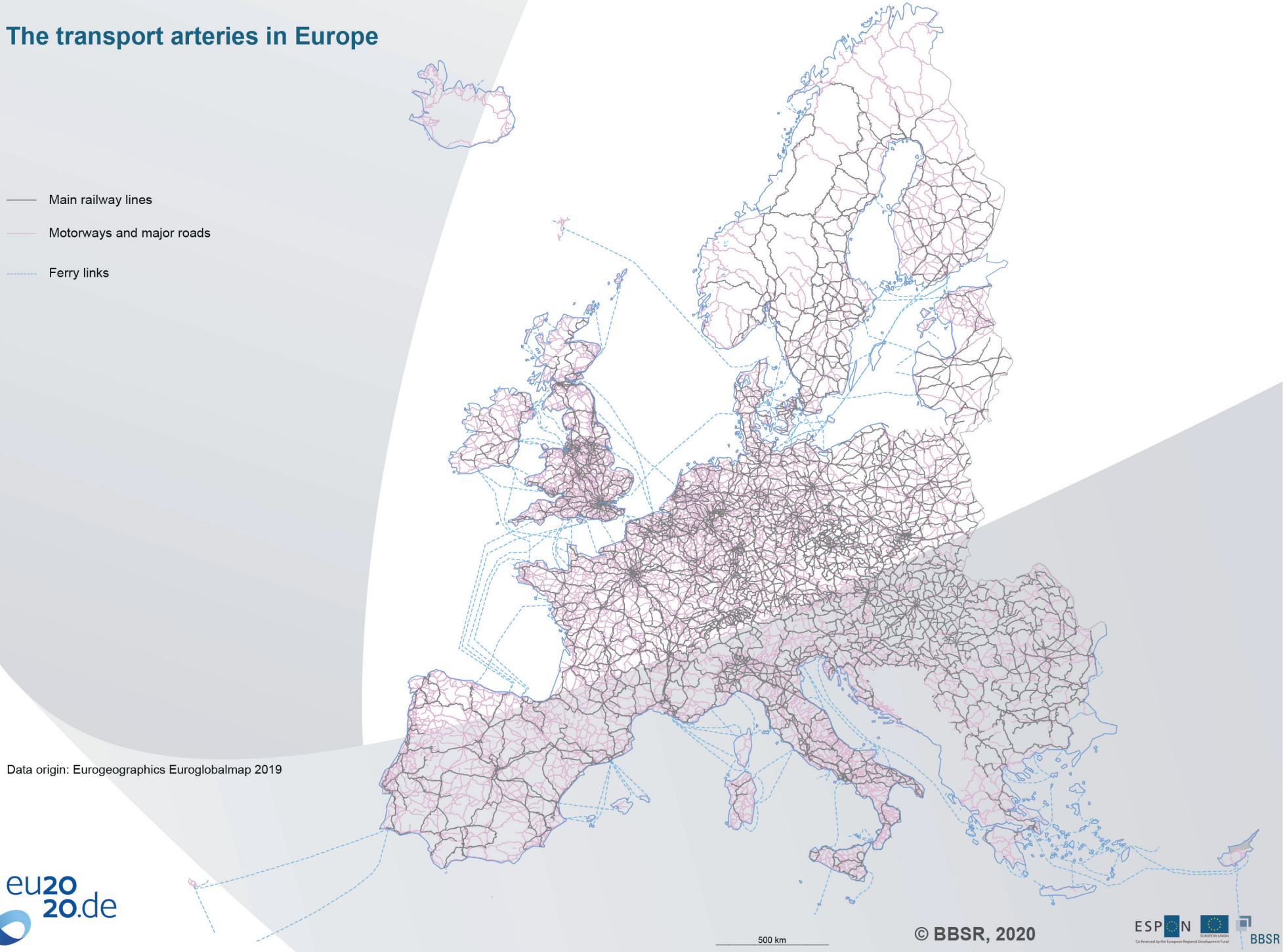
The main lines of these transport networks connect the EU's capital cities with other important cities, ports and airports and ensure access to intermodal passenger and goods transport for every location in Europe.

In many countries, the main rail network in particular is oriented on the capital and radiates outward to the surrounding regions and territories. As a result, the rail network tends to link urban centres rather than provide access to the entire country. The road network is not designed to focus on urban centres alone. Because of the way it developed, it forms a dense network once based on daily driving stages and offers intraregional and local connections. How well the entire country is covered depends on the degree to which rural and peripheral areas and cities outside metropolitan areas are linked by secondary and local transport networks.

Transport networks determine how accessible and connected cities and regions are. Accessibility determines the attractiveness of one area compared to others and how useful the relevant transport infrastructure is for the area concerned. Accessibility can therefore be understood as an important goal of the transport system for the territorial development on all spatial levels. The quality of transport infrastructure and services as such is a decisive factor for the development of cities and regions.

In addition to physical connections by means of road, railway, air and ship transport, digital connections are increasingly important for access and inclusion. As in the case of road and rail, availability and accessibility of digital infrastructure have a growing influence on economic growth and quality of life, especially in areas away from metro regions and cities. Broadband connections in rural areas are the local railway lines of the 21st century. Just as in the past, it is essential to provide connections to these regions and guarantee their digital future.

The transport arteries in Europe



Data origin: Eurogeographics Euroglobalmap 2019

The natural landscapes

One-third of the European Union is covered by forest. Semi-natural areas with scrub and/or herbaceous vegetation, open areas with little or no vegetation and wetlands make up another 15% of the EU's area. The spatial distribution varies widely, depending on climate-related vegetation zones and soil quality. This is reflected in the forests and herbaceous vegetation in northern Europe and the mountainous regions of central and southern Europe.

The diversity of the natural heritage is indicated by the roughly 450 species of trees native to Europe and some 11,000 different European plants.

Semi-natural areas include the rich and diverse cultural landscapes which have developed out of various agricultural uses over the centuries, above all in central Europe.

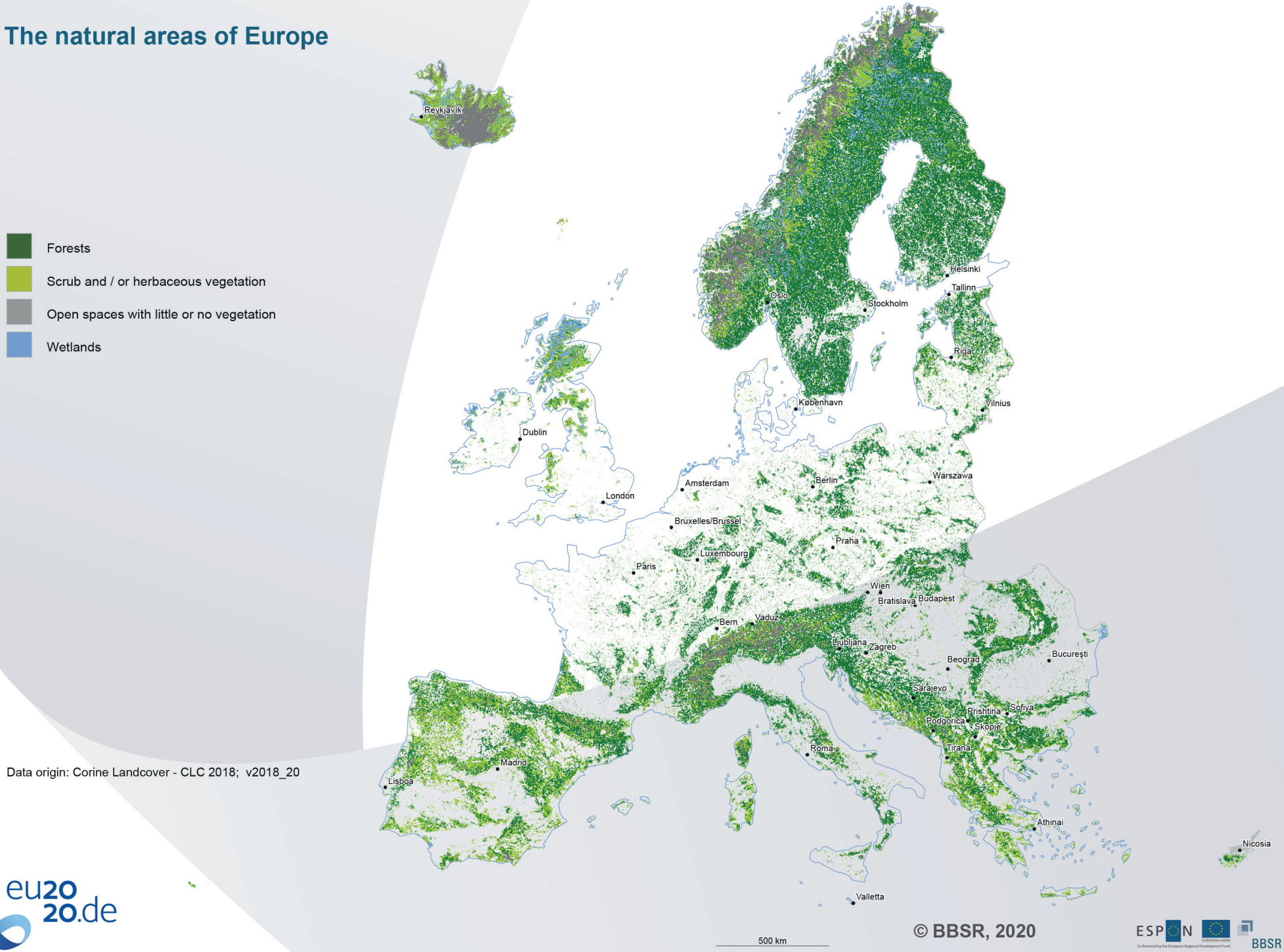
Europe's natural and cultural heritage is a unique and diverse asset that must be protected, managed and further developed. For regions with a rich natural and cultural heritage or unique landscapes, these assets are especially important for their economic prospects and development potential.

The entire spatial fabric of Europe rests on the balance between land use for settlement and industry, intensification of agriculture and fisheries, transport and the preservation of ecological assets, environmental quality and cultural assets.

Balanced territorial development is also important for dealing with climate change. It is necessary to reduce regional vulnerabilities to climate change and to develop capacities for mitigating and adapting to the impacts of climate change.

Climate change will affect urban life, cultural landscapes, agricultural regions and semi-natural areas individually and in the totality of their interrelationships. Climate-induced changes in vegetation zones and the crops that can be grown, as well as the warming of the urban environment will alter regional working and living conditions. For example, the distribution of trees follows the changed climate conditions, as can be seen from adaptation even in recent geological time. Regional climate strategies must also enable agriculture to adapt to climate change taking into account regional economic conditions.

The natural areas of Europe



Data origin: Corine Landcover - CLC 2018; v2018_20

Population development on local level

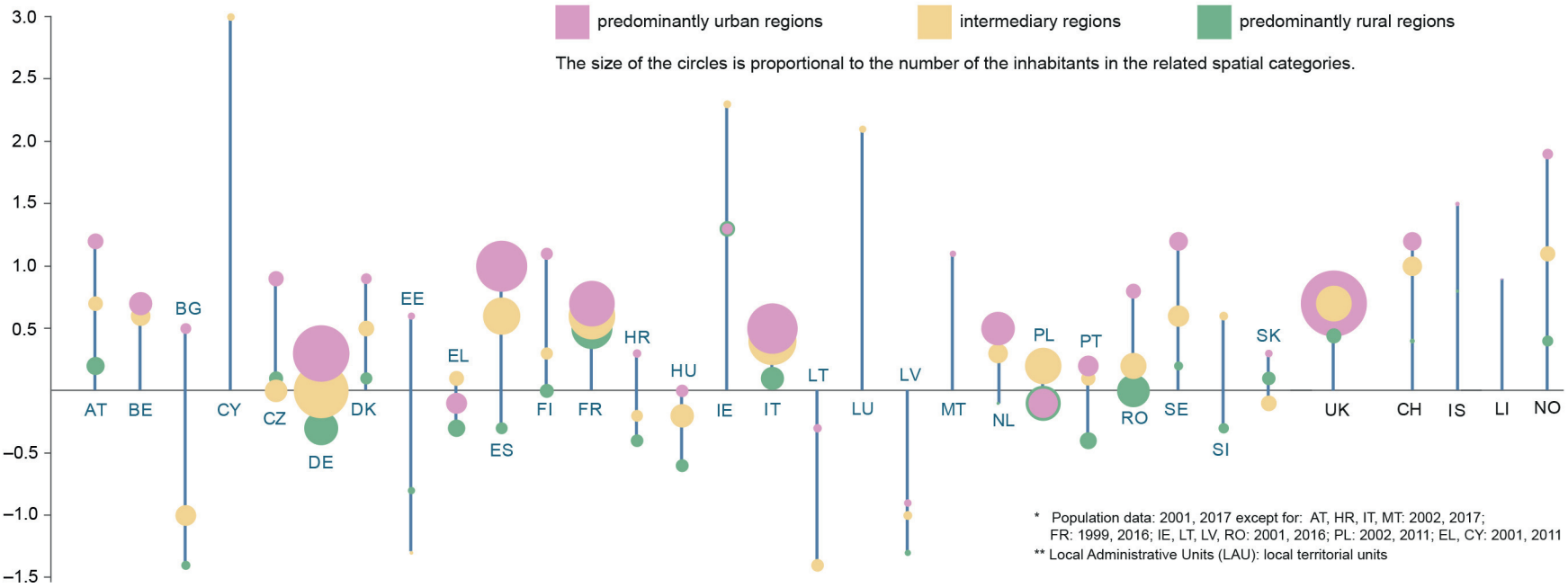
The population of the EU27 member states grew by 3.8% from 2001 to 2017. This overall development covers many regional differences. Even in regions where the population increased overall, it did not grow in every local authority; by the same token, there were centres of population growth even in regions where the overall population decreased.

The number of inhabitants rose in particular in local authorities within largely urban regions and the surrounding urban fringe areas. In all the member states, the population development was more positive in these regions than in rural regions. In only four member states did the population in urban regions fall at all, and then only slightly. By contrast, the population in rural regions decreased to a somewhat greater degree in 11 member states.

In much of France, the number of inhabitants grew about equally in both urban and urban fringe areas. In Germany, however, the population decreased in the eastern part of the country, with the exception of Berlin and other large cities and their urban fringe, while it remained largely stable in the west. In the countries of central and eastern Europe, in particular Poland, population growth was concentrated in urban regions, and especially in urban fringe areas. These developments are visible in rings of suburbanisation and continue on into the surrounding areas. In the Baltic member states and in Germany, rural regions are losing population, both in urban centres and urban fringe areas; by contrast, in France and Spain, population centres are growing in rural regions as well.

In many regions, population growth is clearly apparent along the Mediterranean and Atlantic coasts.

Average annual population development in local authorities (LAU) 2001–2017* according to urban-rural classification**

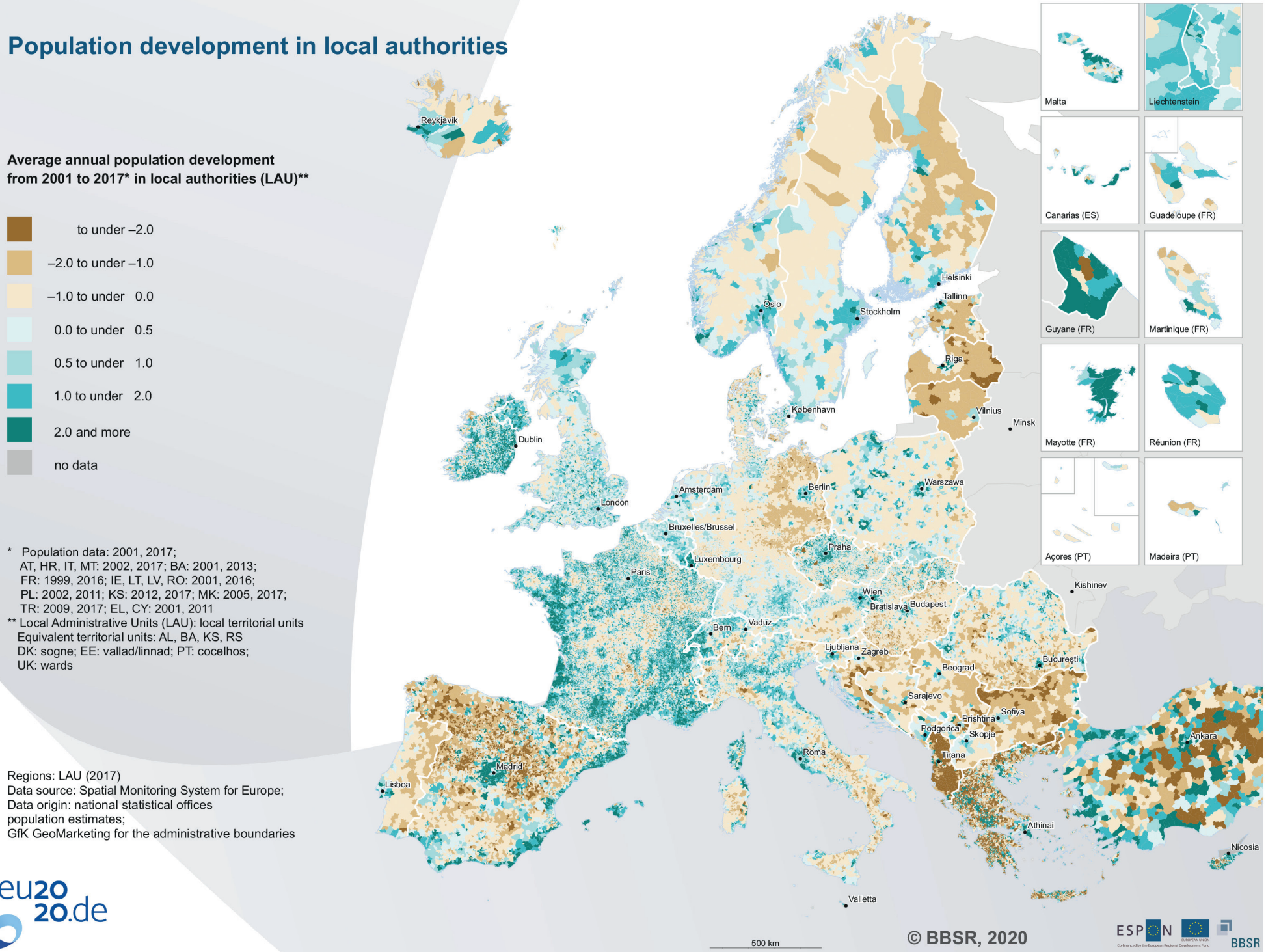


* Population data: 2001, 2017 except for: AT, HR, IT, MT: 2002, 2017; FR: 1999, 2016; IE, LT, LV, RO: 2001, 2016; PL: 2002, 2011; EL, CY: 2001, 2011

** Local Administrative Units (LAU): local territorial units

Data source: Spatial Monitoring System for Europe; data origin: national statistical offices; Eurostat for urban-rural-typology

Population development in local authorities



* Population data: 2001, 2017;
AT, HR, IT, MT: 2002, 2017; BA: 2001, 2013;
FR: 1999, 2016; IE, LT, LV, RO: 2001, 2016;
PL: 2002, 2011; KS: 2012, 2017; MK: 2005, 2017;
TR: 2009, 2017; EL, CY: 2001, 2011

** Local Administrative Units (LAU): local territorial units
Equivalent territorial units: AL, BA, KS, RS
DK: sogne; EE: vallad/linnad; PT: cocelhos;
UK: wards

Regions: LAU (2017)
Data source: Spatial Monitoring System for Europe;
Data origin: national statistical offices
population estimates;
GfK GeoMarketing for the administrative boundaries

Population trends in cities and their surroundings

Cities provide an anchor for economic and social development and are places where investment, work, life and leisure activities come together.

Together with their urban fringe areas, cities form for mutual benefit so-called functional urban area (FUA), in which the city and its urban fringe area benefit each other. For the 27 countries of the European Union, the European Commission has identified 582 of these functional areas, plus another 90 in the United Kingdom. Some 280 million people live in these FUAs, or nearly 63% of the EU's total population.

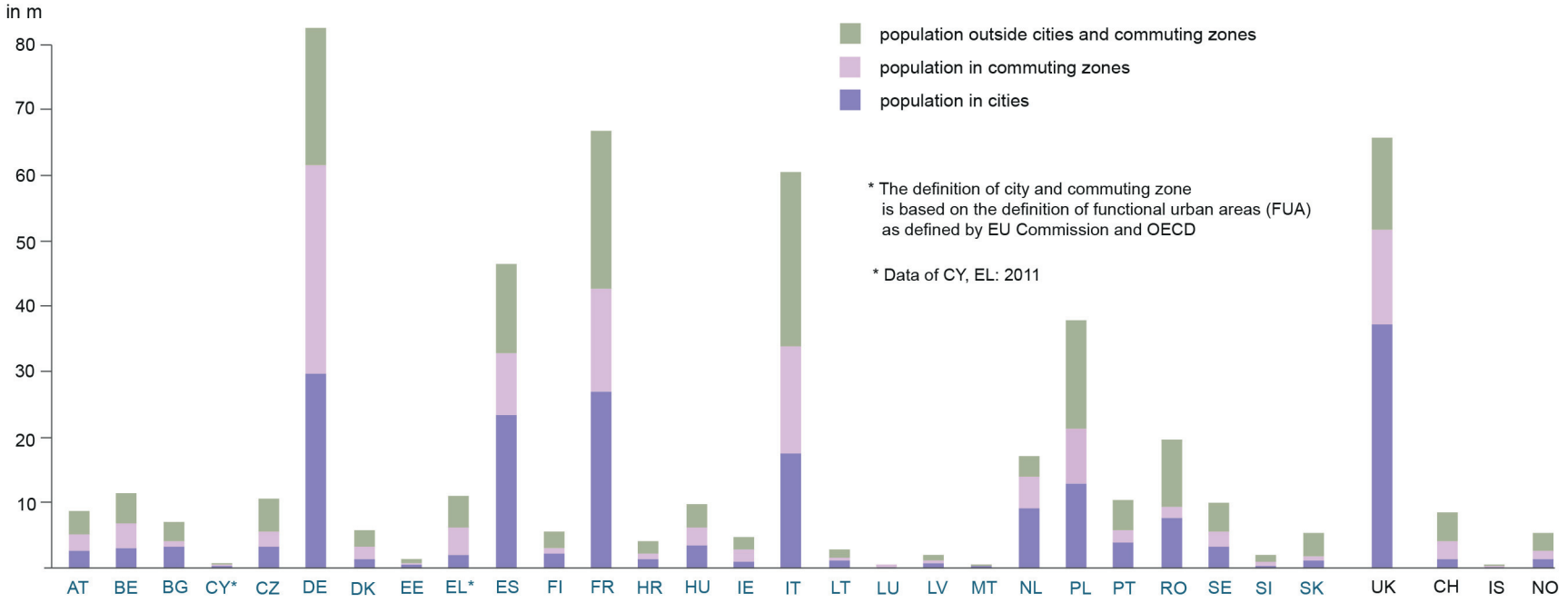
The number of inhabitants of FUA shows a broad range and shows that FUAs are not necessarily large urban or metropolitan areas; smaller and medium-sized cities also constitute functional units and have an influence on the surrounding region. Berlin is part of the largest FUA in Germany, with around 5.2 million inhabitants.

In the Madrid FUA, 75% of inhabitants live within the city, making it rather monocentric; the same is true of the Berlin FUA, where 72% of inhabitants live within the city. In the Paris and Warsaw FUAs, 56% of inhabitants live in the city, and the population of the surrounding areas is growing. The FUAs of Frankfurt, Naples and Dublin, where only 30% of the population lives in the city itself, are much more polycentric.

The trend towards faster population growth in urban fringe areas than in cities is widespread, especially in southern and eastern Europe. The typical migration of families from cities, especially cities where the economy is growing, to urban fringe areas can be seen in eastern Europe; in the cities of western Europe, the trends are more mixed.

In some parts of Europe, such as Italy, eastern Germany and rural areas in northern Europe, the population in both large and smaller cities is growing faster than in the surrounding areas. In eastern Germany, the cost of living in the city is comparable to that of living in the surrounding areas, and the attractiveness of city life is leading to an urban renaissance. In rural areas, the growth of the cities points to a concentration of the population.

Population in cities and their commuting zones 2017*



Data source: Spatial Monitoring System for Europe; data origin: national statistical offices

Population development in cities and commuting zones

Average annual development of the population in cities and commuting zones* from 2001 to 2017 in %

- to under –0.25
- –0.25 to under 0.00
- 0.00 to under 0.25
- 0.25 to under 0.50
- 0.50 to under 1.00
- 1.00 and more

Population in cities and commuting zones in 2017* in billion

20
10
5
1

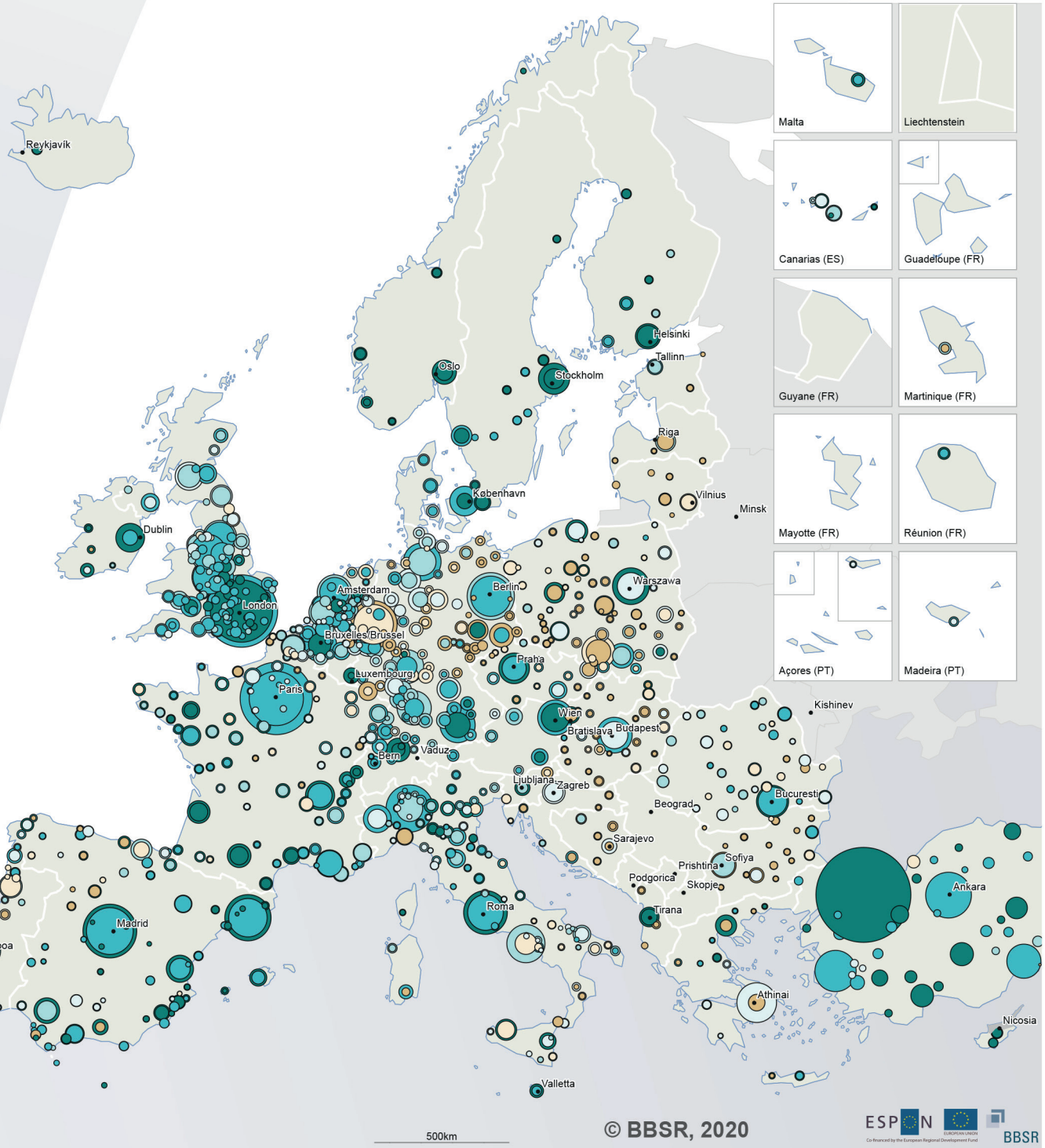
cities and commuting zones altogether
among them cities

* The definition of city and commuting zone is based on the definition of functional urban areas (FUA) as defined by EU Commission and OECD
TR: only cities and commuting zones altogether

** EL, AL: the related information refers to the period 2001–2011 in terms of development and 2011 in terms of population

The population figures are based on Local Administrative Units (LAU) (2017)

Regional level: functional urban areas (FUA)
Data source: Spatial Monitoring System for Europe
Data origin: national statistical offices
EuroGeographics for the administrative boundaries



Components of population development

Two components determine whether the population of a region is growing or declining. The development of the population is determined by: the natural balance, the difference between births and deaths, and the net migration resulting from immigration and emigration.

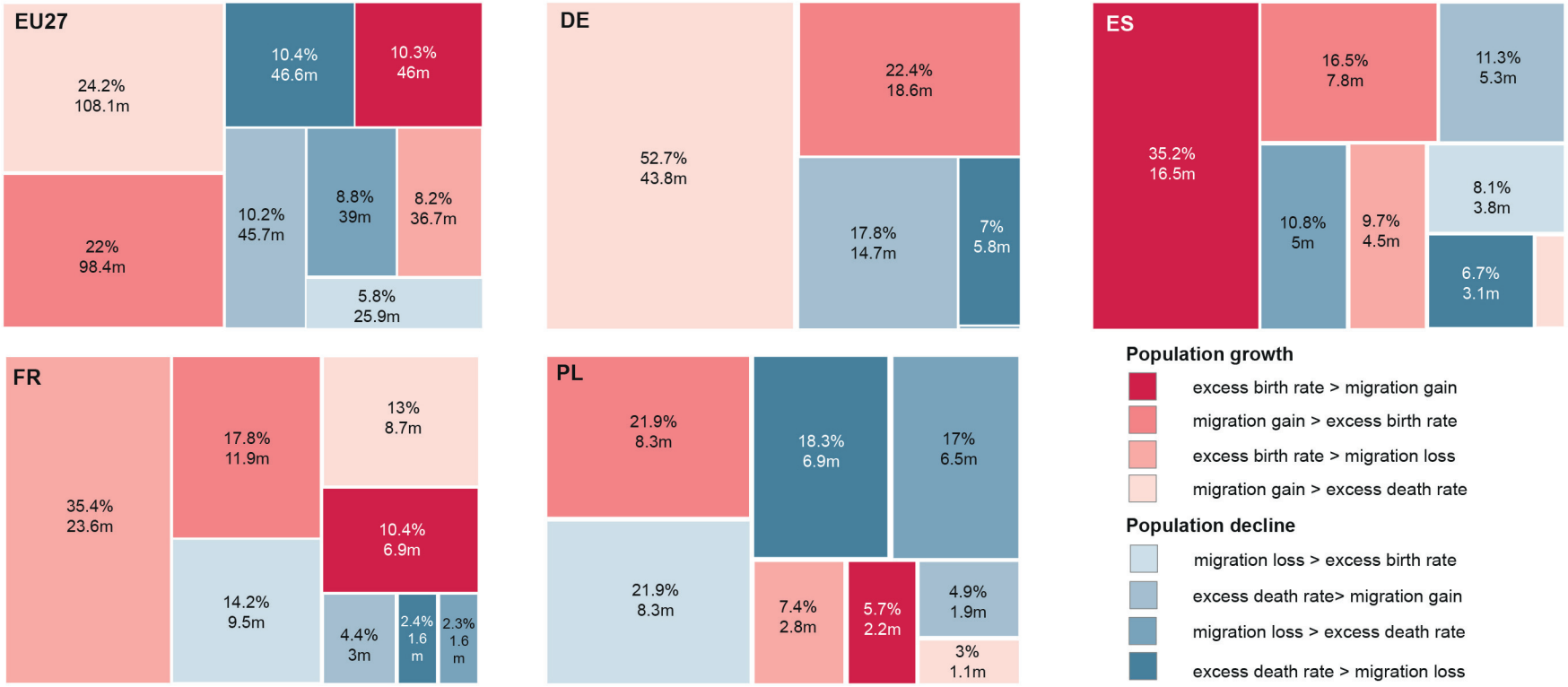
Overall, around 65% of Europeans live in growing regions and 35% in shrinking regions.10% each live in regions where the excess birth rate is higher than the migration gains. or where the excess death rate is higher than the loss of migration.

Overall, only a few countries have a homogeneous picture. In some countries, like in the Netherlands, almost all regions are growing, while in others it is declining area wide, such as the Baltic countries. The bigger countries have very different regional developments.

In Germany, the population growth in the west is determined in general by migration gains, in the east, the population is declining due to loss of migration. Existing surpluses of births are not compensated or are exacerbated by surpluses of deaths. Many regions in Europe are losing population despite increased migration because the excess death rate is even higher.

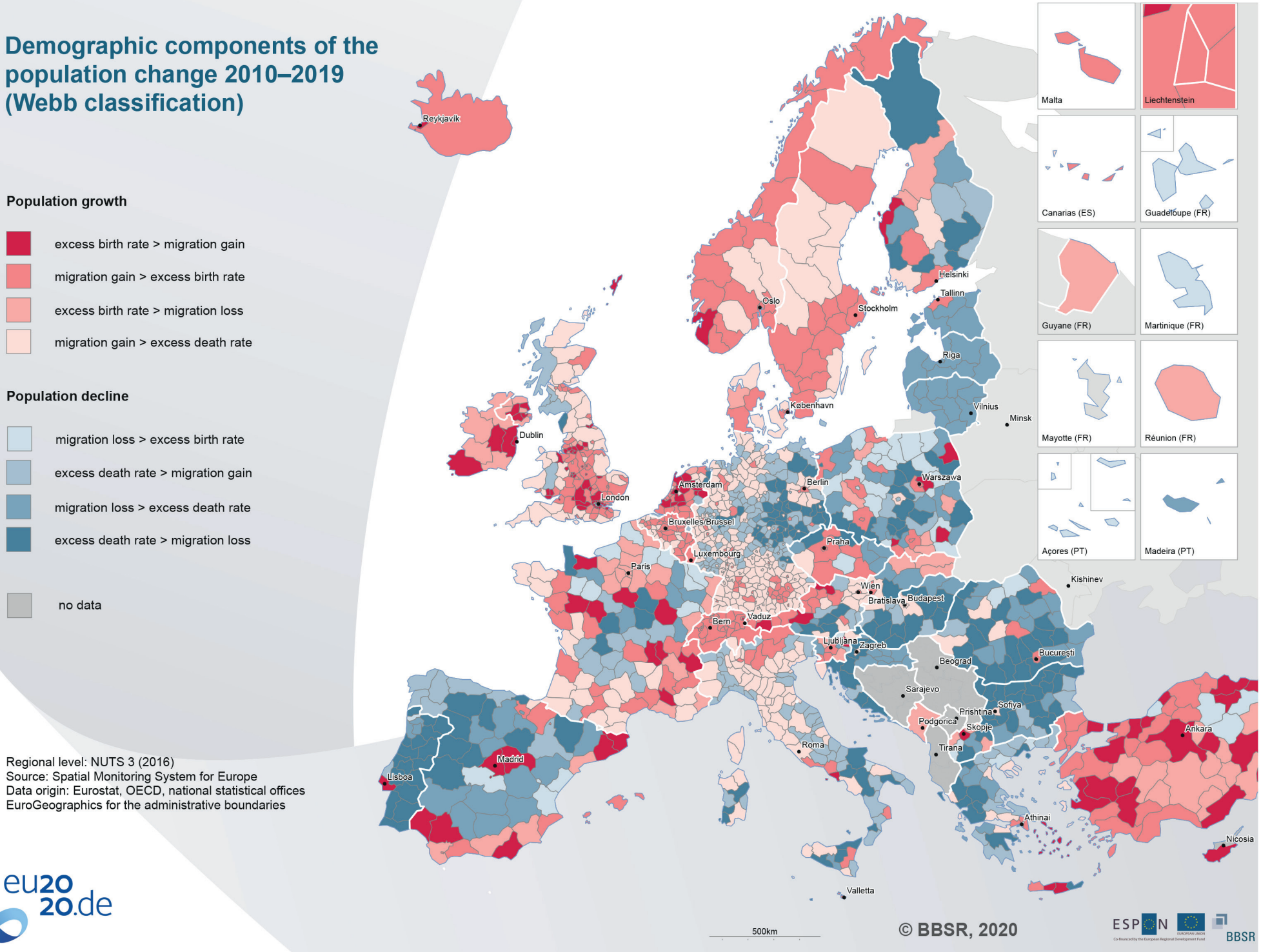
In the Netherlands, Ireland and parts of France, most people live in regions where growth is driven by excess birth rates. In Eastern Europe, migration gains and excess birth rates determine the developments in the metropolises, outside both negative migration balances and excess death rates shape the population decline. A similar picture can be found in Portugal and Spain. Besides the capital, only the eastern coastal regions are growing there.

Population figures and proportions of selected countries according to Webb classification categories 2019



Data source: Spatial Monitoring System for Europe; data origin: Eurostat, OECD, national statistical offices

Demographic components of the population change 2010–2019 (Webb classification)



Regional level: NUTS 3 (2016)
Source: Spatial Monitoring System for Europe
Data origin: Eurostat, OECD, national statistical offices
EuroGeographics for the administrative boundaries

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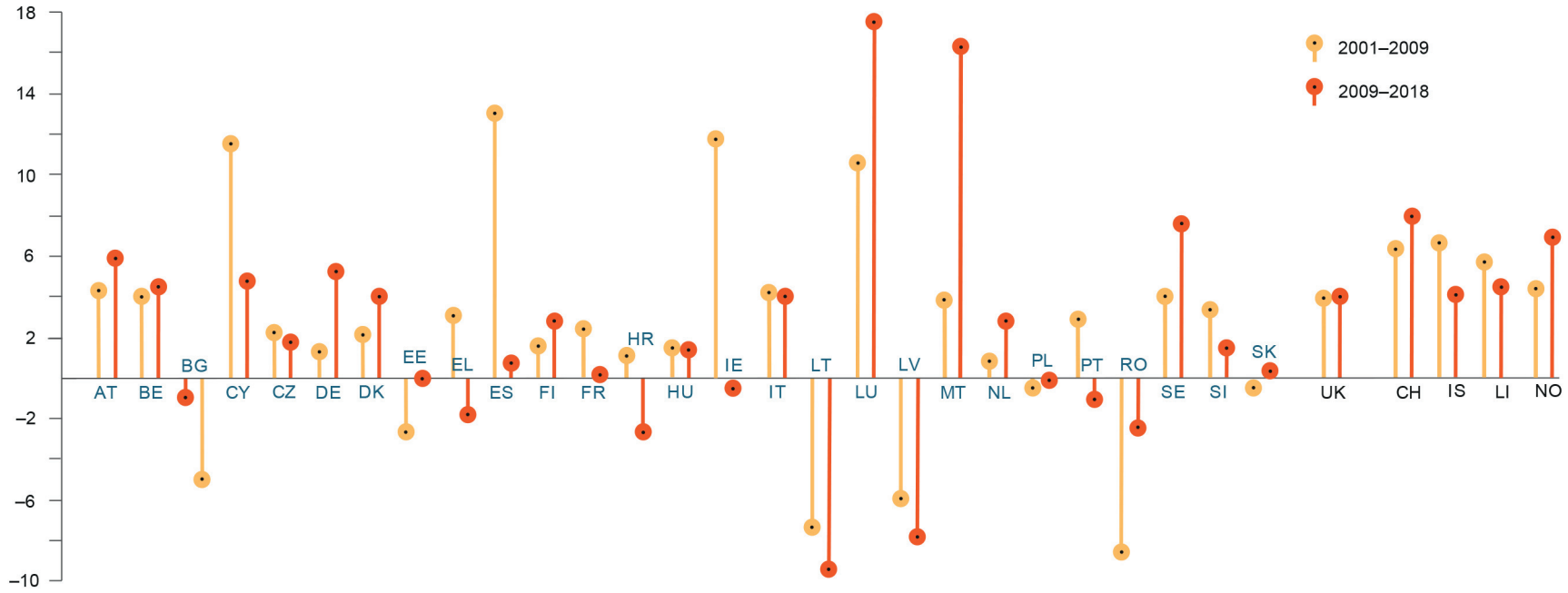
Regional migration

Migration movements are the result of national and regional disparities and inequalities. These disparities grow if emigration and immigration are concentrated in different sub-regions.

Migration within a country follows long-term trends determined by mainly internal reasons. Migration across national borders is triggered above all by changes in the economic and social conditions such as those caused by the last economic and financial crisis. Such changing parameters can influence migration very quickly.

People emigrate mainly from rural or peripheral regions, while most immigrants move to big cities - Madrid, Barcelona, Berlin, Stockholm and Milan have the highest net immigration. But there are also exceptions, such as Paris and Naples: of all EU regions, these two cities have seen the highest net out-migration in absolute figures. Out-migration does not always mean a decrease in population; there are regions in Europe where, thanks to a surplus of births, the number of inhabitants has remained stable despite out-migration.

Average annual net migration per 1,000 inhabitants 2001–2009 compared to 2009–2018

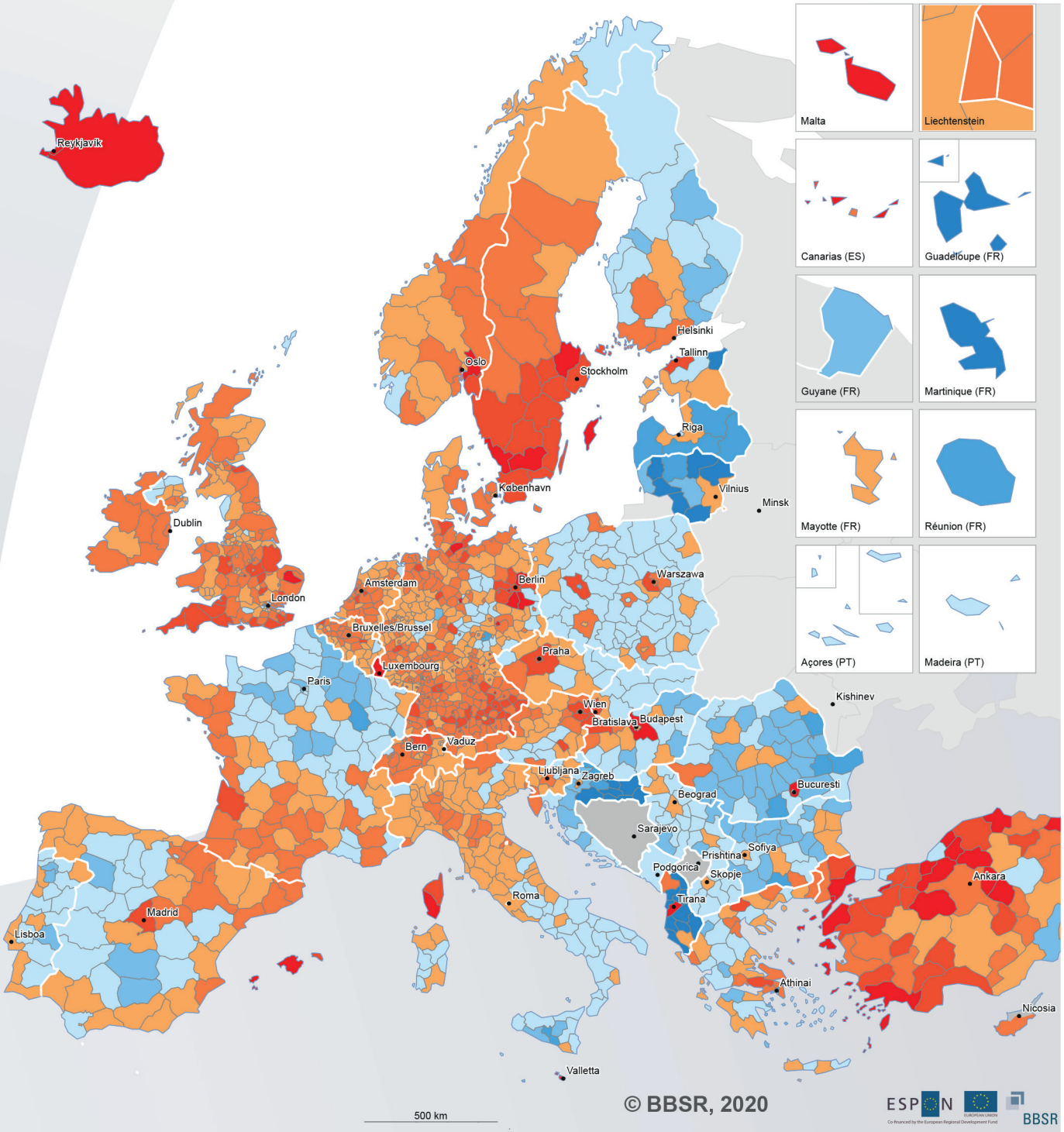


Data source: Spatial Monitoring System for Europe; data origin: Eurostat

Net migration rate

Average annual net migration per 1,000 inhabitants, 2016–2018

- to under –12
- –12 to under –8
- –8 to under –4
- –4 to under 0
- 0 to under 4
- 4 to under 8
- 8 to under 12
- 12 and more
- no data



Regions: NUTS 3 (2016)
Data source: Spatial Monitoring System for Europe;
Data origin: Eurostat;
EuroGeographics for the administrative boundaries

Destination and origin countries of migration

The European countries are closely intertwined with the whole world, especially with other European countries and within the European Union. The European Single Market and the free movement of workers are a logical consequence of this.

At the same time, economic structures and developments in Europe differ from region to region and from country to country. These differences become more pronounced as a result of economic ruptures such as the economic and financial crisis at the end of the last decade or the expected economic consequences of the COVID-19 pandemic.

Migration movements of people are a reaction to regional disparities or to a changing economic environment as in the wake of the economic and financial crisis.

These migration movements, whether within a country or across borders, represent two sides of the same coin. Regions of origin that do not provide a sufficient income base lose inhabitants and with them also potential economic room for manoeuvre. At the same time, a decrease in population provides a certain relief, for example by reducing the burden on social welfare systems.

Regions of destination take in additional, often sought-after workers, although they face growing challenges for their social infrastructure and regarding integration.

In 2017, the EU member states registered 3.7 million immigrants. Of this number, 1.7 million moved from one member state to another, almost 60% of them from eastern European member states.

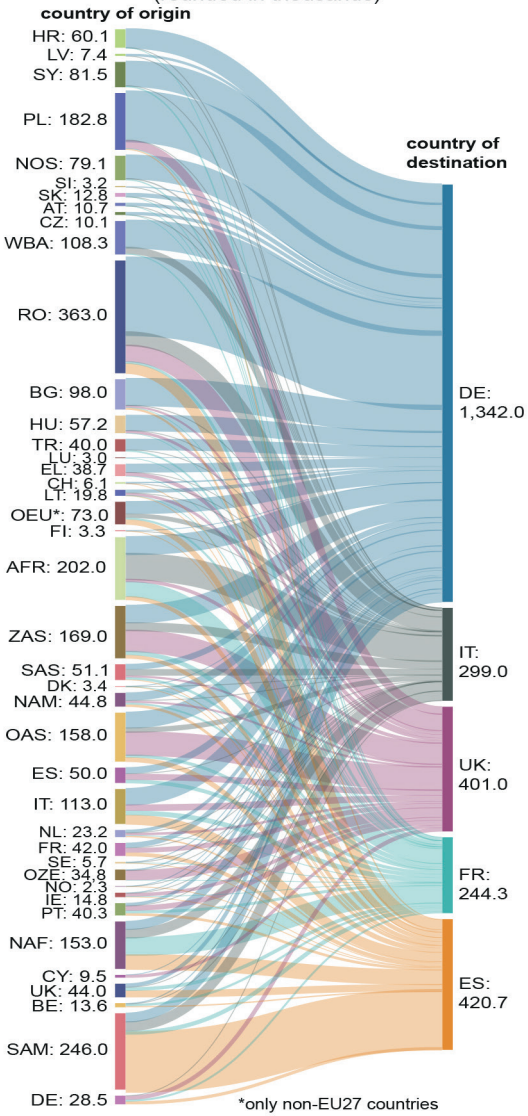
Germany, Italy, Spain and France received the largest influx of migrants within the EU. They are also the countries of destination of almost two-thirds of all migration within and into the EU. Another important country of destination is the United Kingdom, which received about 400,000 immigrants from other European countries and from outside Europe.

The reasons for which countries of destination are chosen often have to do with their colonial past or their language. Thus, 41% of migrants to France come from Africa, 35% of migrants to Spain come from Central and South America, and 20% of migrants come to the UK from South and East Asia.

Migration between states is not uni-directional. In 2017, about 2.2 million people left the EU countries again. In particular, the eastern European member states of the EU and the countries of the Western Balkans have been experiencing a strong return of former emigrants. Poland, Bulgaria and Romania have been the most important countries of emigration; however, they also receive the largest number of returnees. The ratio of emigrants to returnees is 4 to 3.

Immigration to selected countries of destination in 2017

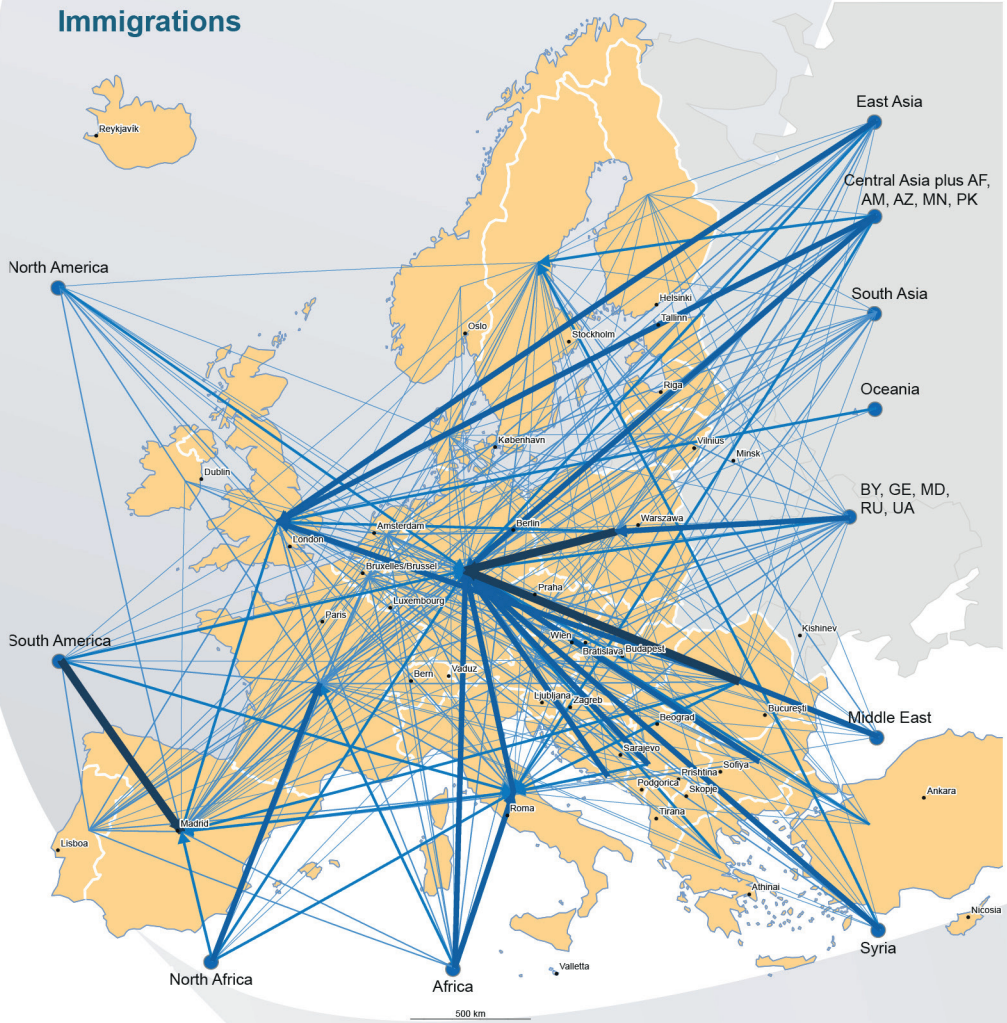
excluding citizens of the countries of destination
(rounded in thousands)



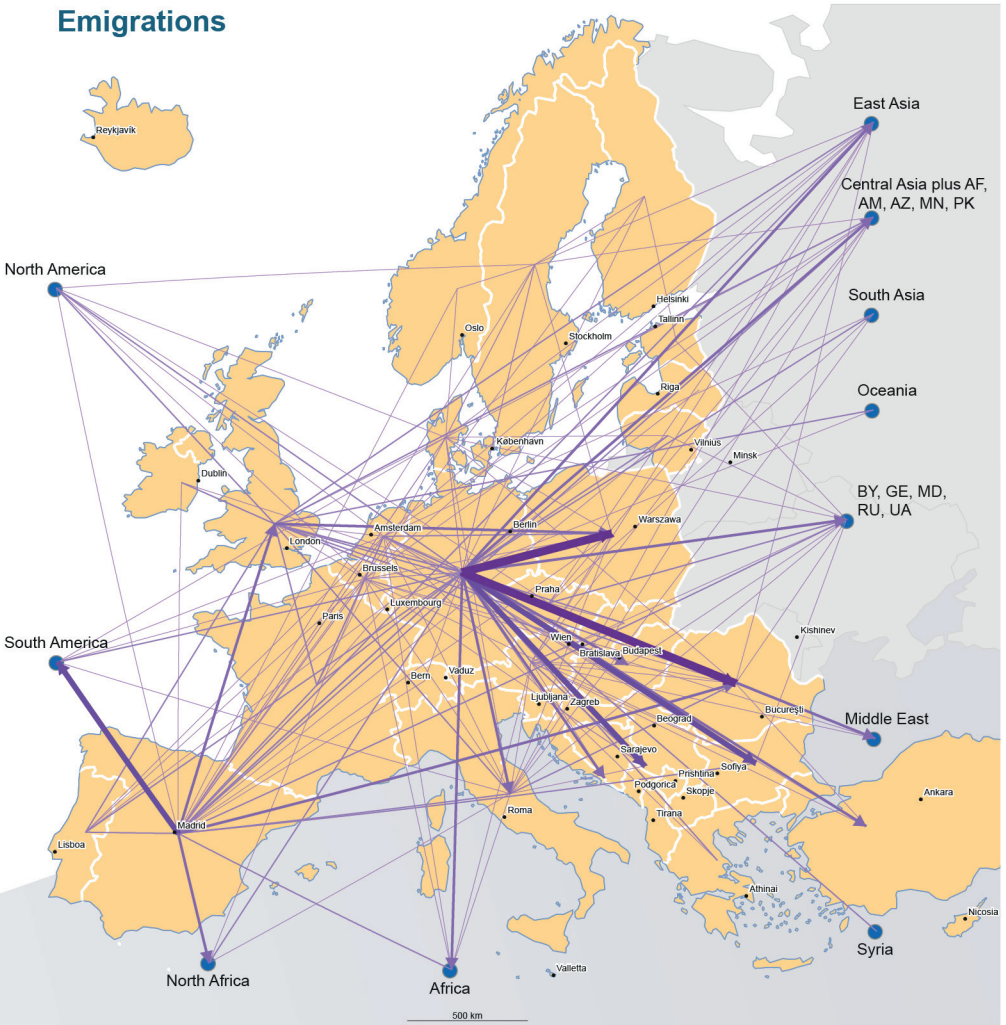
Data origin: OECD, Eurostat

Migrations in Europe

Immigrations



Emigrations



Regions: NUTS 0
Data source: Spatial Monitoring System for Europe;
Data origin: OECD, Eurostat;
EuroGeographics for the administrative boundaries

Number of immigrating and emigrating persons according to nationality in 2017

to under	5,000
5,000 to under	20,000
20,000 to under	50,000
50,000 to under	100,000
100,000 and more	

The exact definition of the country groups can be found in the notes.

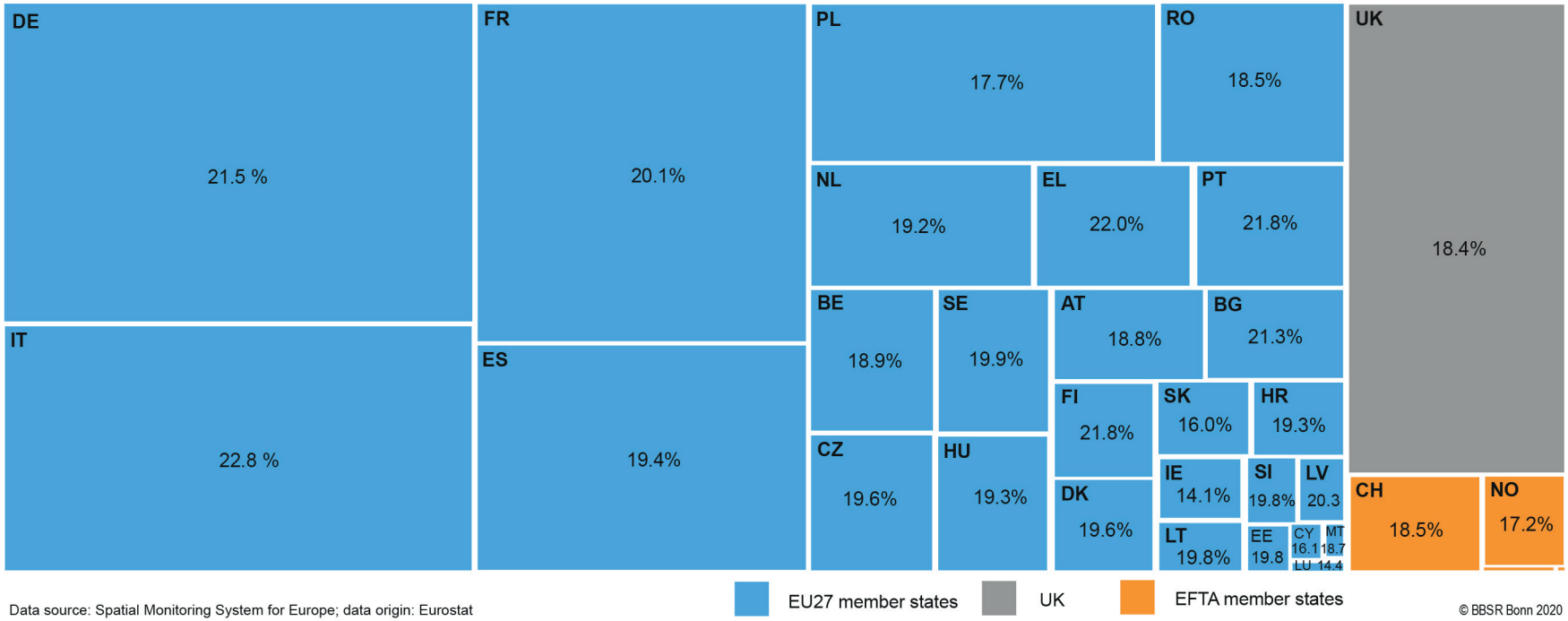
Older population

Population ageing is a challenge for social insurance systems and infrastructure. This is true especially of rural and peripheral regions.

In 2019, every fifth inhabitant of the EU was 65 or older, which is about twice as many as the global average. Even the U.S. and China have much smaller proportions of elderly persons: 16% and 11%, respectively.

In some cases, there are significant national differences: the share of people aged 65 or older ranges from 14% in Ireland to 23% in Italy. The eastern EU member states are still relatively young, with minor regional differences. The western EU member states have older populations with more noticeable regional differences. In Spain and Portugal, larger shares of the elderly population tend to live in peripheral regions; in France, more tend to live in rural regions in the centre of the country; and in Germany, a higher-than-average share of the elderly population lives in the eastern regions.

Number and proportion of the population aged 65 and over, 2019

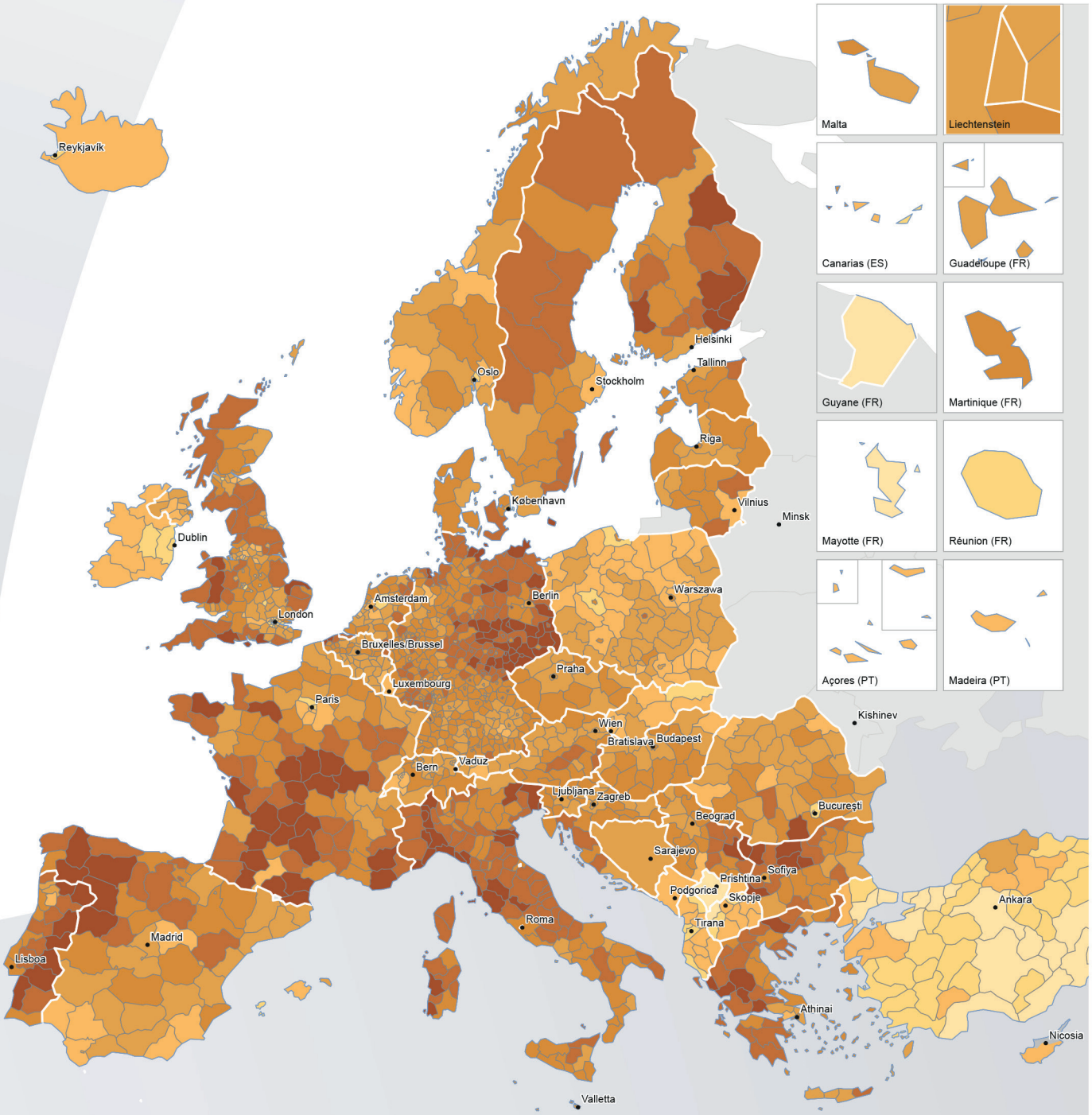


Data source: Spatial Monitoring System for Europe; data origin: Eurostat

Older population

Proportion of the population aged 65 and over in %, 2019

- to under 10
- 10 to under 14
- 14 to under 17
- 17 to under 20
- 20 to under 23
- 23 to under 26
- 26 and over
- no data



Regions: NUTS 3 (2016); BA, KS: NUTS 0
Data source: Spatial Monitoring System for Europe;
Data origin: Eurostat, UN Statistics Division;
EuroGeographics for the administrative boundaries

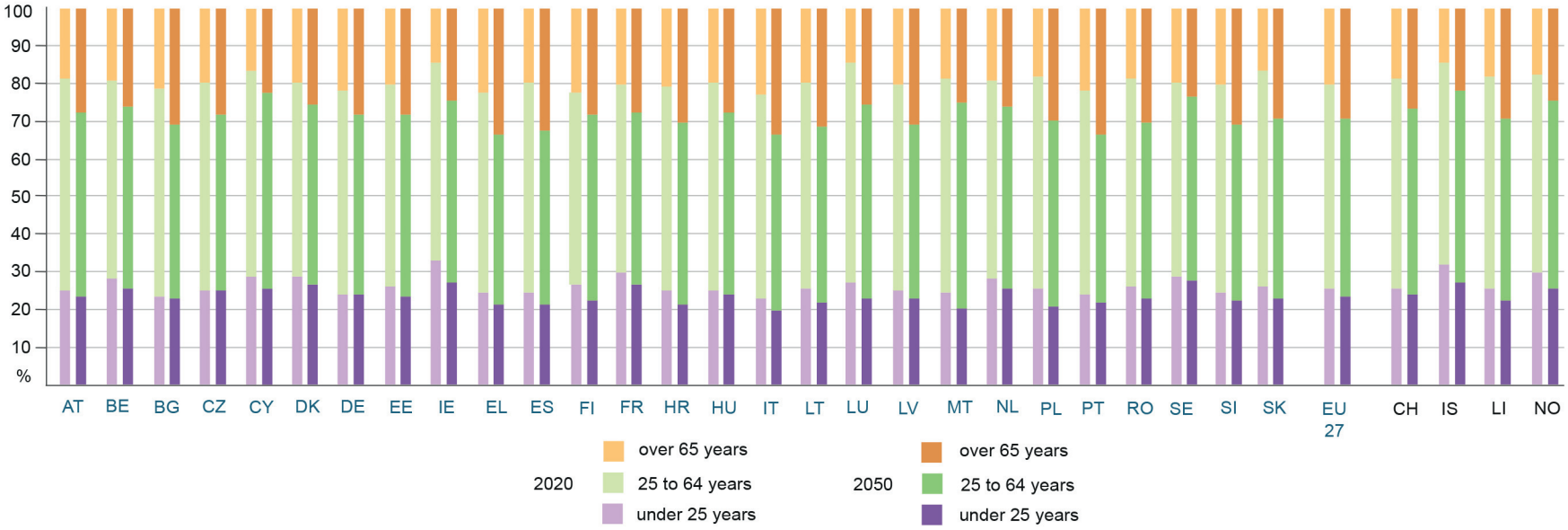
Relations of the generations

Low dependency ratios promote economic growth while high dependency ratios decrease economic growth due to the large amounts of dependents that pay little to no taxes. A high dependency ratio can cause serious problems for a country if a large proportion of a government's expenditure is on health, social security and education, which are most used by the youngest and the oldest in a population. The fewer people of working age, the fewer the people who can support schools, retirement pensions, disability pensions and other assistances to the youngest and oldest members of a population,

In the EU, there were approximately 100 persons working for every 85 dependent persons. The dependency ratios are most significant in rural areas in Scandinavia and France and Greece and in coastal regions of the UK where there are around 110–120 dependent persons for every 100 persons working.

In most parts of Europe, the old age dependency is increasing. These trends are accentuated due to consistently low levels of fertility, an increasing longevity and negative net migration in many parts of Europe. The old-age dependency is higher than young-age dependency across Portugal, Greece, Italy, Romania and Germany, northern Spain, central and southern France and Eastern Finland, indicating, that ageing will be a particularly difficult challenge for these parts of Europe.

Age structure (2020 and 2050 projection)



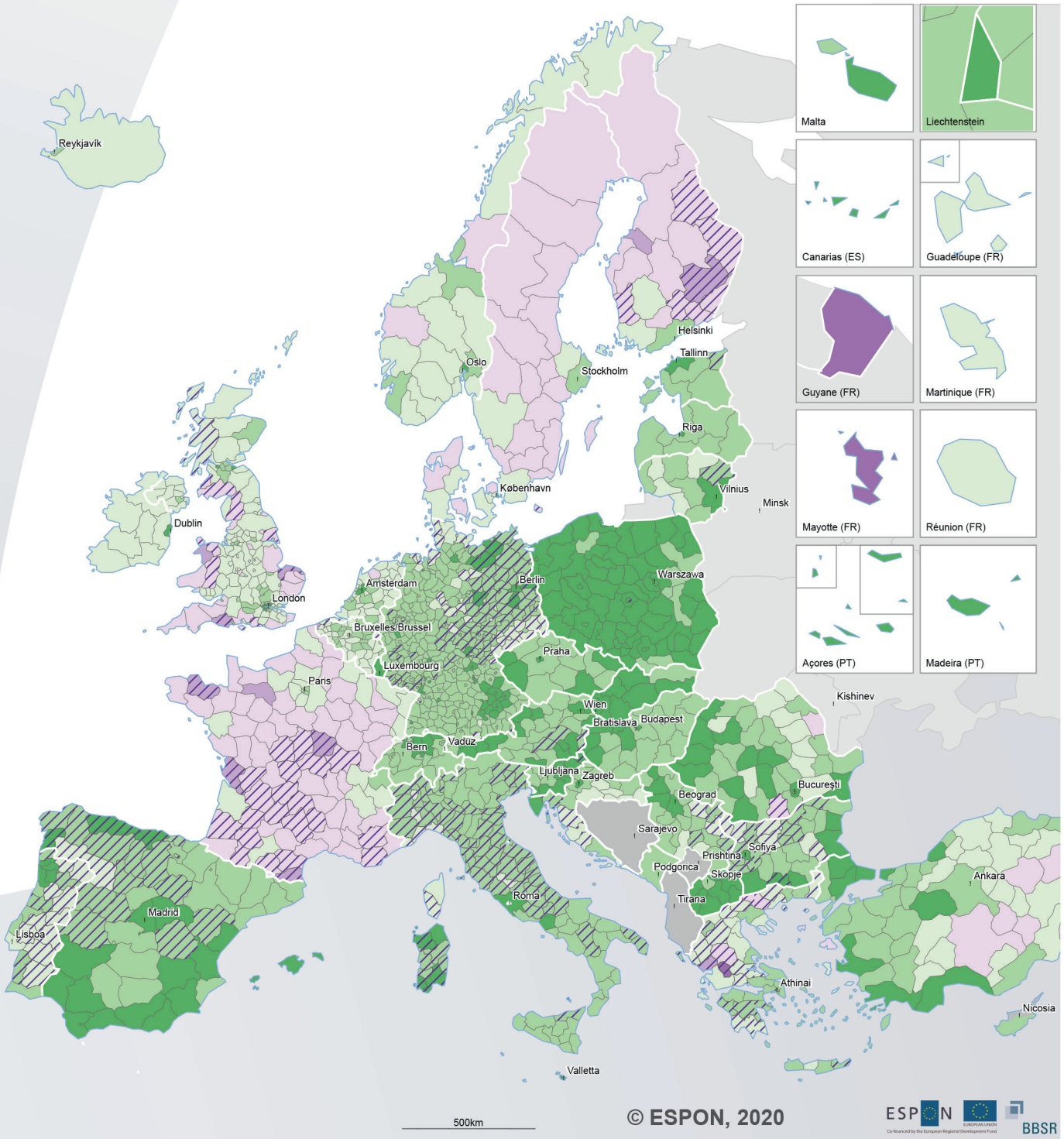
Data source: Spatial Monitoring System for Europe; data origin: Eurostat

Regional age structure

Proportion of young (aged 0–24) and old (aged 65+) population per 100 working-age population (aged 25–64) – dependency ratio 2019

- to under 80
- 80 to under 90
- 90 to under 100
- 100 to under 110
- 110 to under 120
- 120 and over
- no data

Old-age dependency ratio > young-age dependency ratio



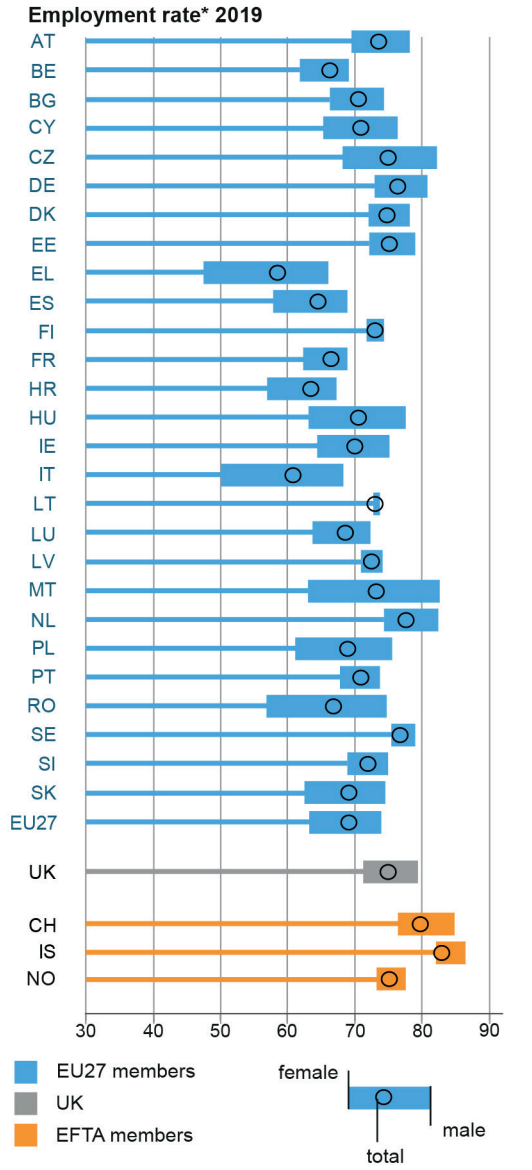
Regional level: NUTS 3 (2016)
Data origin: Eurostat;
EuroGeographics for the administrative boundaries

Development of employment

In the 27 EU member states, the employment rate (persons in employment as a percentage of the population between 15 and 64 years of age) increased by 3.9 percentage points between 2015 and 2019. This positive trend was seen in almost all European regions, above all in peripheral regions: in southern Spain, Finland and eastern Europe, the employment rate rose by more than 3.5 percentage points almost everywhere. But despite this growth, the employment rate remained relatively low in 2019, especially in southern Europe.

The employment rate fell in Iceland and Turkey and in some regions of Norway, France, Scotland and southern Sweden. Despite some slight decreases, the employment rate in northern European regions remained above the EU average. In 2019, despite a slight drop, Iceland had the highest employment rate in Europe at 84%, ahead of Switzerland and the Netherlands. Greece had the lowest rate of the 27 EU member states at 56.5%, followed by Italy at 59%.

In all European countries, women's employment rates are lower than those of men, but differences between the two vary greatly by country: the difference between women's and men's employment rates is less than four percentage points in Finland, Latvia, Lithuania and Sweden, but 19.6 percentage points in Malta and 18.6 percentage points in Greece.

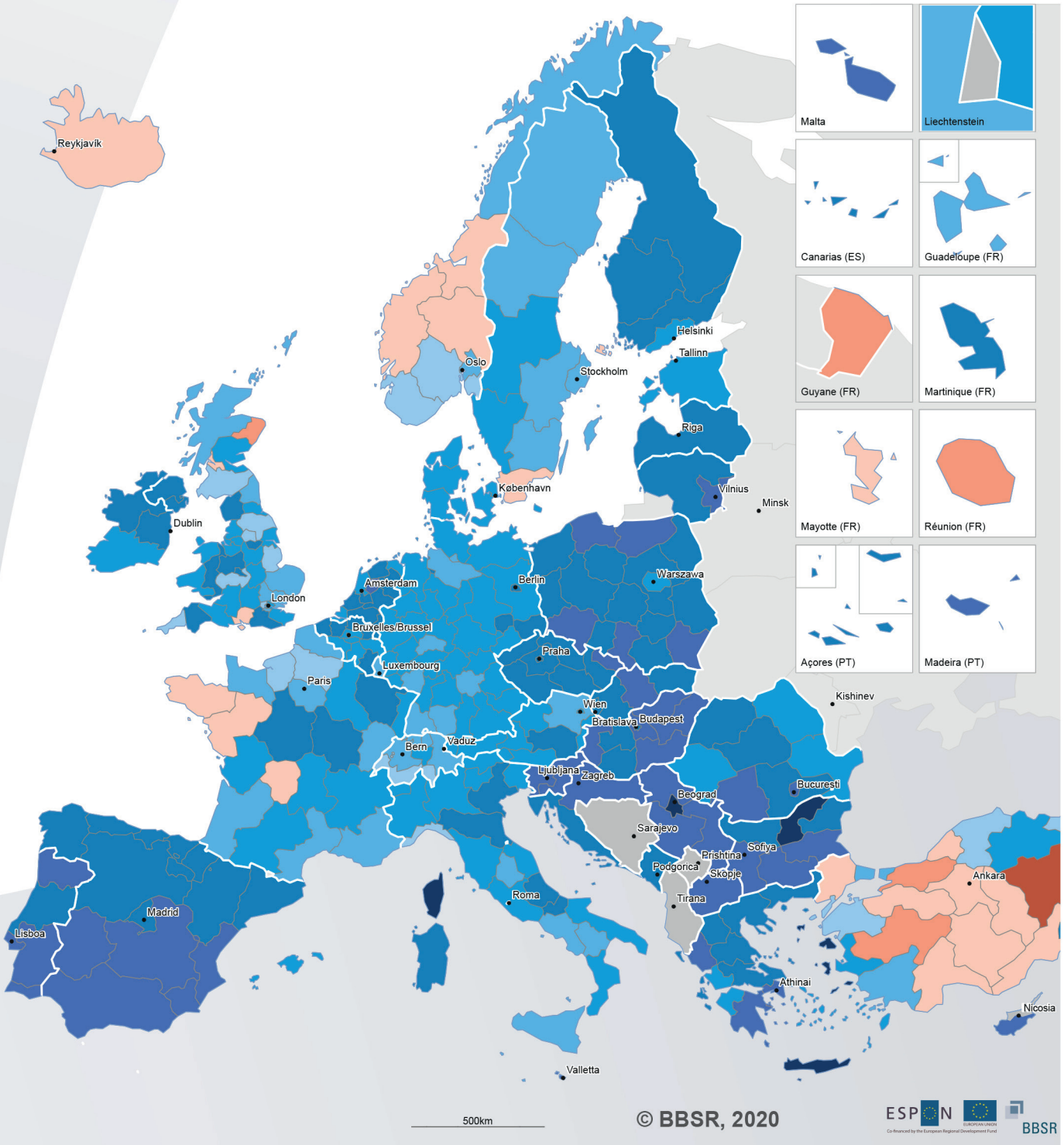


*Employment rate of the age group 15 - 64 years
Data source: Spatial Monitoring System for Europe
Data origin: Eurostat

Employment rate

Development of the employment rate 2015-2019 in percentage points

- to under –3.5
- –3.5 to under –1.0
- –1.0 to under 0.0
- 0.0 to under 1.0
- 1.0 to under 2.0
- 2.0 to under 3.5
- 3.5 to under 6.0
- 6.0 to under 9.0
- 9.0 and more
- no data



Regional level: NUTS 2 (2016)
Data source: Spatial Monitoring System for Europe
Data origin: Eurostat;
EuroGeographics for the administrative boundaries

Structure of employment

In Europe, manufacturing is no longer the sole basis for economic prosperity; the significance of this sector for employment is steadily shrinking. In 2016, about 39 million people were employed in manufacturing, making up 17% of the total number of workers.

A comparison with the year 2000 plainly shows the shrinking significance of industrial employment: at that time, nearly 41 million people were employed in manufacturing, accounting for 20% of total employment.

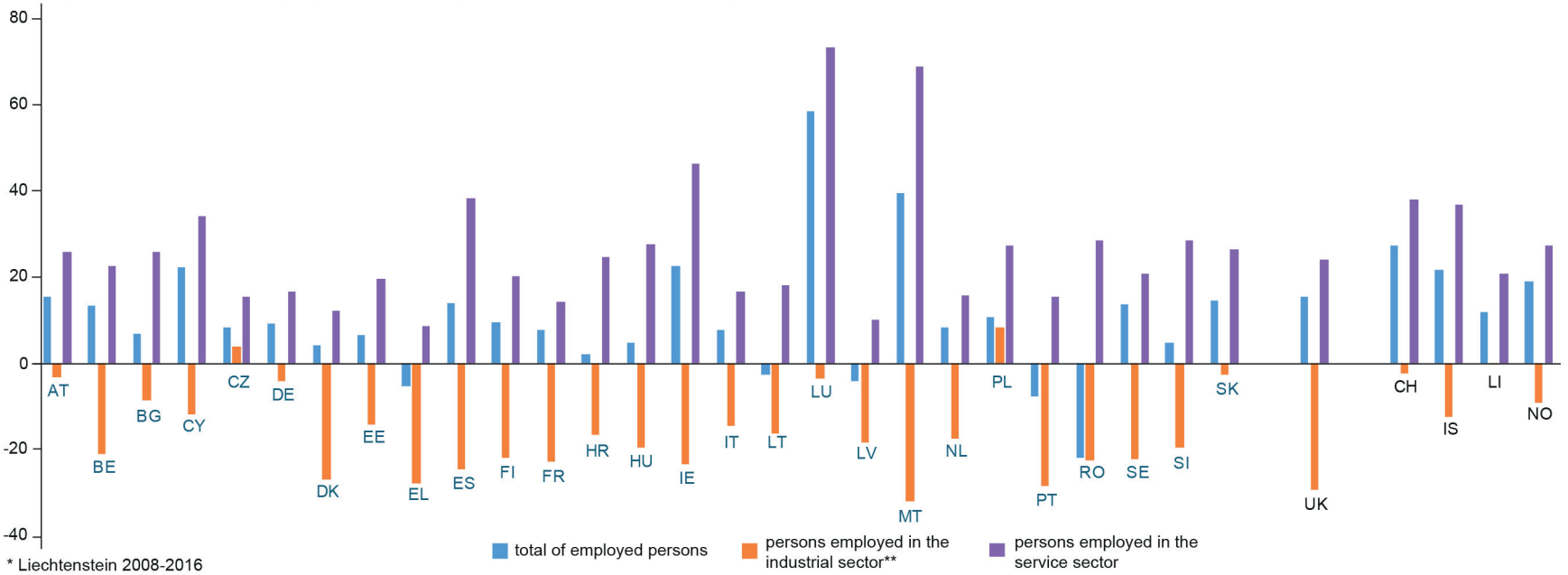
In the service sector, the trend is moving in the opposite direction: over the same period, the number of workers rose from 115 million to 141 million, and their share of the total number of workers increased by eight percentage points to 73%.

In almost all countries there are regions where manufacturing still plays a greater role. The industrial heart of Europe, with large shares of workers in this sector, extends across large parts of Germany, the Czech Republic, southern Poland and northern Italy all the way to eastern Romania.

As would be expected, the largest percentages of workers in the service sector are found in cities and in some coastal areas of France and Spain where tourism is important. However, the regional situation outside of the metropolitan centres is quite homogeneous.

Despite the economic and financial crisis of 2008/2009, employment is growing in most of the EU countries, while employment in manufacturing is clearly shrinking in many countries. The exceptions are Poland and the Czech Republic, where there has been a slight increase in industrial employment. Most employment growth has been in the service sector.

Development of persons in employment according to sectors 2000 to 2017* in %

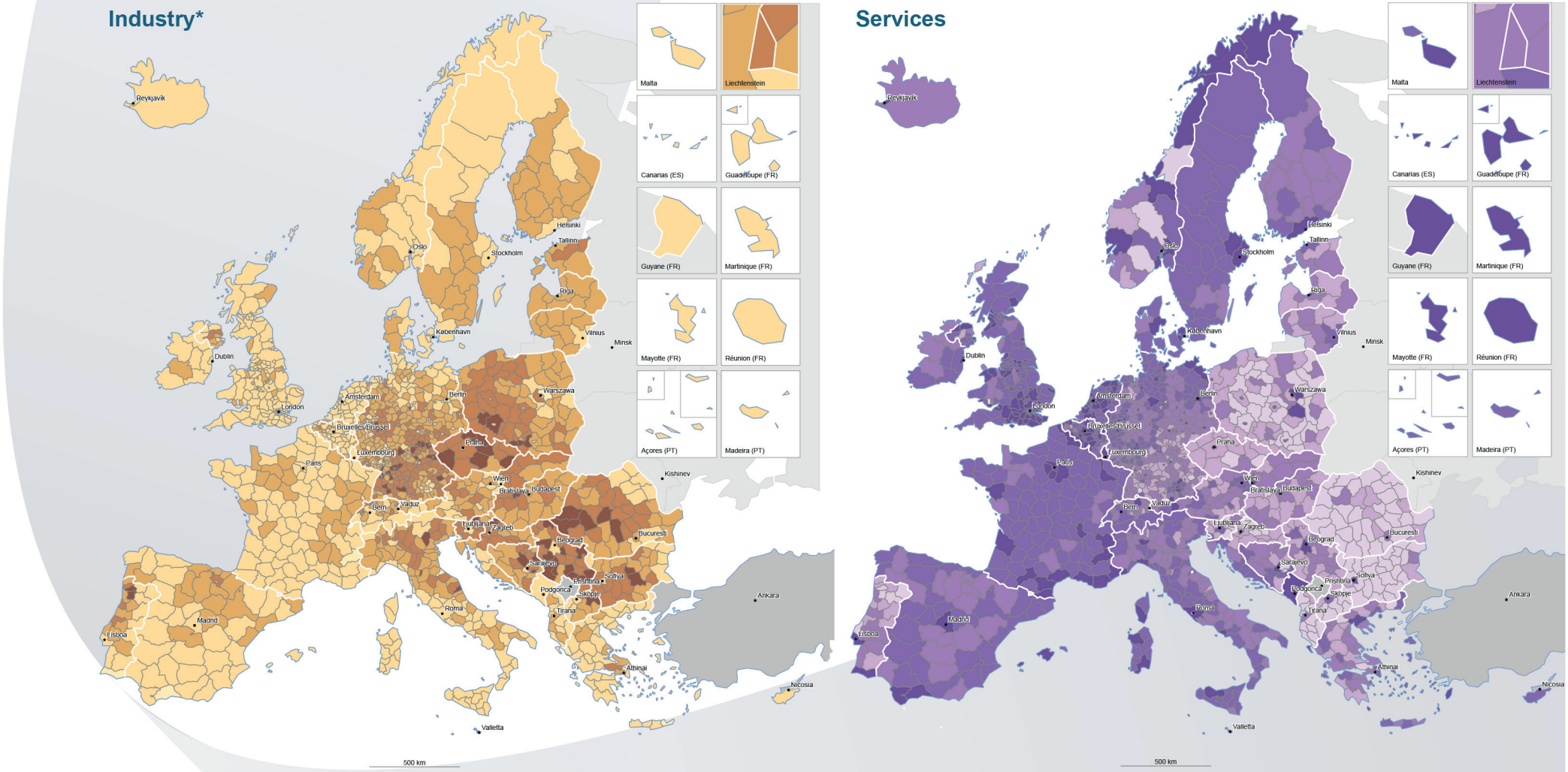


* Liechtenstein 2008-2016

Data source: Spatial Monitoring System for Europe; data origin: Eurostat, OECD, national statistical offices

** industrial sector without construction

Employment structure according to economic sectors



Regional level: NUTS 3 (2016)
Data source: Spatial Monitoring System for Europe;
Data origin: Eurostat, OECD, national statistical offices
EuroGeographics for the administrative boundaries

Proportion of the employed persons of each sector in all employed persons in 2016 in %

Industry*

- to under 5
- 5 to under 15
- 15 to under 25
- 25 to under 35
- 35 and more

Services

- to under 45
- 45 to under 60
- 60 to under 75
- 75 to under 90
- 90 and more

no data

* Industry without construction sector

Youth without employment and education

Currently around four million young people are unemployed in the EU and the youth unemployment rate is more than double the overall unemployment rate. Moreover, some six million young people are neither in employment, education or training, the so called NEETs. These experiences and challenges young people face calls for more imaginative and effective policies.

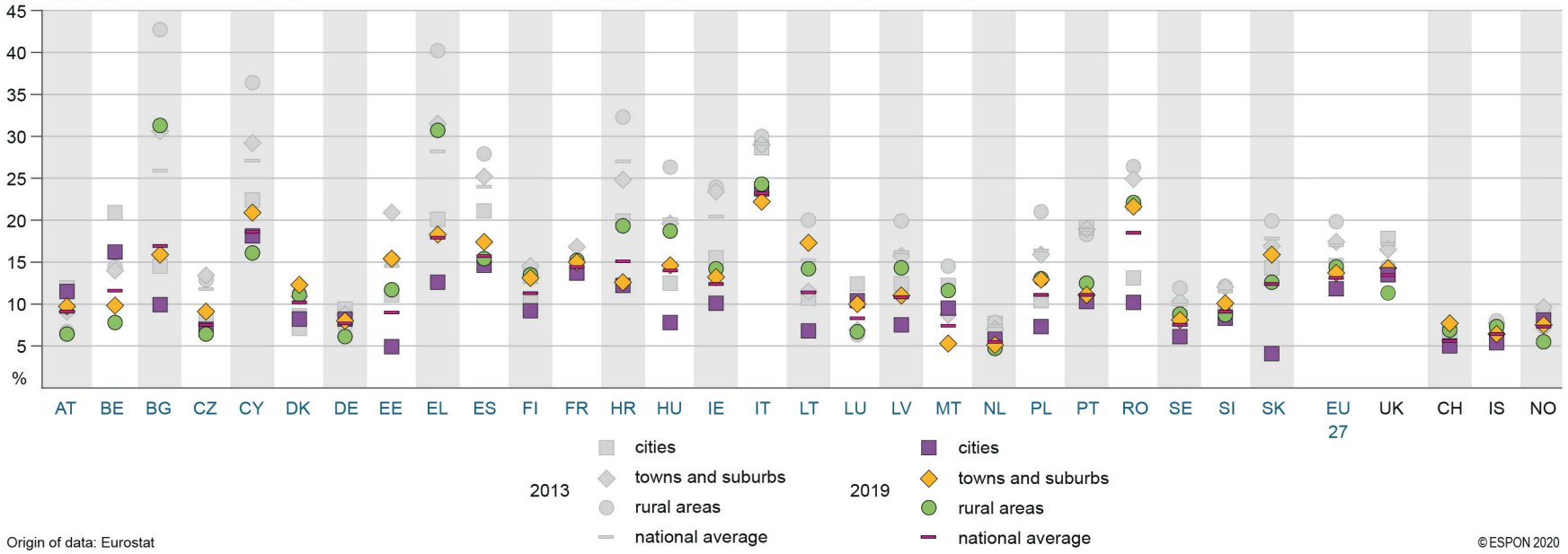
The NEET (18–24) rate declined from a high of 17% in 2013 to 13% in 2019, and even below the level before the crisis of almost 14% in 2008. The NEET rates are consistently higher in eastern, southern and some of the western parts of Europe such as in the UK and France and lower in central and northern Europe. They are very also high across the outermost territories.

Young people have been amongst the hardest hit by the aftermath from the economic and financial crisis of 2008/2009 and they are severely affected by labour market mismatches caused by a lack of skills, limited geographic mobility or inadequate wage conditions, putting them at higher risk of ending up in precarious employment, or no job at all. The crisis aggravated NEET rates across the whole EU, but especially for southern and eastern regions, with peaks near to 30% Italy (Sicilia, Campania, Calabria), Greece (Peloponnisos, Anatoliki Makedonia, Thraki) and Bulgaria (Yugoiztochen).

However, many of the regions in EU MS have proved to be more resilient towards NEET rates than others, displaying comparatively small job losses and inactivity in the first place or experiencing a quickly-recovering labour market from the downturn. By 2019, most of the regions have recovered from the impacts of the crisis, with the exception of a few regions scattered across Europe.

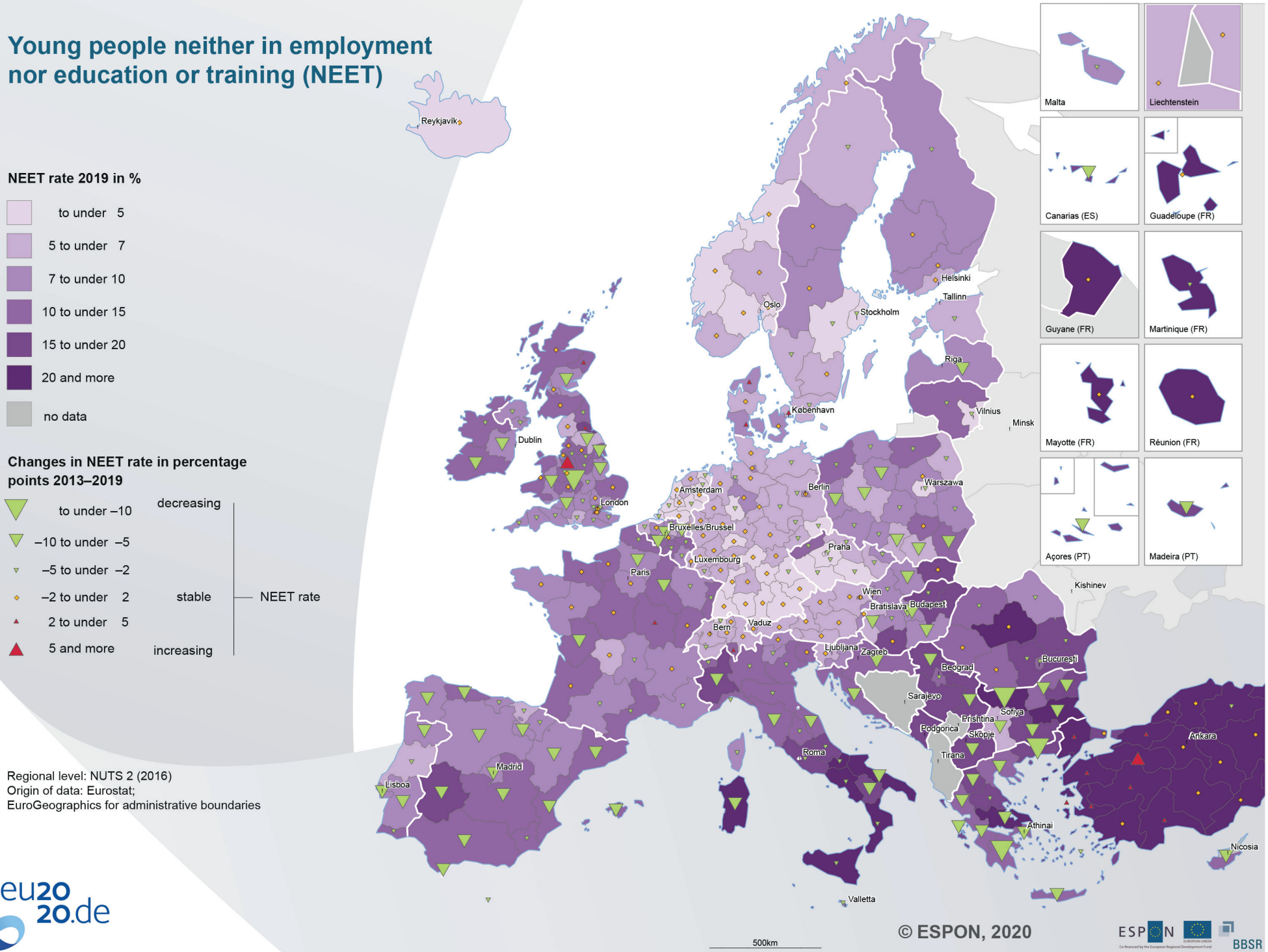
The urban-rural disparities were the most accentuated by the crisis, but have shown significant recovery between 2013 and 2019. The urban-rural disparities are the most visible in Bulgaria, Greece and Romania.

Young people neither in employment nor in education and training by degree of urbanisation (NEET rates), 2013 and 2019



Origin of data: Eurostat

Young people neither in employment nor education or training (NEET)



Regional level: NUTS 2 (2016)
Origin of data: Eurostat;
EuroGeographics for administrative boundaries

SMEs and entrepreneurship

Small and medium-sized enterprises (SMEs) and entrepreneurship are essential drivers of economic and social well-being. They play a major role in the major changes in economies and societies.

SMEs are enterprises with less than 250 persons employed, a turnover of less than 50 million EUR and balance sheet under 43 million EUR. SMEs can be further broken down into micro (less than 9 persons employed), small (10–49 persons employed) and medium-sized enterprises (50–249 persons employed).

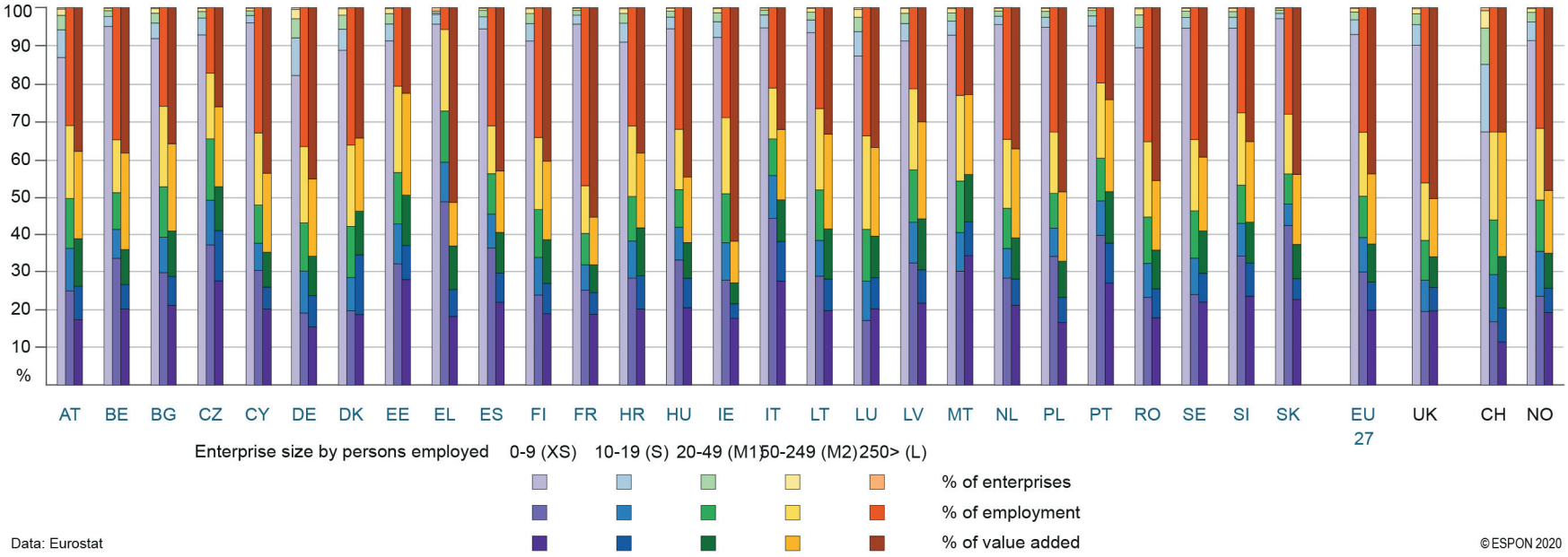
In total, SMEs make up over 99.8% of all enterprises in all EU countries, Norway, Switzerland and the United Kingdom in 2018. They account for around two-thirds of total employment and contribute about 56% of the total added value.

SMEs, and more precisely, micro-enterprises make up the majority of the new enterprises created each year in the EU. The largest share of new micro-enterprises (60% to 92%) are one person enterprises or enterprises with one or several owners but no employees. Enterprise creation with no employees is most dominant in urban areas

After a decline in recent years, enterprise creations have now returned to the levels before the 2008/2009 economic and financial crisis. The enterprise birth rate, the number of enterprise creations as a percentage of the total number of active enterprises, is particularly high in Lithuania, Latvia, Portugal, Germany

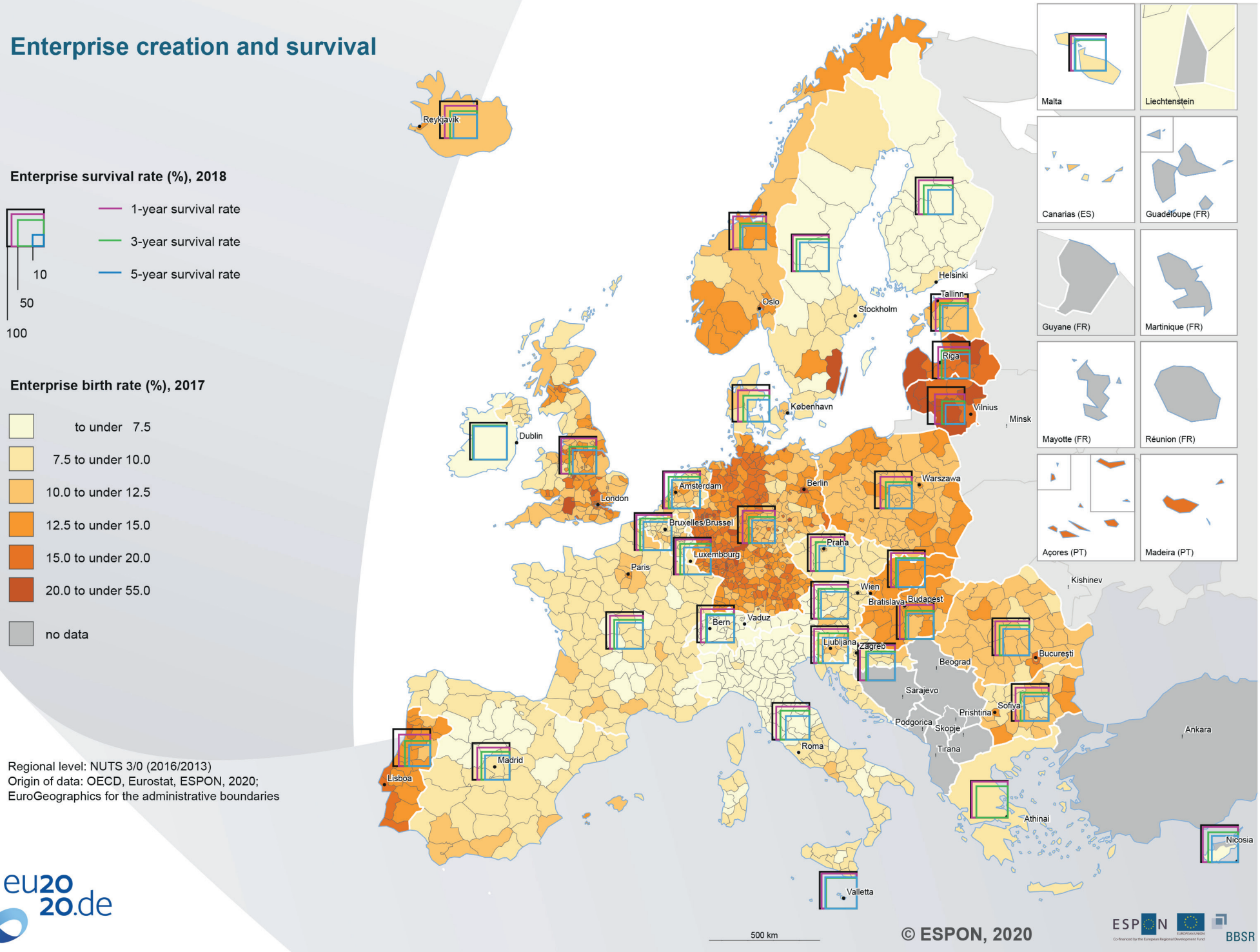
By 2018, 82% of newly created companies survived their first year in business, 58% their first three and 51% their first five years (enterprises founded in 2017, 2015 and 2013 respectively). The survival rates have been especially low in Lithuania. Only 63% of the businesses created in 2017, 38% in 2015 and 26% in 2013 have survived until 2018. Similar trends can also be observed in Latvia, Portugal, Germany Denmark and Poland. The new businesses have been proven to be most resilient in Ireland, Malta and Sweden, where over 60% of businesses created in 2013 were still operating by 2018.

Share of enterprises, persons employed and value added by enterprise size (%), 2018



Data: Eurostat

Enterprise creation and survival



Regional level: NUTS 3/0 (2016/2013)
Origin of data: OECD, Eurostat, ESPON, 2020;
EuroGeographics for the administrative boundaries

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Quality of life

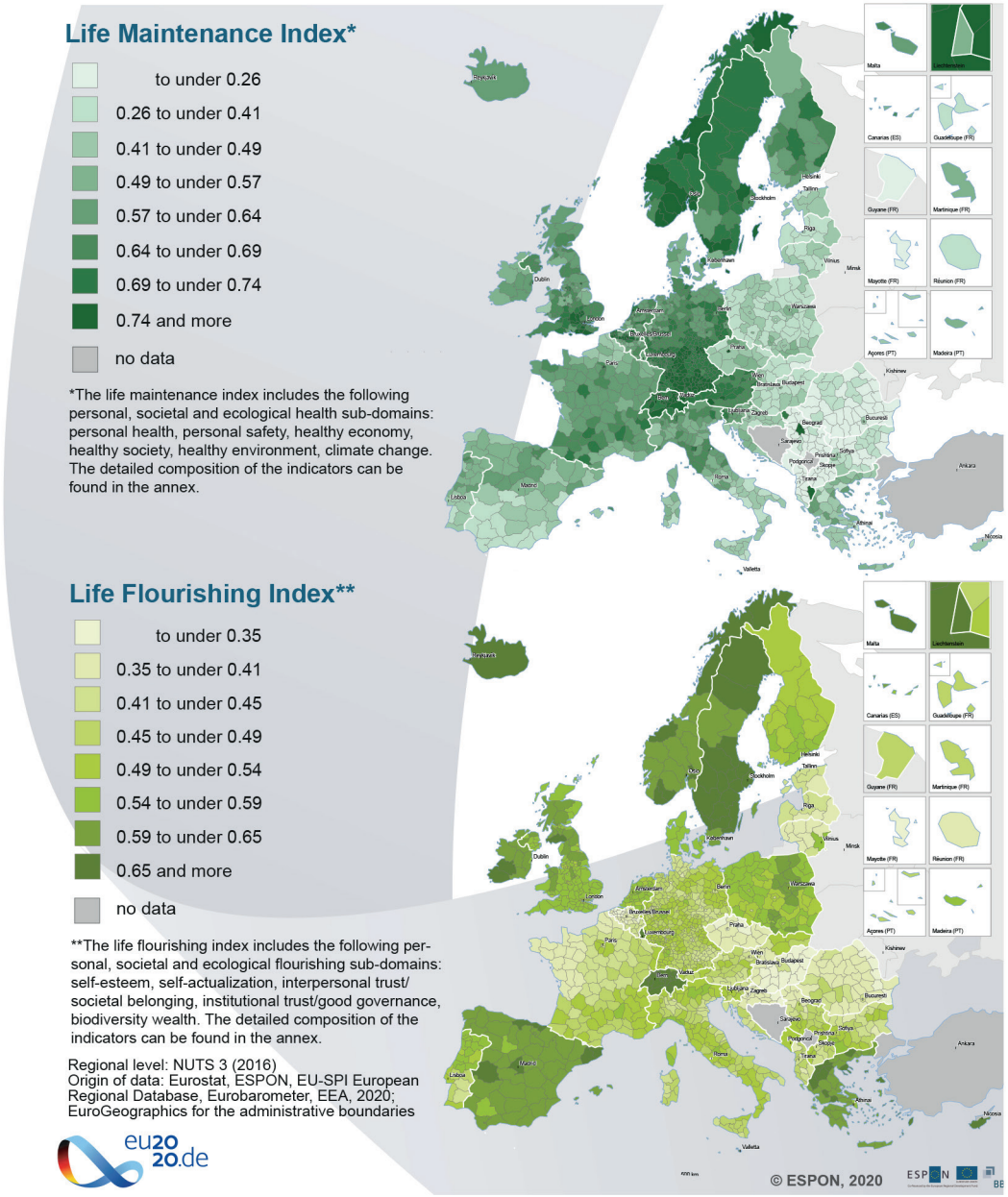
Territorial Quality of Life (TQoL) is measured with an approach including all “good life” enablers and objective and subjective dimensions necessary for life homeostasis – i.e. people at their living place.

As for the first pillar, in the personal sphere, enablers of good shelter, education and health are included. In the socio-economic sphere, enablers of good mobility, digital connectivity, work and consumption choices, social and cultural life in the territory have been in the focus. Finally, in the ecological sphere enablers of good life in green environments have been considered.

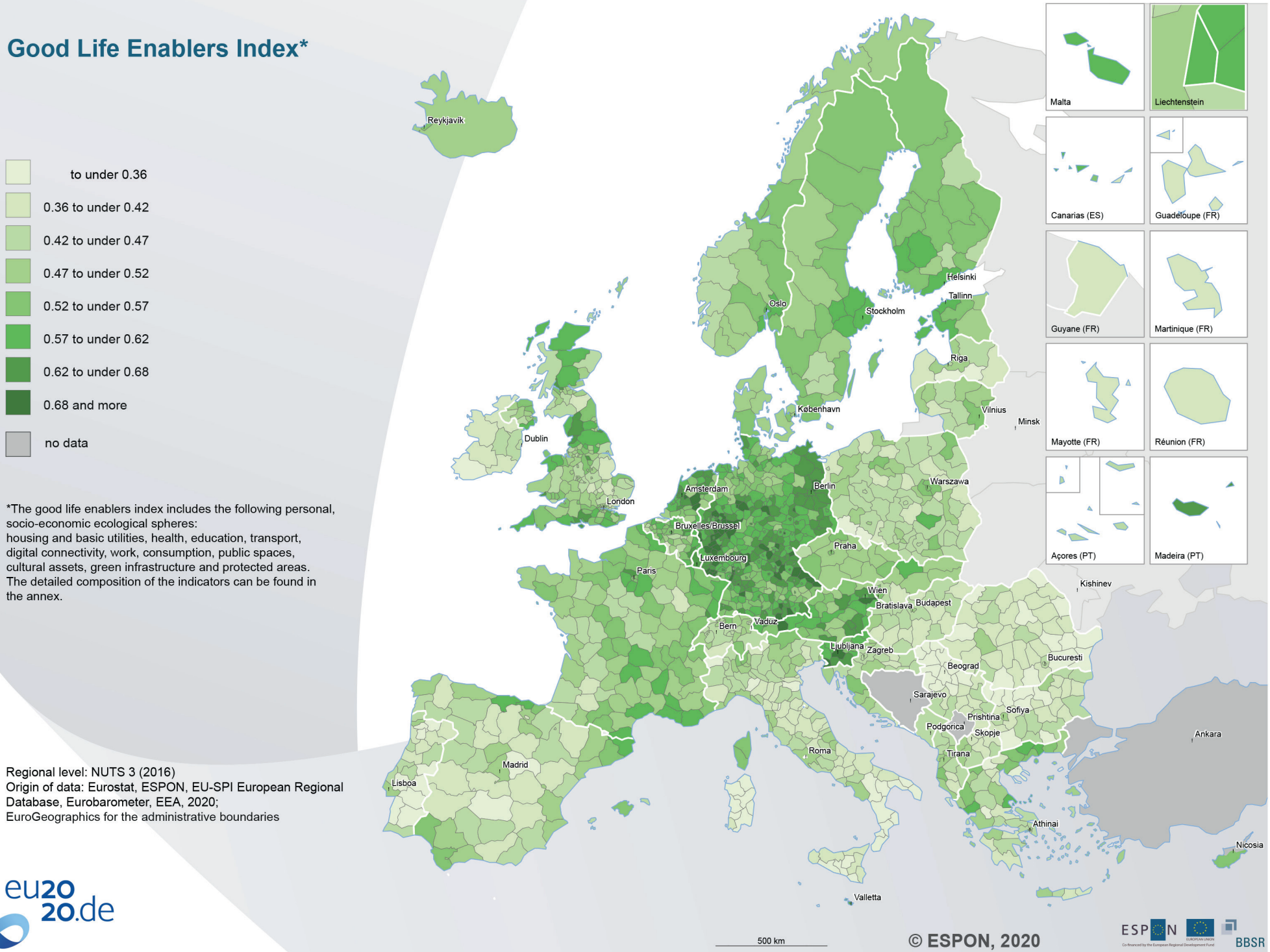
As for the second pillar, quality of life outcomes are measured. This pillar is further divided in two dimensions, “life maintenance” and “life flourishing”. Thusly, territorial quality of life outcomes includes aspects that are good for life maintenance (a healthy personal life, an inclusive economy and healthy society, healthy environment) together with aspects that measure life flourishing (the fulfilment of personal aspirations, community flourishing and ecological flourishing).

Life Maintenance experienced by citizens is still generally performing worse in Southern and Eastern European regions than in Central and Northern regions, given poorer socioeconomic conditions, lower life expectancy and higher supervening deaths.

Low Personal flourishing patterns are identified in countries where community flourishing or community engagement is relatively low and when trust in public institutions is also suffering. We see some underperformance especially in eastern Europe, in Italy and the United Kingdom. The Nordic countries, Switzerland, Spain, Greece and Poland perform well in this respect.



Good Life Enablers Index*



*The good life enablers index includes the following personal, socio-economic ecological spheres:
housing and basic utilities, health, education, transport, digital connectivity, work, consumption, public spaces, cultural assets, green infrastructure and protected areas.
The detailed composition of the indicators can be found in the annex.

Regional level: NUTS 3 (2016)
Origin of data: Eurostat, ESPON, EU-SPI European Regional Database, Eurobarometer, EEA, 2020;
EuroGeographics for the administrative boundaries

Regional imbalances

After many years in which GDP per capita was approaching similar levels throughout the member states and regions, the global economic and financial crisis in 2008/2009 slowed and in some cases interrupted this process of convergence. For 2018, the distribution of GDP per inhabitant in purchasing power standards displayed clear regional differences, above all between east and west and between north and south. In the eastern member states that joined the EU after 2004, GDP per inhabitant in most regions was less than 75% of the EU average. It was also much less than the EU27 average in the southern European countries Spain, Italy and Greece, which were strongly affected by the crisis. The regions with the highest GDP per inhabitant are concentrated in the centre of Europe.

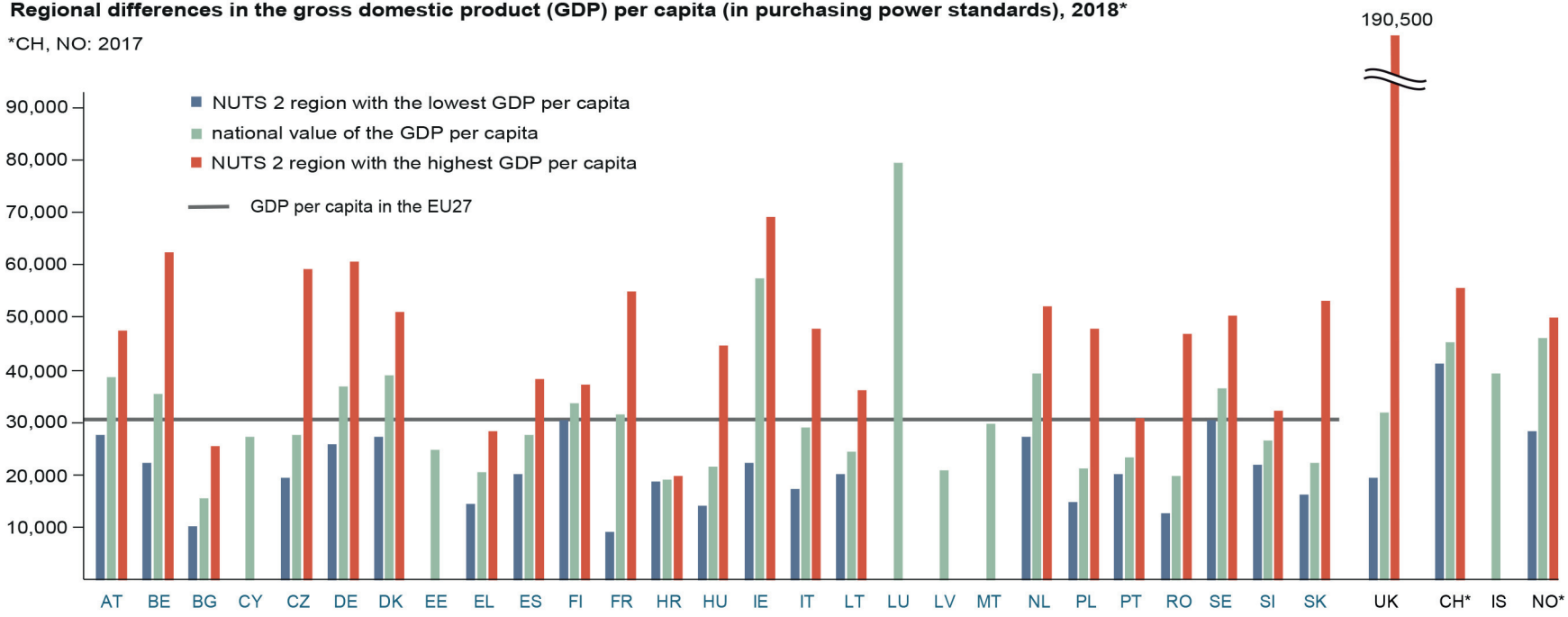
There are also differences within countries. In many countries, GDP per inhabitant is higher in the capital region than in the rest of the country. In Germany, it is lower in the east than in the west; in Italy and Spain, it is lower in the south compared to the north.

These differences are especially marked in France, where GDP per inhabitant in the Paris region is six times higher than that of Mayotte, the region with the lowest value in the EU. Only in the UK are the differences more extreme: GDP per inhabitant in Inner London West is 620% of the EU27 average, making this the region with the highest GDP per capita in Europe and constituting something of an exception. Regional differences are smallest in Croatia and Finland.

The COVID-19 pandemic and the resulting restrictions threaten to widen these differences: regions which depend heavily on tourism or cultural activities have been hit especially hard by the current crisis.

Regional differences in the gross domestic product (GDP) per capita (in purchasing power standards), 2018*

*CH, NO: 2017



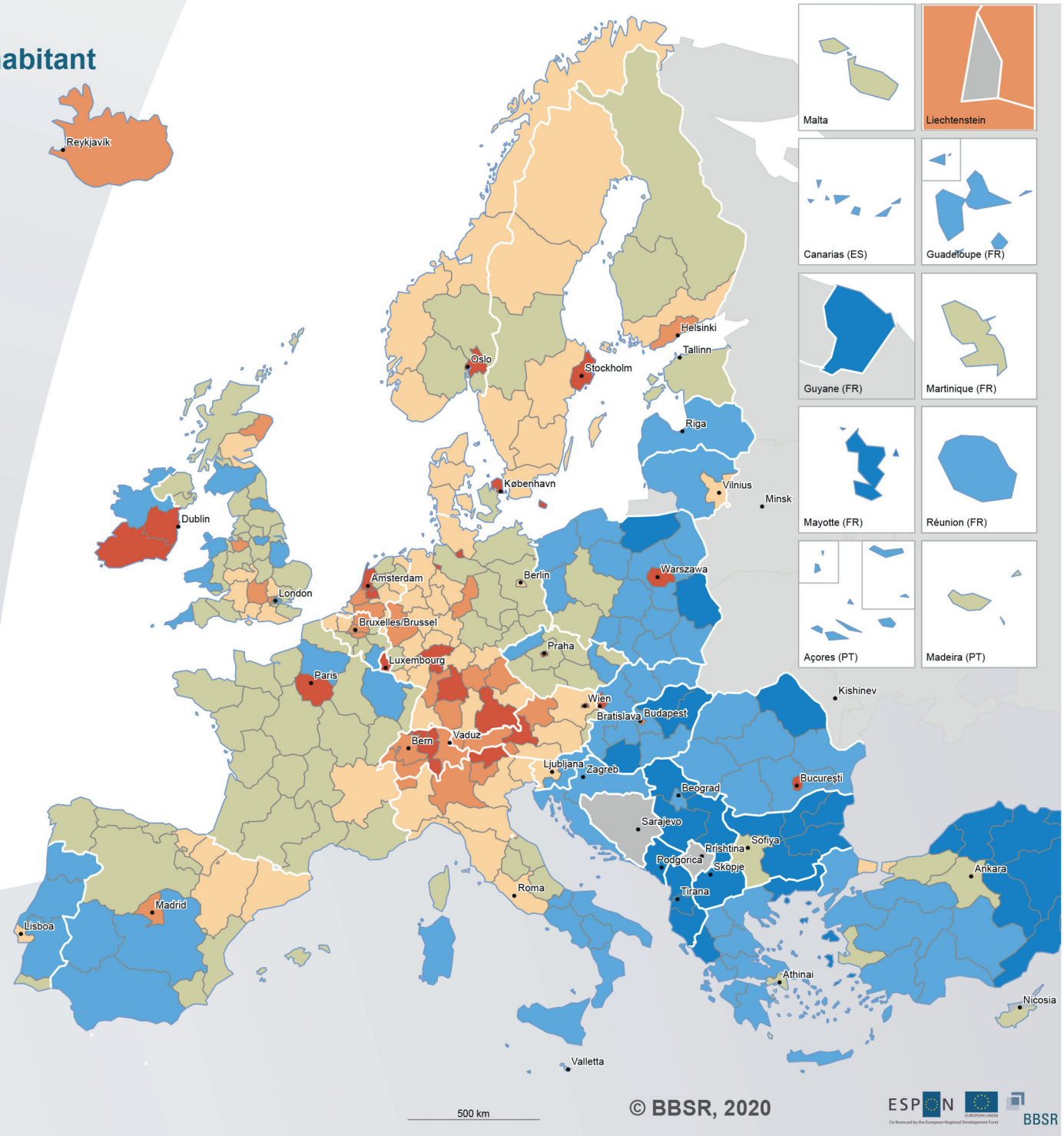
Data origin: Eurostat, national statistical offices

Gross domestic product per inhabitant

Regional gross domestic product (GDP) in purchasing power standards (PPS) per inhabitant 2018* (EU27 = 100)

- to under 50
- 50 to under 75
- 75 to under 100
- 100 to under 125
- 125 to under 150
- 150 and more
- no data

*NO, CH, AL, MK: 2017



Regions: NUTS 2 (2016)
Data source: Spatial Monitoring System for Europe;
Data origin: Eurostat, national statistical offices;
EuroGeographics for the administrative boundaries

Deepening of the economic divide

The social and economic geography of Europe is characterised by growing inequalities. The economic and financial crisis 2008/2009 has been a decisive factor in this development, and its impact can still be felt today. In its wake, regional disparities have grown and become more persistent. In addition, living and working conditions have changed in such a way that fewer and fewer people benefit from the economic recovery. The COVID-19 pandemic and its aftermath will also leave their mark on the economy. Industries and regions which are particularly affected by measures to control the pandemic due to their strong focus on the service sector have been hard hit.

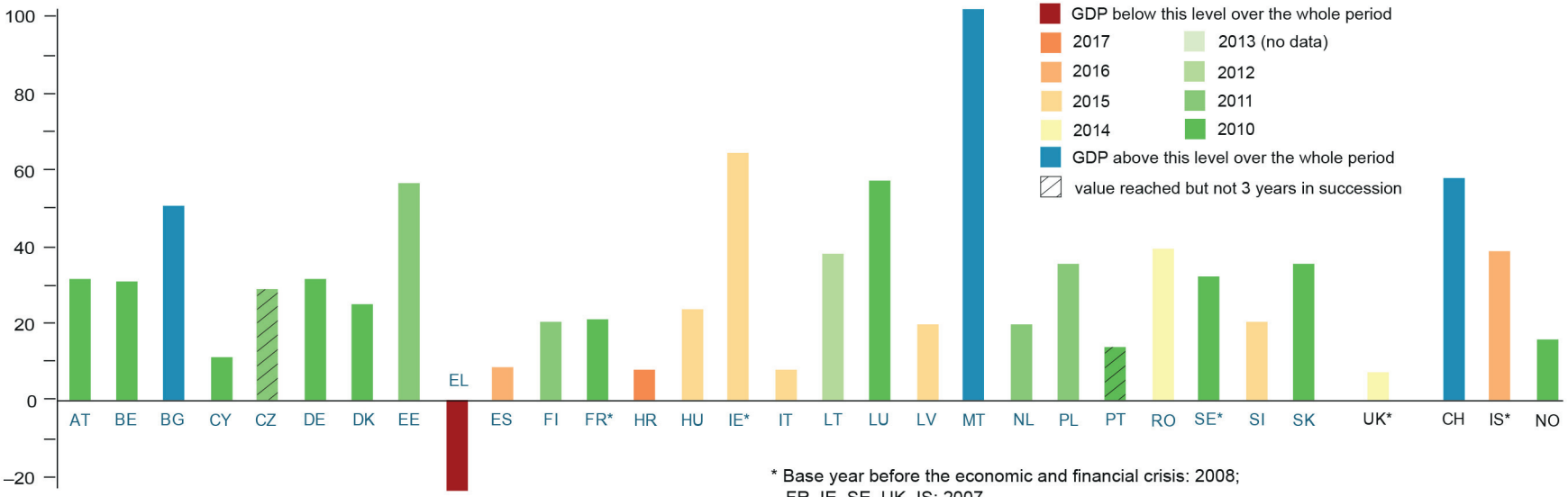
The economic and financial crisis 2008/2009 started in the member states at different times, at the latest in the second quarter of 2008; by the second quarter of 2009 member states' seasonally and calendar-adjusted gross domestic product (GDP) had shrunk by around 176 billion euro. Spain and Greece saw the biggest declines in GDP, to 85% and 75% respectively compared to pre-crisis figures.

For many countries, the way out of the crisis was long. While the economic performance of Belgium, Germany, France, Luxembourg, Austria, Sweden and Slovakia reached pre-crisis levels by 2011, Italy, Ireland and Hungary took until 2015, Spain until 2016 and Croatia even until 2017 to regain their former economic strength. Until 2018, Greece's economic performance was still more than 20% below pre-crisis levels.

Only in very few countries did the economy recover evenly in all regions. In particular, in Italy, France, Spain and Portugal the development and pace of the economic recovery differed greatly from region to region, exacerbating regional disparities within member states.

These pronounced differences in economic development between and within member states led, in the final analysis, to the aggravation of regional disparities in Europe. This has given rise to social challenges, especially in less-developed regions.

Development of gross doemstic product (GDP) following the economic and financial crisis 2008/2008* measured in euros at current prices in %



* Base year before the economic and financial crisis: 2008; FR, IE, SE, UK, IS: 2007

Data source: Spatial Monitoring System for Europe; data origin: Eurostat

Regional differences of economic development

Year in which, within the period up to 2018*, the GDP reached or exceeded the value before the economic and financial crisis 2008/2009** 3 years in succession

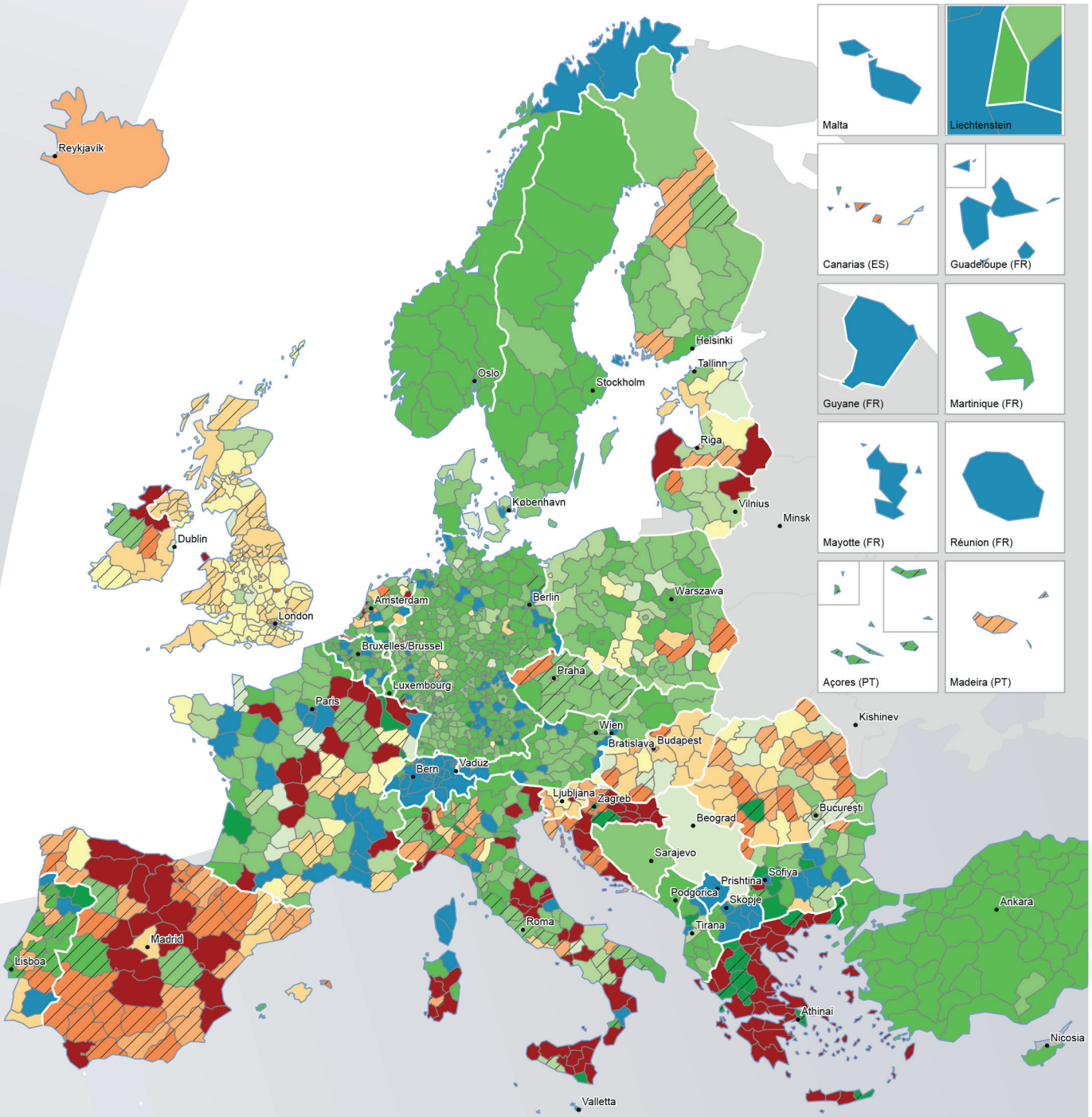
- GDP below this level over the whole period
- 2018
- 2017
- 2016
- 2015
- 2014
- 2013
- 2012
- 2011
- 2010
- 2009
- GDP above this level over the whole period
- value reached but not 3 years in succession
- no data

GDP - measured in euros at current market prices

* 2018 or latest year
2014: IE (South-West & Mid-West)
2016: FR
2017: AL, AT, BG, CH, CZ, DE, EL, ES, FI, HR, IT, LT, LV, MK, NL, NO, PL, PT, RO, RS, SE, IE

** Base year before the economic and financial crisis: 2008; FR, IE, SE, UK, IS: 2007

Regions: NUTS 3 (2016), NUTS 0
Data source: Spatial Monitoring System for Europe;
Data origin: Eurostat;
EuroGeographics for the administrative boundaries



Research without borders

Horizon 2020 is the name of the largest funding programme in the fields of research and innovation so far launched by the European Union. Since 2014, the programme has been bundling all previous funding programmes and has been supporting both public and private projects with up to 80 billion euros over seven years (2014-2020).

By spring 2020, around 29,600 research projects with just under 131,100 participating partners had been running. Colleges and universities, public and private research institutions and companies from 165 countries are involved in this programme worldwide, the project coordinators come from a total of 53 countries. The total project volume amounts to around 64.9 billion euros by spring 2020, of which 52.9 billion euros come from the Union's contribution.

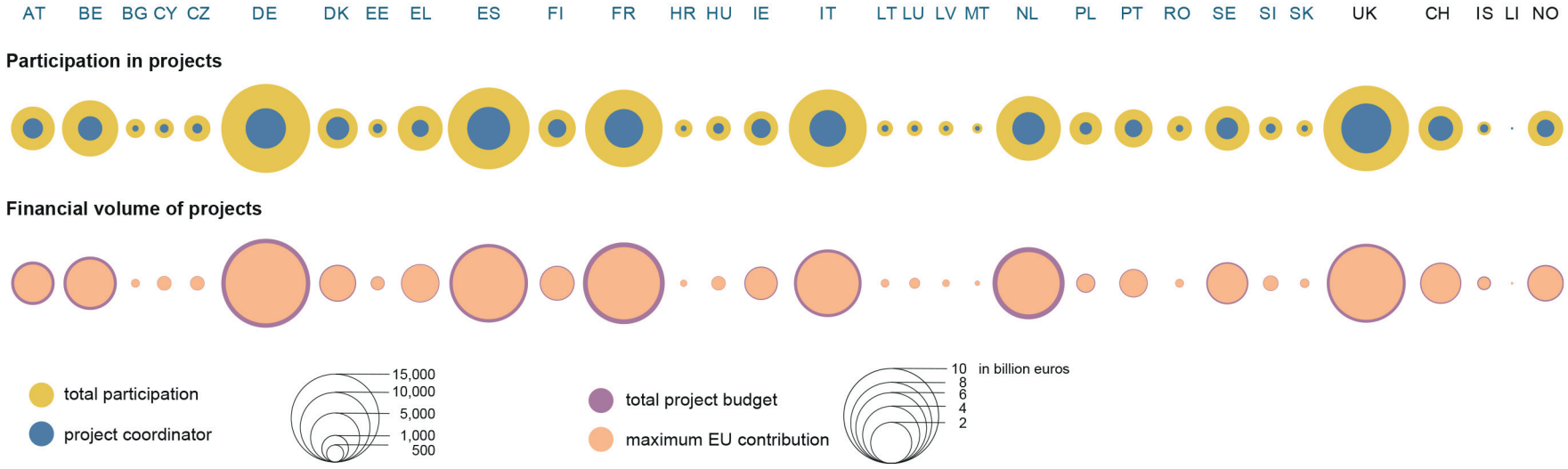
In the EU 27 countries, 21,600 projects with 100,100 participating partners have been carried out so far. The volume of funds adds up to a total of 51.1 billion euros, the EU funding amounts to 43.3 billion euros.

The group of institutions conducting research in the context of the programme is large. In terms of the total number of project participations, private companies come first at European level followed by organisations of the tertiary and secondary education sector. They are followed by non-university research institutions and other public organisations.

However, project coordination and control are mainly carried out by universities and colleges.

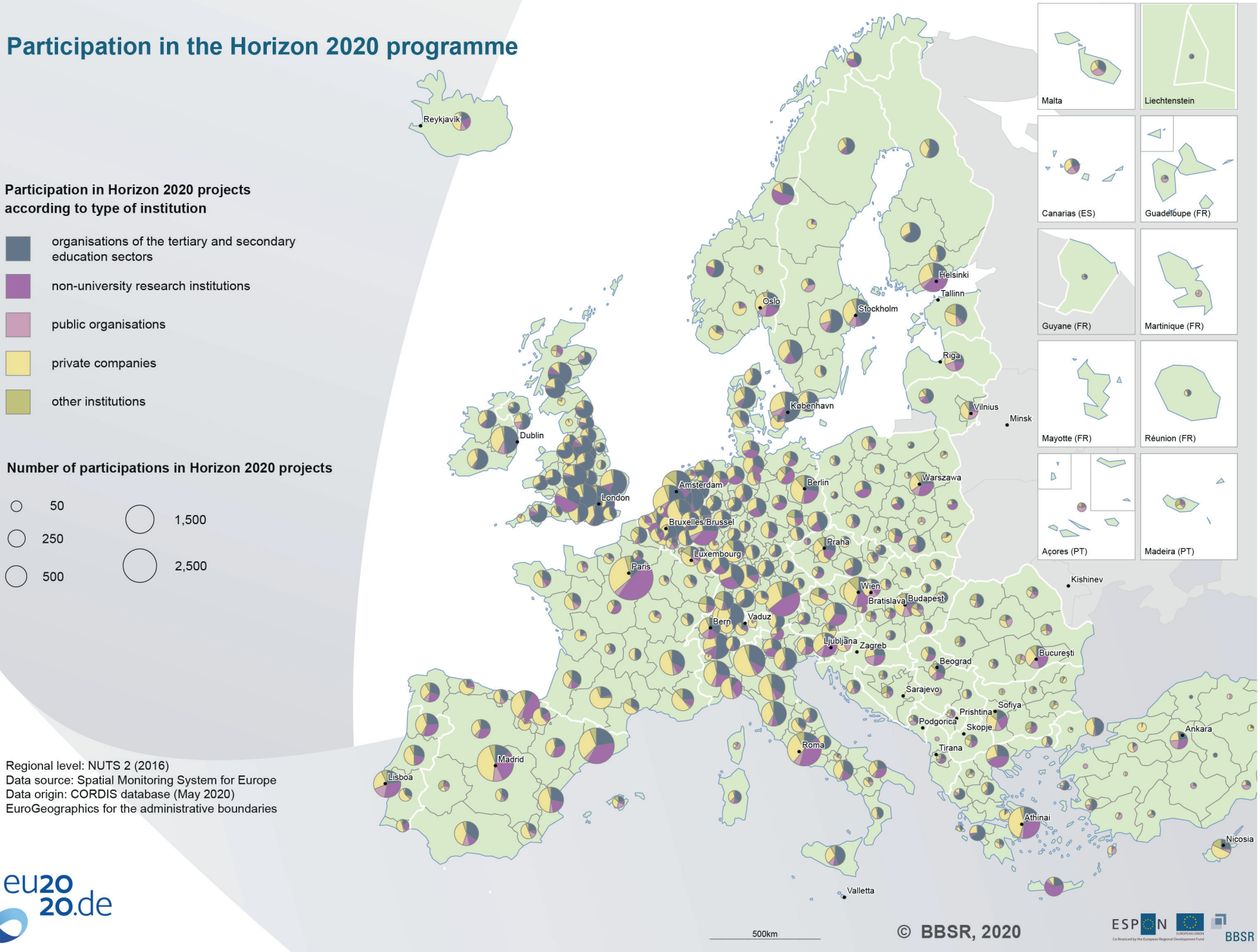
While the project coordination is carried out by universities in almost all countries, which are also the main recipients of the grants, the structure of project participation differs in the individual countries. While in Denmark, Ireland, Sweden and especially in the United Kingdom universities predominantly participate, mainly private companies are involved in Germany, France and Spain. In France in particular, but also in Spain and Italy, non-university research institutions play an important role. In France and Spain, these institutions coordinate the majority of the projects.

National participation and financial volume of Horizon 2020 projects



Data source: Spatial Monitoring System for Europe; data origin: CORDIS database (May 2020)

Participation in the Horizon 2020 programme



Regional level: NUTS 2 (2016)
Data source: Spatial Monitoring System for Europe
Data origin: CORDIS database (May 2020)
EuroGeographics for the administrative boundaries

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Air passenger flows

In 2019, 1 billion passengers travelled by air in the European Union (EU), an increase by 30% compared with 2007. In addition, 278 million passengers travelled by air in the UK and 106 million in the EFTA countries. In 2019, extra-EU transport represented half (50%) of total air passenger transport in the EU and intra-EU transport one third (34%), while national transport accounted for fewer than 1 in every 5 passengers (15%).

In 2019, the largest number of air passengers in the EU were recorded in Spain, Germany (both 227 million), France (169 million) and Italy (161 million). The number of air passengers carried in 2019 rose in all EU Member States compared with 2007. The highest increases were registered mostly in the new Member States and also Luxembourg and Portugal.

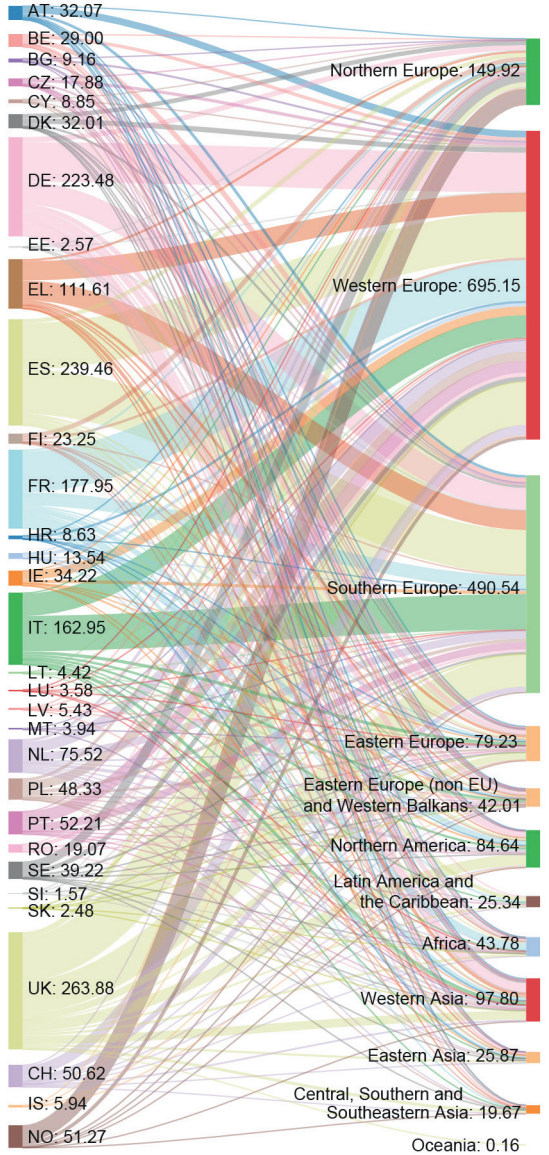
Overall in the EU, the number of air passengers rose by 313 million between 2007 and 2019, driven mostly by the rise in intra-EU and extra-EU transport from 236 to 356 million (+33%) and from 340 to 521 million (+35%) respectively.

Most popular extra-European (EU countries together with UK and EFTA countries) flight connections are with countries in Western Asia (98 million), Northern America (85 million), Africa (44 million) and non-EU eastern Europe and Western Balkans (42 million). Most popular intra-European flight routes are with western and southern European countries (695 million and 490 million respectively). National air travel is the most prevalent in larger Member States, tourism hotspots and in Scandinavia, with Norway standing out especially where national air travel accounts for 40% of the total passengers carried.

Aside London/Heathrow in the United Kingdom with 81 million passengers, Paris/Charles de Gaulle remained the EU's busiest passenger airport in 2019, with 76 million passengers.

When comparing the passengers carried in each airport or group of airports to the regional population, main economic hubs, capital city regions as well as the main holiday/tourism destinations stand out with 10–25 passengers carried for every inhabitant. Air connectivity still remains poor in the capitals of Baltic and eastern Europe and remote rural areas across Europe.

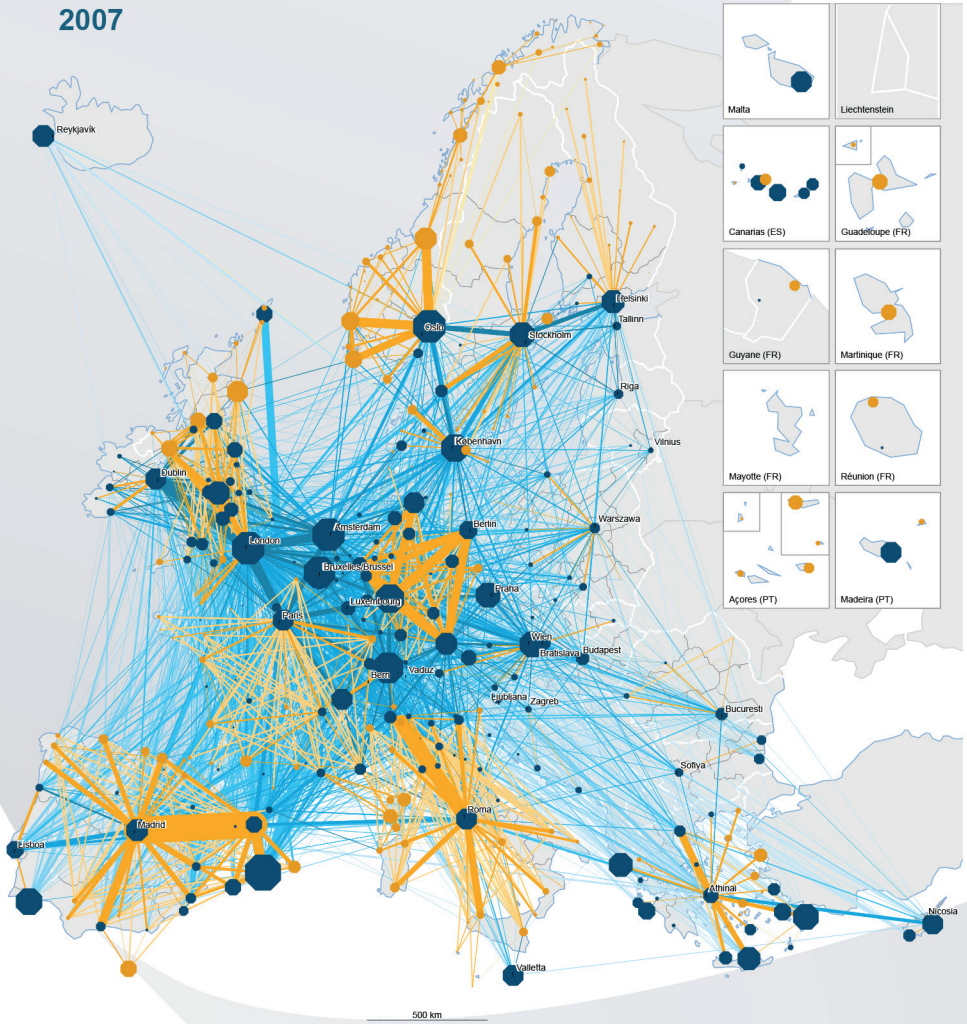
Air passenger flows between European countries and world regions destinations in million 2019



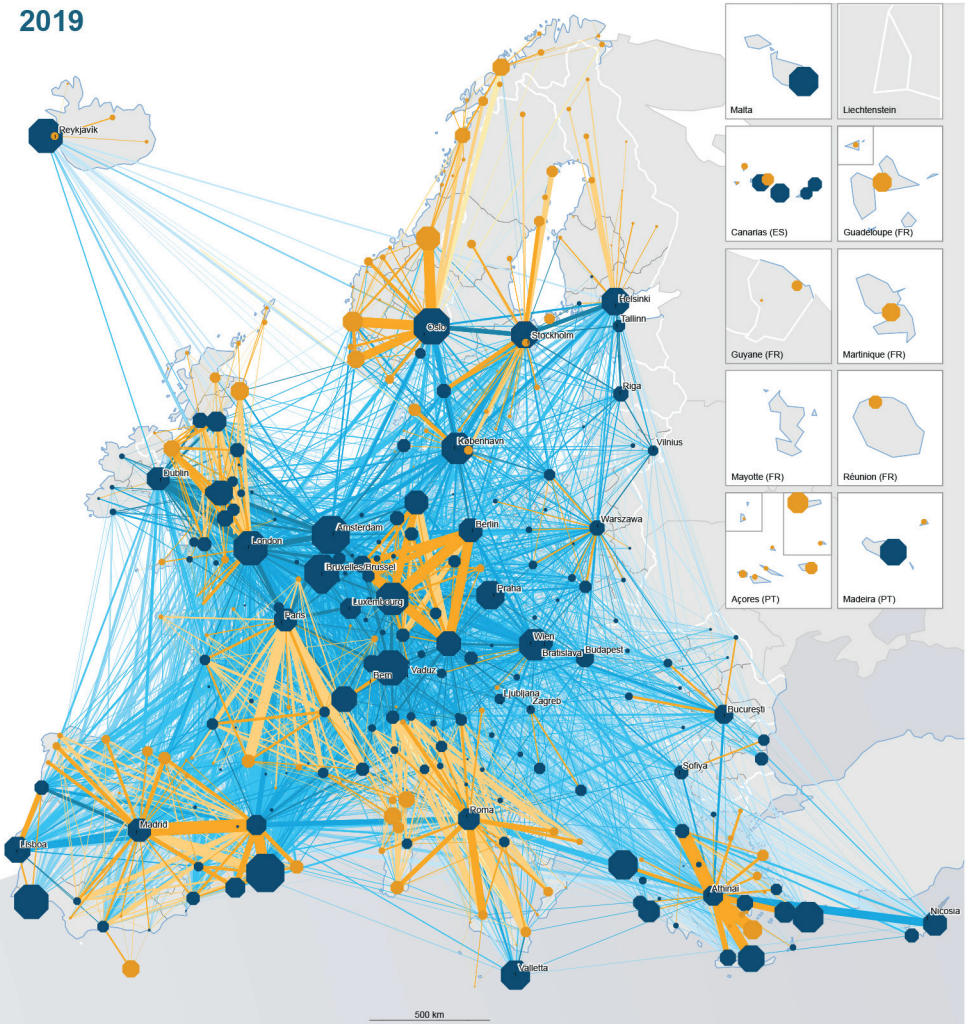
Data origin: Eurostat

Air passenger transport

2007



2019



Regions: NUTS 2 / NUTS 1 (2016)
Data origin: Eurostat, 2020;
EuroGeographics for the administrative boundaries

Number of passengers in an airport or group of airports per inhabitant in the NUTS 2 region

- international airport
- domestic airport

25
5

Flight time in hours

- international routes
- domestic routes

to under 1.0
1.0 to under 1.5
1.5 to under 2.0
2.0 to under 2.5
2.5 and more

Number of passengers per route in thousands

5000
1000
10

Transnational cooperation

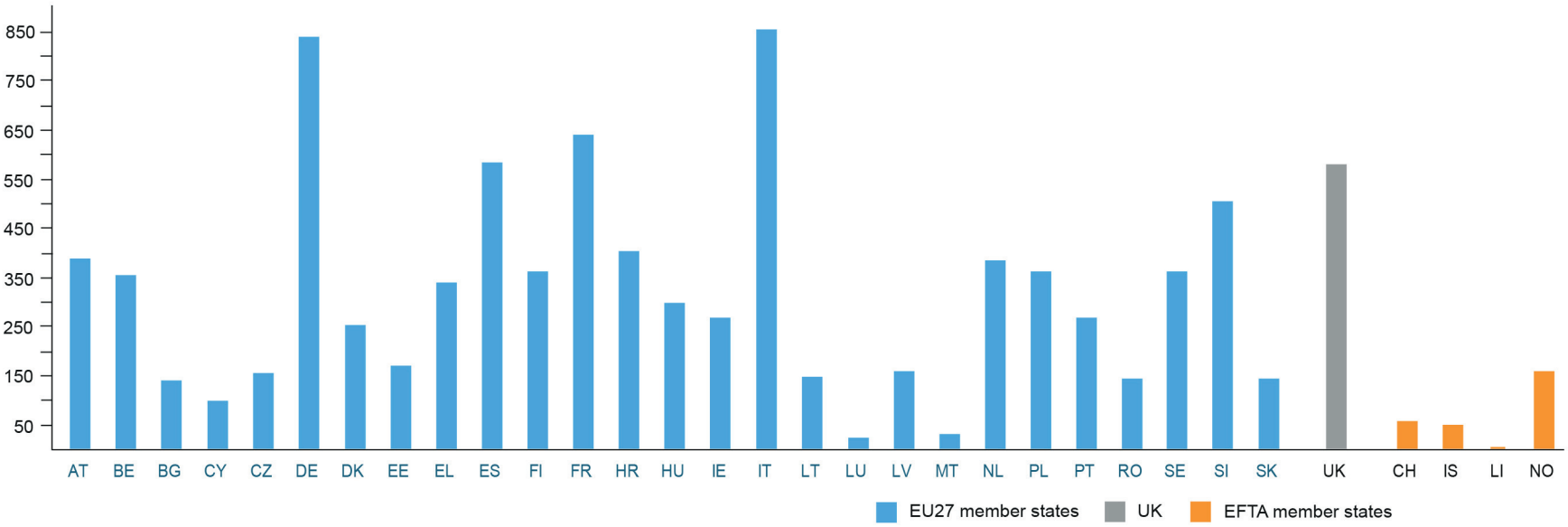
European territorial cooperation, also known as Interreg, is an important instrument of European cohesion policy. With its three main thrusts – cross-border, transnational and interregional – Interreg helps to promote integrated regional development across borders.

In the area of transnational cooperation (Interreg B), funding is provided for projects concerned with climate change, the economy and spatial development among different countries within larger geographical areas. Institutions outside the EU may also participate as partners. During the funding period 2014–2020, more than 1,000 projects in the following locations received funding: Adriatic Sea and Ionian Sea; Alpine region; Atlantic Ocean; Balkans–Mediterranean; Danube region; Mediterranean Sea; Baltic Sea region; North Sea region; north-western Europe; the northern periphery and Arctic; south-western Europe and central Europe. There are also projects in three overseas locations: the Caribbean, Indian Ocean and Amazonia. The EU provides total support of 2.1 billion EUR for projects in all locations.

The map shows cooperation within funded projects between partners in various locations. The number of project partnerships is especially large in the Baltic Sea region, central Europe and the Danube region. Partners that work together most frequently are those in Budapest and Vienna and those in Riga and Tallinn.

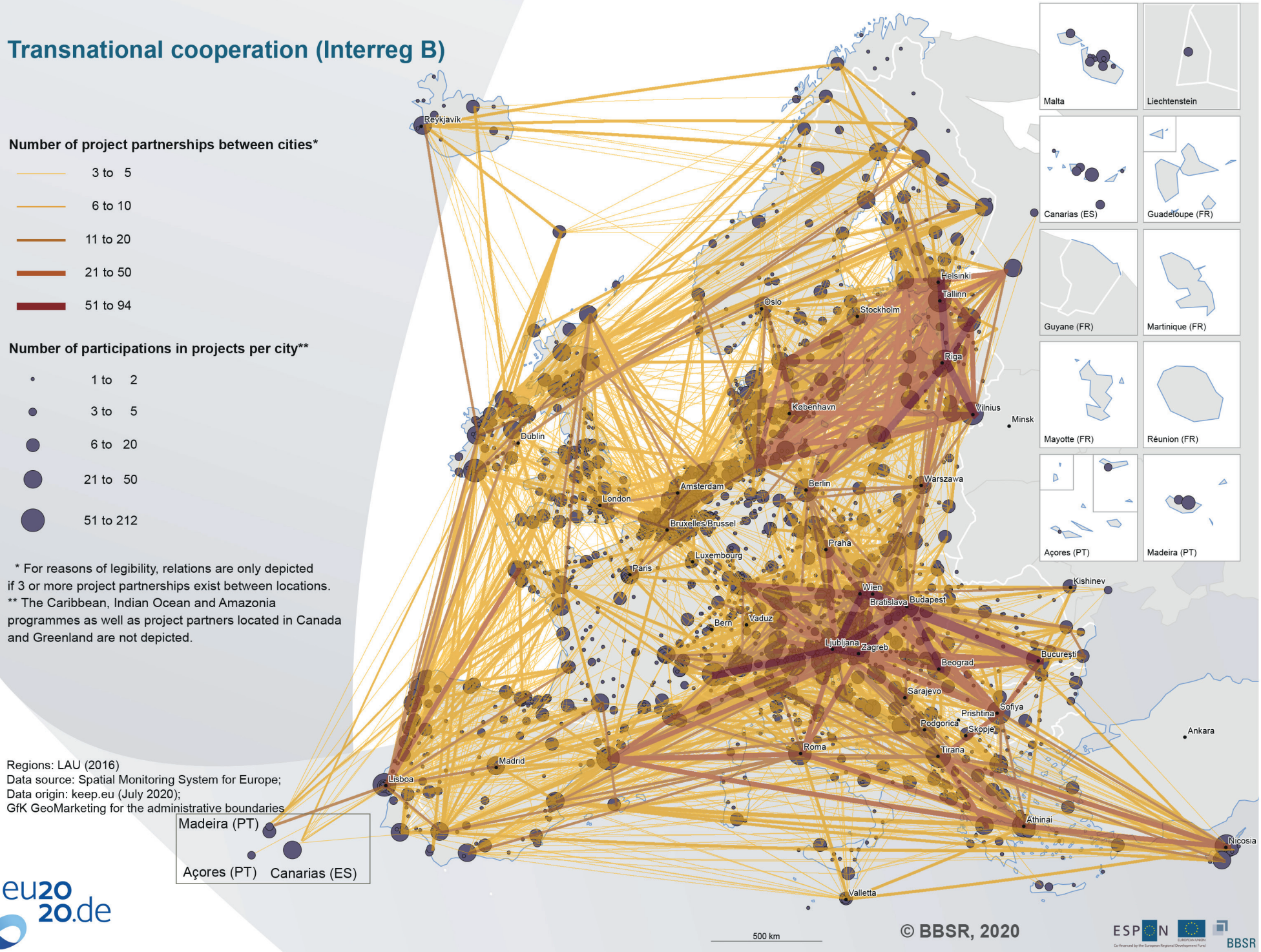
Local, regional and national agencies, universities, non-governmental organisations and private enterprises may become project partners. Some 6,000 different partners are participating in Interreg B projects; about 75% of them are public-sector institutions. The highest level of project participation is found in Italy, with participation in more than 800 different projects, followed by Germany and France. At local level, Ljubljana has by far the most projects: more than 200. It is followed by Vienna, Budapest and Zagreb, each of which participates in more than 100 projects. The large number of partners from relatively small countries such as Slovenia and Finland is noteworthy.

Interreg B project participations per country



Data source: Spatial Monitoring System for Europe; data origin: keep.eu (July 2020)

Transnational cooperation (Interreg B)



Cross-border cooperation

Of the three strands of European territorial cooperation – transnational, interregional and cross-border cooperation – the last (Interreg A) is the largest. Interreg A funds projects involving cooperation between regions of at least two different EU or EFTA member states which share a border.

In the funding period 2014–2020, the EU has provided total funding of €6.6 billion for more than 4,000 projects in 60 programmes to date, including five in EU overseas locations. There is an average of 78 projects in each of the 60 programme areas. Thanks to its location in the centre of Europe and the large number of its neighbouring countries, Germany is participating in more cooperation programmes than any other member state.

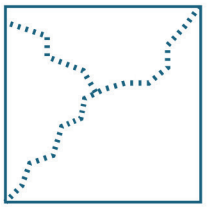
All cooperation projects are based on the 11 priorities shown on the map, which were defined by the EU. In northern and western Europe, projects largely focus on topics such as competitiveness, research and innovation, and information and communications technology; by contrast, projects in the eastern EU member states are more concerned with topics such as social inclusion and efficient public administration. Everywhere in the EU, some projects are devoted to environmental protection issues and efficient resource use, and some projects address topics where the individual priorities overlap.

Cross-border cooperation projects help to manage specific local challenges and improve the quality of life for the more than one-third of Union citizens who live in border regions.

35.5% of the EU population lives in border regions.

2m
cross-border commuters

38
EU internal borders



60
cooperation programmes

10m
EU citizens of working age live in another EU/EFTA country.

6,6bn
EU funds for cross-border cooperation

Data source: Spatial Monitoring System for Europe; data origin: Eurostat, European Commission

Cross-border cooperation (Interreg A)

Number of projects*

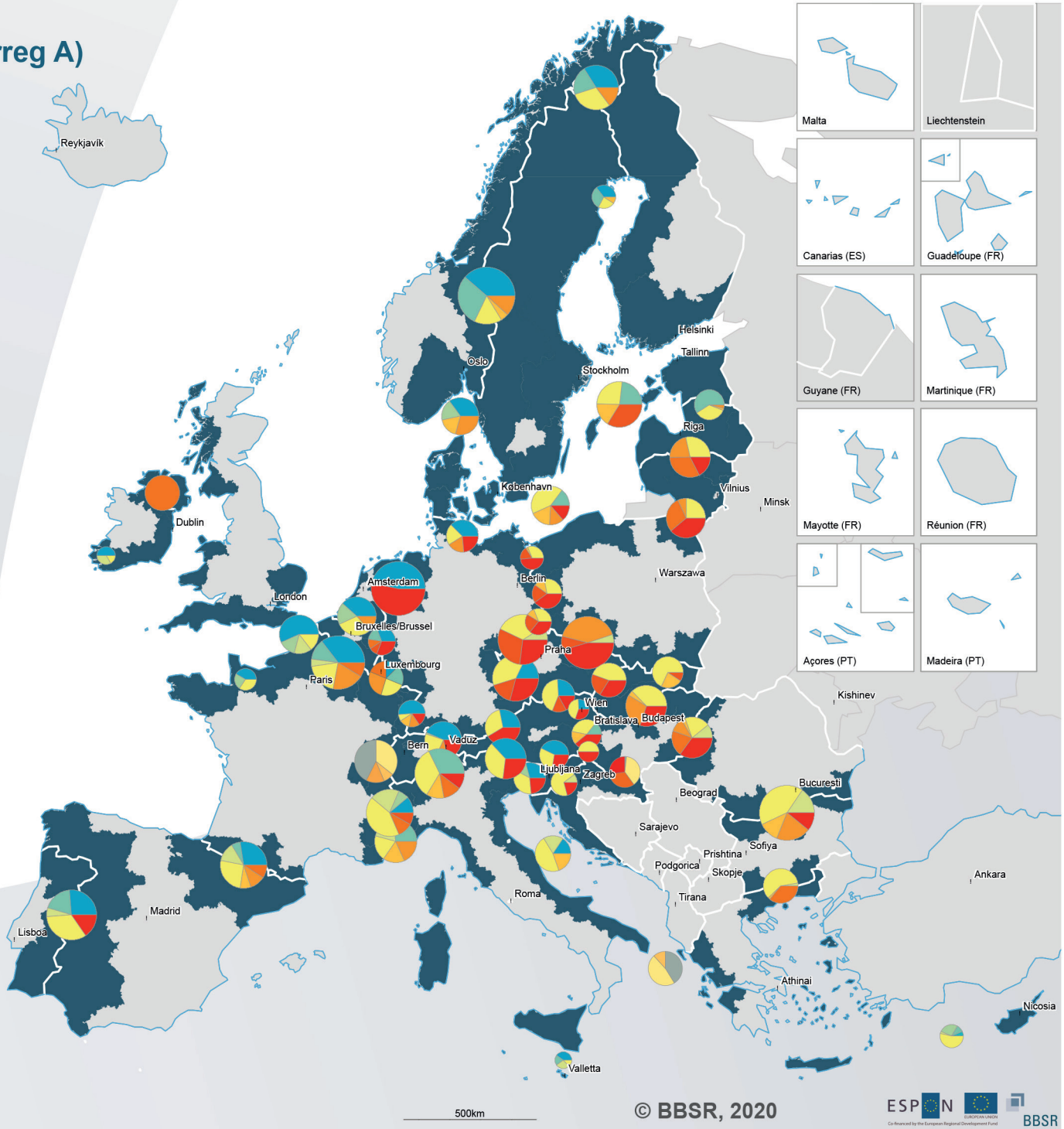
Thematic objectives of the projects

- research and innovation
- information and communication technologies
- competitiveness of SMEs
- low-carbon economy
- climate change adaptation
- environmental protection and resource efficiency
- sustainable transport
- employment and mobility
- social inclusion
- improved educational and vocational training
- efficient public administration

cooperation areas

* Cooperation areas situated in the overseas areas, such as the Madeira-Açores-Canarias programme, are not presented.

Regional level: NUTS 3 (2016)
Data origin: keep.eu (September 2020); Interreg Greater Region, Interreg France-Switzerland, Interreg Hungary-Croatia
EuroGeographics for the administrative boundaries



Remittances to home countries

Remittances are typically funds sent by migrants or foreign workers to support their families in their home countries; however, they also include salary transfers for people who work in one country and live in another country.

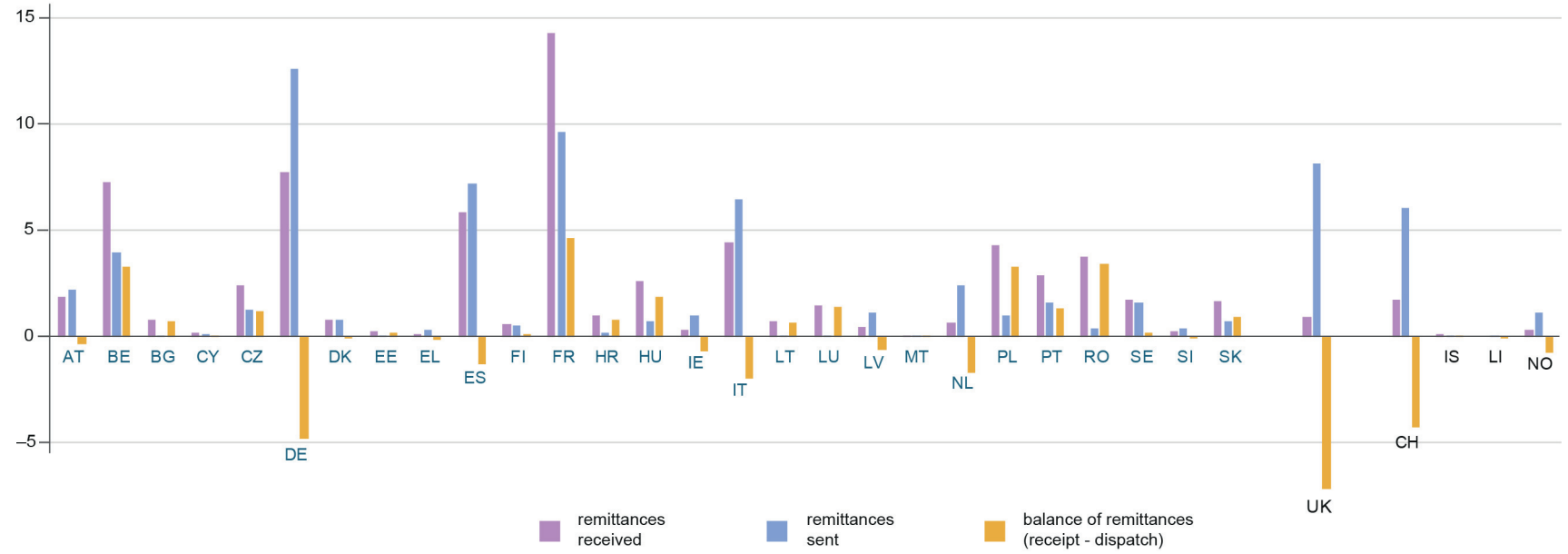
According to the World Bank, remittances within Europe amounted to some €68 billion in 2017. The most significant sender–recipient country pairs for remittances in Europe, with total transfers of more than €1.8 billion in 2017, were Spain and France, France and Belgium, France and Germany, and Germany and Poland.

A large positive balance (i.e. more remittances received than sent) is especially significant for those countries, such as Hungary, Poland and Romania, which benefit from the remittances sent by their citizens who have emigrated to work in other countries. This significance is clear from the share of remittances in gross domestic product (GDP): in Romania, remittances amounting to some €3.8 billion make up 2% of GDP.

However, some countries, like France and Belgium, are net recipients, receiving on balance even more remittances than they send; there is apparently a very large number of people who live in these countries and work abroad.

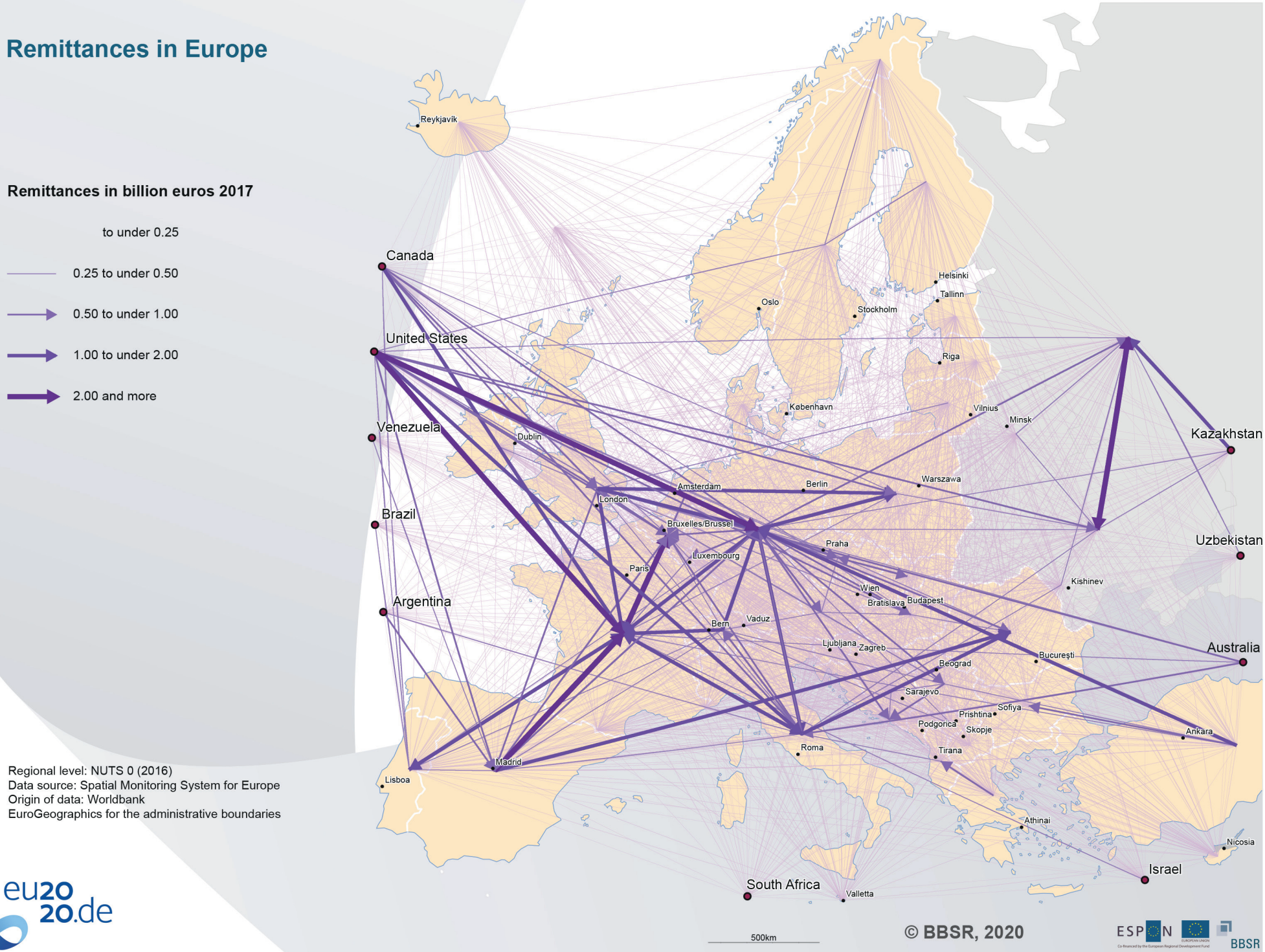
Several countries from which more remittances are sent than received can also be viewed as countries of destination for potential labour migration.

Remittances within Europe in billion euros 2017



Data source: Spatial Monitoring System for Europe; data origin: Worldbank

Remittances in Europe



Regional level: NUTS 0 (2016)
Data source: Spatial Monitoring System for Europe
Origin of data: Worldbank
EuroGeographics for the administrative boundaries

Foreign direct investment

As barriers to cross-border trade and investments have been dismantled during the past two decades, worldwide competition for attracting multinational firms has intensified. Investors have historically been attracted to the EU. Before the economic and financial crisis 2008/2009, the EU was the destination for almost half of the global FDI flows, in 2015 it was only around 25%. An important driver for the shift in global FDI flows is the opening up of new emerging markets with high economic growth, light regulation and more active use of state aid than the EU.

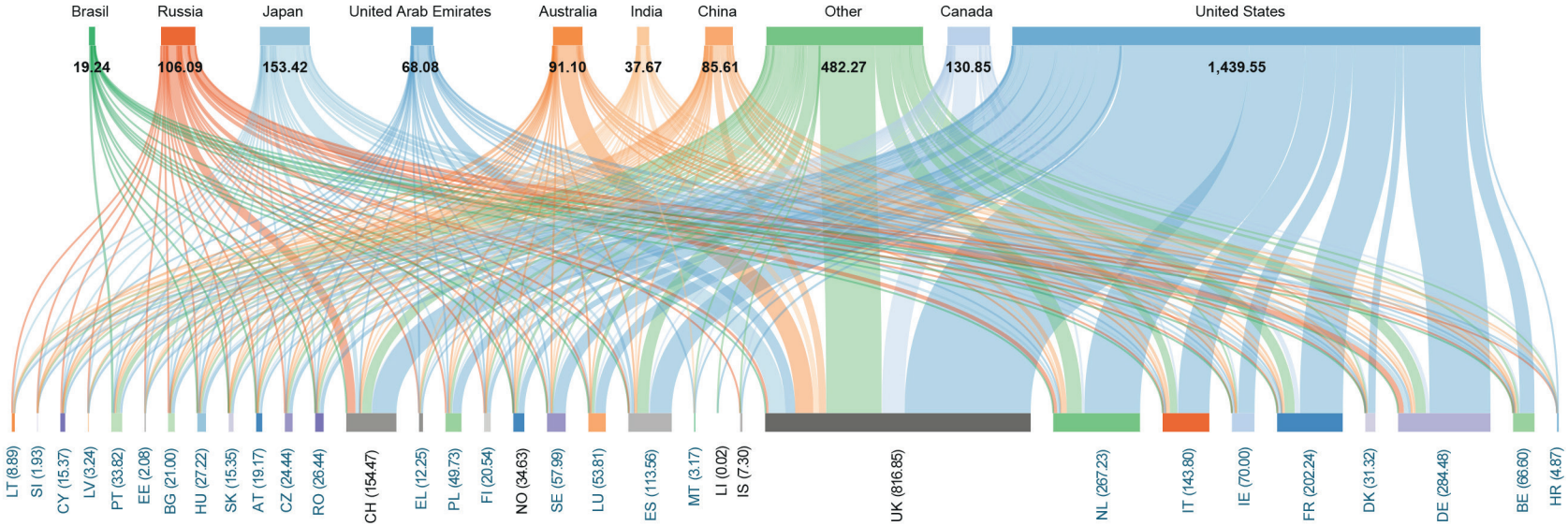
During 2003-2015, investors from outside the EU28 and EFTA carried out more than 52,000 FDI projects in Europe amounting to a total value of more than EUR 2,550 billion. 70% of these investments were mergers and acquisitions (M&As) and the rest greenfield investments. M&As take place when a foreign firm acquires more than 10 per cent of the voting stock in an existing domestic firm.

M&As are most prevalent in urban regions, in particular capitals and metropolitan areas. Around 69% of all non-European owned firms in Europe are situated in urban regions, while 25% are in intermediate regions, and only 6% in rural regions. Rural and intermediate regions on the other hand tend to attract more greenfield investments due mainly to lower costs and better physical accessibility. As greenfield investments are likely to generate new jobs and revenue and make up for a significant proportion of the GDP.

Although extra-European FDI inflows to European countries can be traced to 115 countries, about 55% originate from the US with a total value of 1.46 trillion EUR, followed by Japan (153 billion), Canada (131 billion) and Russia (106 billion). The UK has been most successful in attracting extra-European FDI inflows, amounting to 30% of the total inflow (817 billion EUR) which is more than Germany, the Netherlands and France combined. Eastern and south-eastern countries, especially Baltic states have been the least successful in attracting extra-European investments.

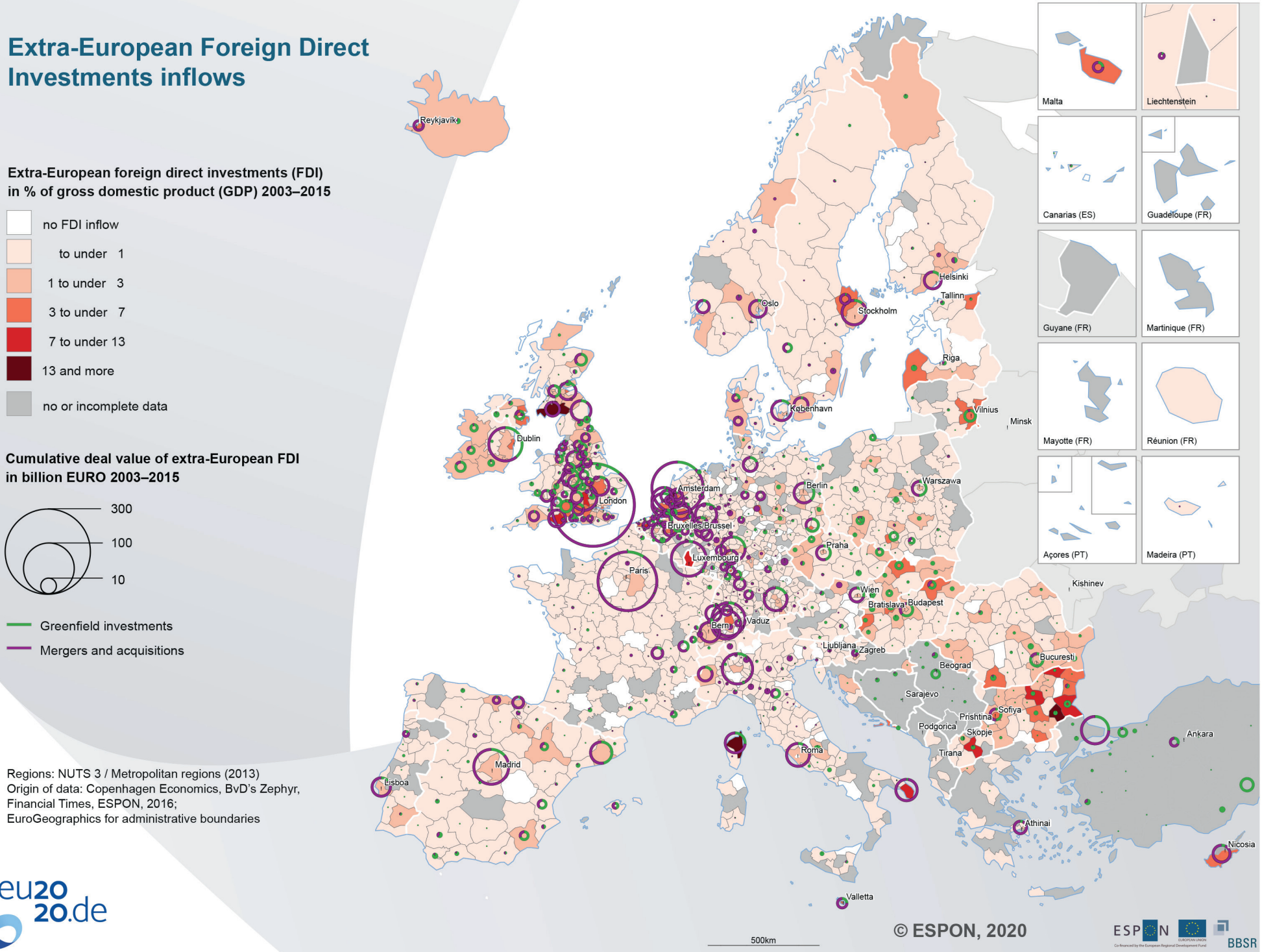
FDI is a significant contributor to European economies. While non-European owned firms on average represent some 1% of the total number of firms, they account for 5% of employment, 11% of production and 9% of value added. There are large territorial differences in the share of foreign-owned enterprises per country. This ranges from 11% in Luxembourg to 0.1% in Belgium, Greece, Spain, Italy, Poland, and Slovakia. The share of employment in foreign-owned firms is highest in Luxembourg, followed by the UK, Hungary, the Czech Republic and the Netherlands. The value added is highest in Hungary, the UK, Luxembourg, the Netherlands and the Czech Republic.

Extra-European foreign direct investments (FDI) of main countries of origin in billion Euro 2003–2015



Origin of data: Copenhagen Economics, BvD's Zephyr, Financial Times

Extra-European Foreign Direct Investments inflows



Temperature in climate change

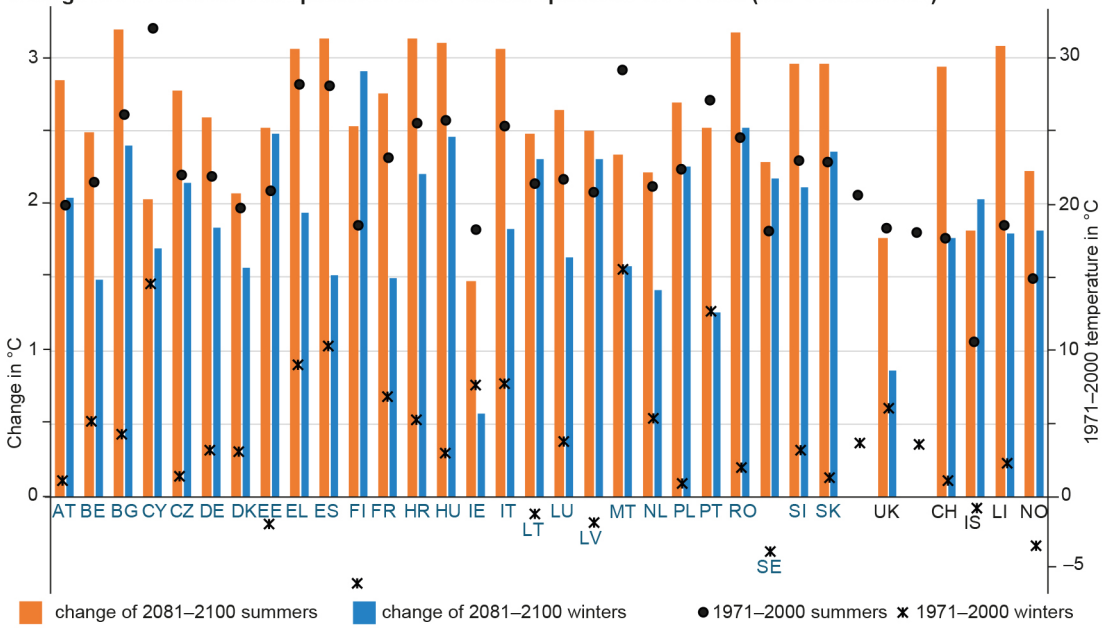
Climate research uses different scenarios and models to show a broad range of possible development trajectories to 2100 and to estimate the impact of human activity on climate change. The current climate projections, called the Shared Socioeconomic Pathways (SSP), for the Sixth Assessment Report of the Intergovernmental Panel on Climate Change focus on societal, demographic and economic changes on a global scale and also take policy decisions into account.

The goal of limiting the rise in global temperature to +2 °C over the pre-industrial level can be achieved only in the SSP1 scenario, and only if existing emissions are reduced and no new emissions are added. In the SSP1 scenario, "Sustainability: Taking the Green Road", the world follows a sustainable and green pathway focused on regional value-added chains, equivalent living conditions worldwide, greater awareness of the environment and reduced energy consumption.

By contrast, the SSP5 scenario, "Fossil-fuelled Development", leads to a higher global temperature than SSP1. The SSP5 scenario describes a world which places increasing faith in competitive markets, innovation and participatory societies to produce rapid technological progress as the path to a more sustainable future. The use of fossil fuels leads to an extreme rise in maximum temperatures in summer, ranging from about +3 °C in Iceland to more than +10 °C in the region around Madrid. According to this scenario, summer temperatures will rise dramatically in southern and central Europe in particular, while winters will be warmer, above all in parts of Scandinavia, Finland and the Balkans. Minimum temperatures will also rise significantly in both summer and winter in large areas of Europe, although not in Norway, Sweden or Finland. With a simultaneous increase in temperature maxima, this results in large swings in temperature during the winter months in this three countries.

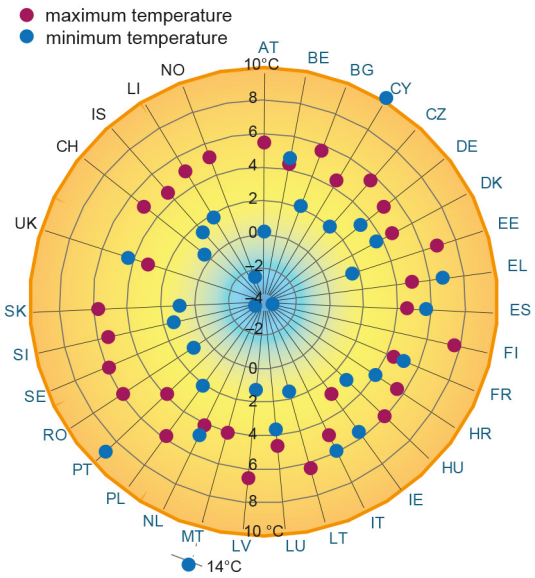
The sustainable and green pathway of the SSP1 scenario leads to a rise in maximum temperatures in both winter and summer, although this rise is not as dramatic as in the SSP5 scenario. An increase of even a few degrees in winter can have negative consequences for ecosystems that depend on snow and ice.

Change of the maximum temperature 2081–2100 compared to 1971–2000 (SSP126 scenario)



Data source: Anna Hellings 2020; data origin: Worldclim

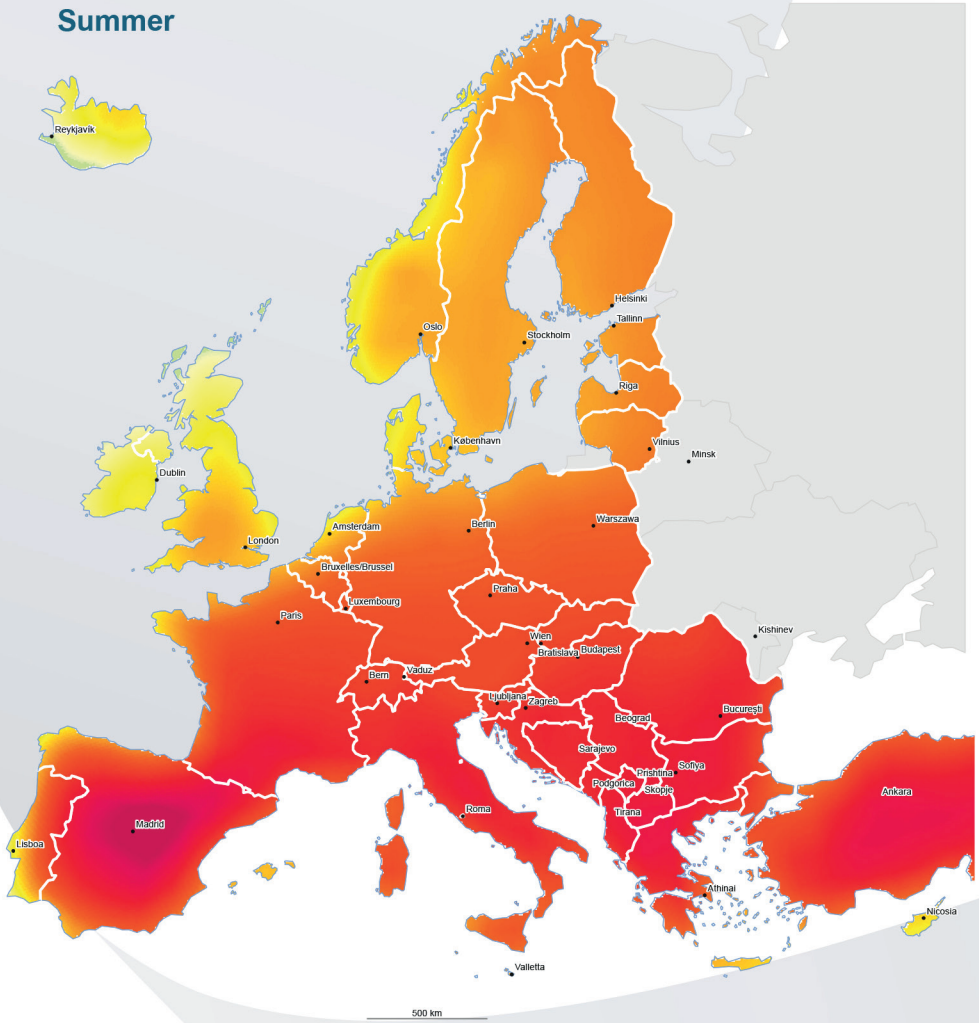
Changes of the average maximum and minimum temperatures in 2081-2100 winters compared to 1971–2000 (SSP585 scenario)



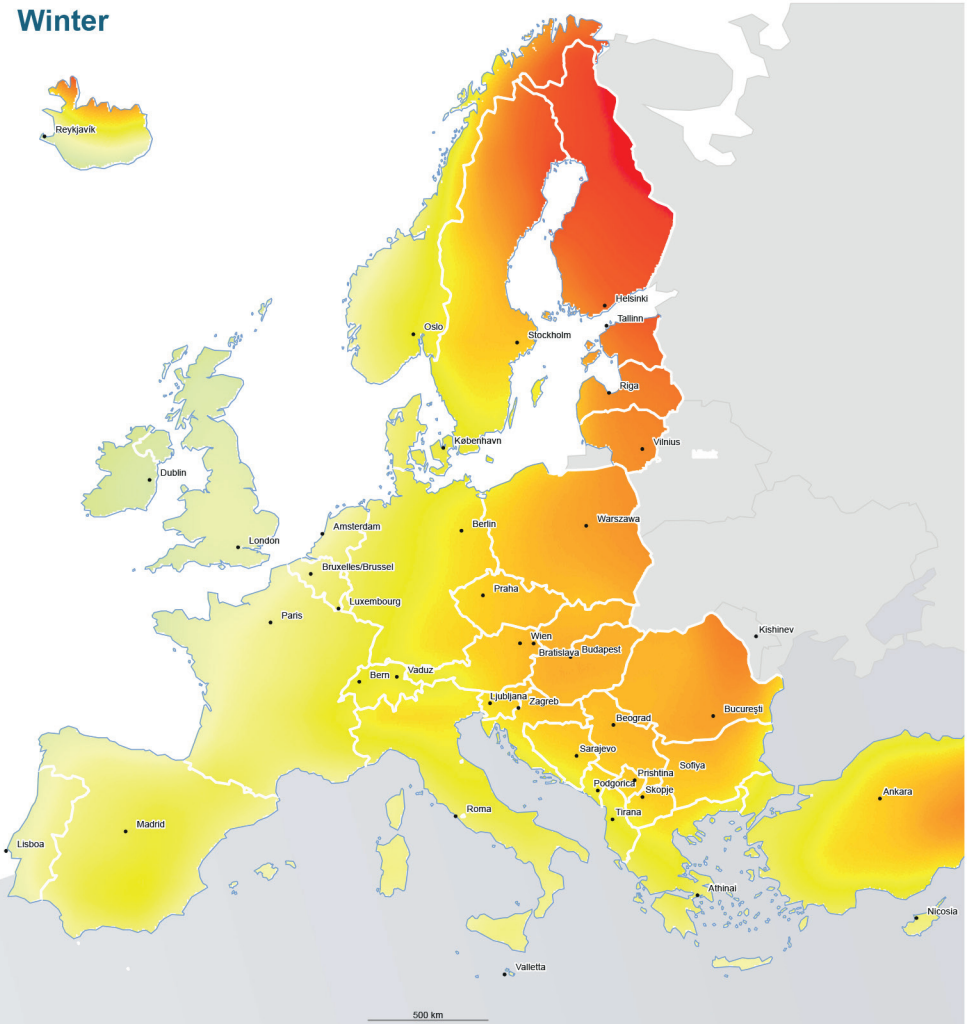
Data source: Anna Hellings, 2020;
Data origin: Worldclim

Change of temperature 2081–2100

Summer

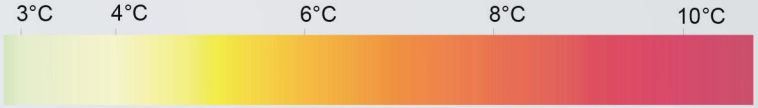


Winter



Regional level: 2.5 minutes (approx. 5km)
Data source: Anna Hellings 2020
Data origin: Worldclim
EuroGeographics for the administrative boundaries

Change of the maximum temperature (SSP585 scenario) compared to 1971–2000 in °C



The detailed composition of the climate models can be found in the annex

Precipitation in climate change

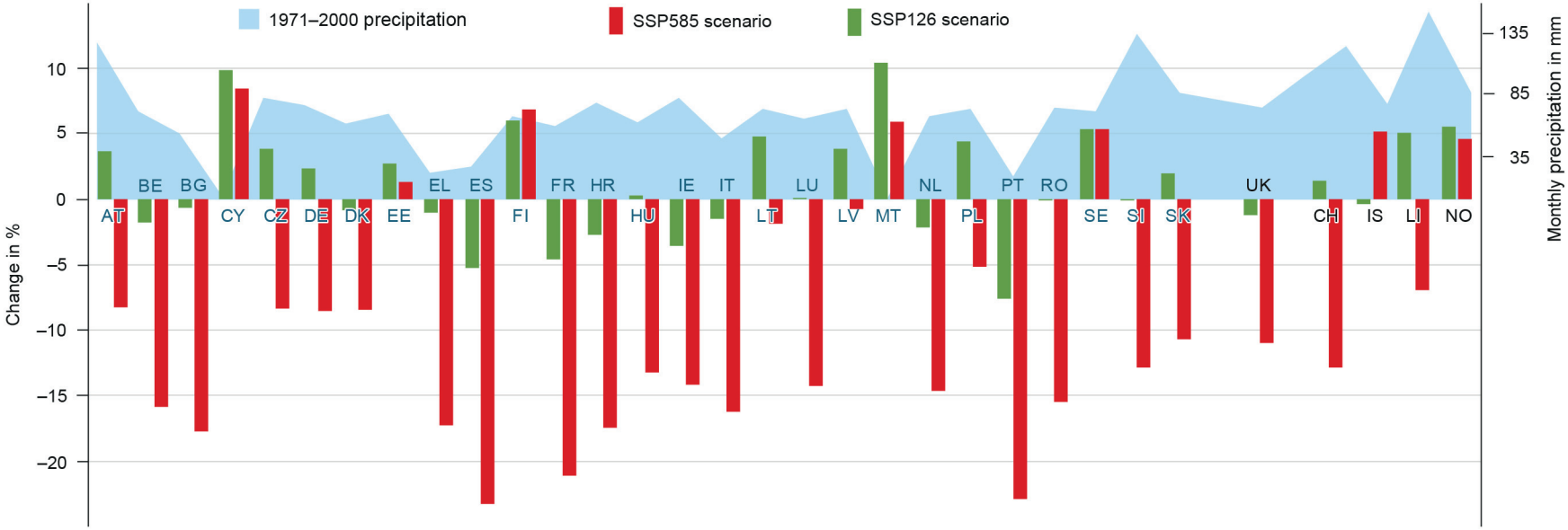
Climate change affects not only temperatures, but also precipitation. According to the SSP585 scenario, precipitation in winter will increase in much of Europe, resulting in about 8% more rainfall in the 27 countries of the European Union. By contrast, precipitation in summer will decrease by as much as 23% in Spain and Portugal and 21% in France. Total precipitation will decrease by about 10%, although in some countries it will increase in comparison to the period 1971–2000. The Scandinavian countries and Estonia, Finland and Iceland are forecast to receive more precipitation, as are regions which are currently arid, such as Cyprus (+ 8%) and Malta (+ 6%), which in the past have had almost no precipitation during the summer months. According to the SSP126 sustainable and green scenario, precipitation will also increase in central Europe, Latvia and Lithuania.

Potential changes in the climate of northern Europe may lead to higher crop yields; on the other hand, however, receding glaciers, the loss of year-round snow cover, the increase in precipitation and more frequent intense rainfall events may increase the risk of flooding.

Faster growth of forests caused by climate change may result in greater insect damage in northern Europe; in many other parts of Europe, the lack of precipitation and higher temperatures may increase the risk of forest fires and reduce the commercial value of forests especially where they are not managed sustainably and large quantities of wood are harvested. In some Balkan countries, the harvesting of wood increased by more than 50% in recent years, compared to the European average of about 20%.

The lack of precipitation in summer, higher temperatures and more frequent heat waves could lead to worse droughts and possibly to a loss of biodiversity. The decrease in winter precipitation in southern Europe is especially problematic; the rainy winters in this area are vital for agriculture and the natural environment. Lower crop yields and more energy needed to cool overheated buildings are only two negative impacts of climate change, which will affect almost every sector of the economy, above all in southern Europe.

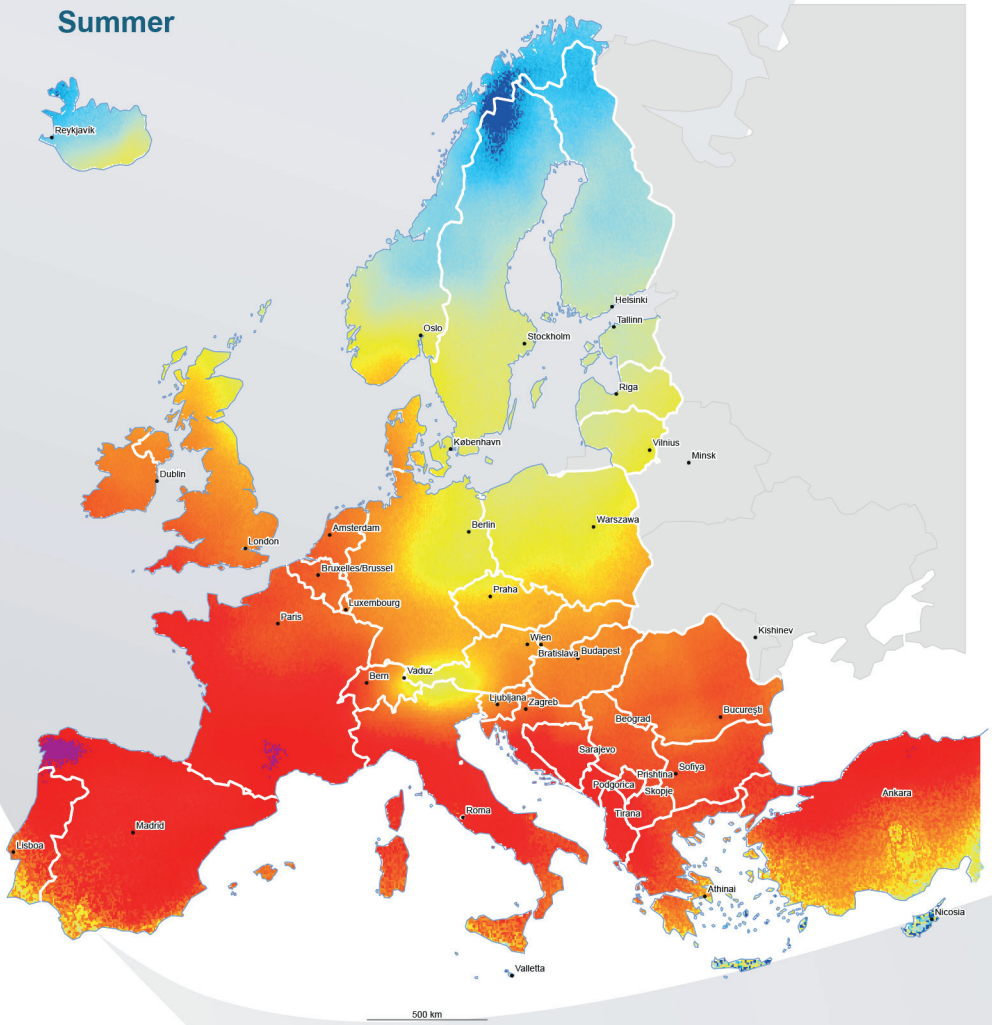
Change of the average precipitation in the 2081–2100 summers compared to 1971–2000



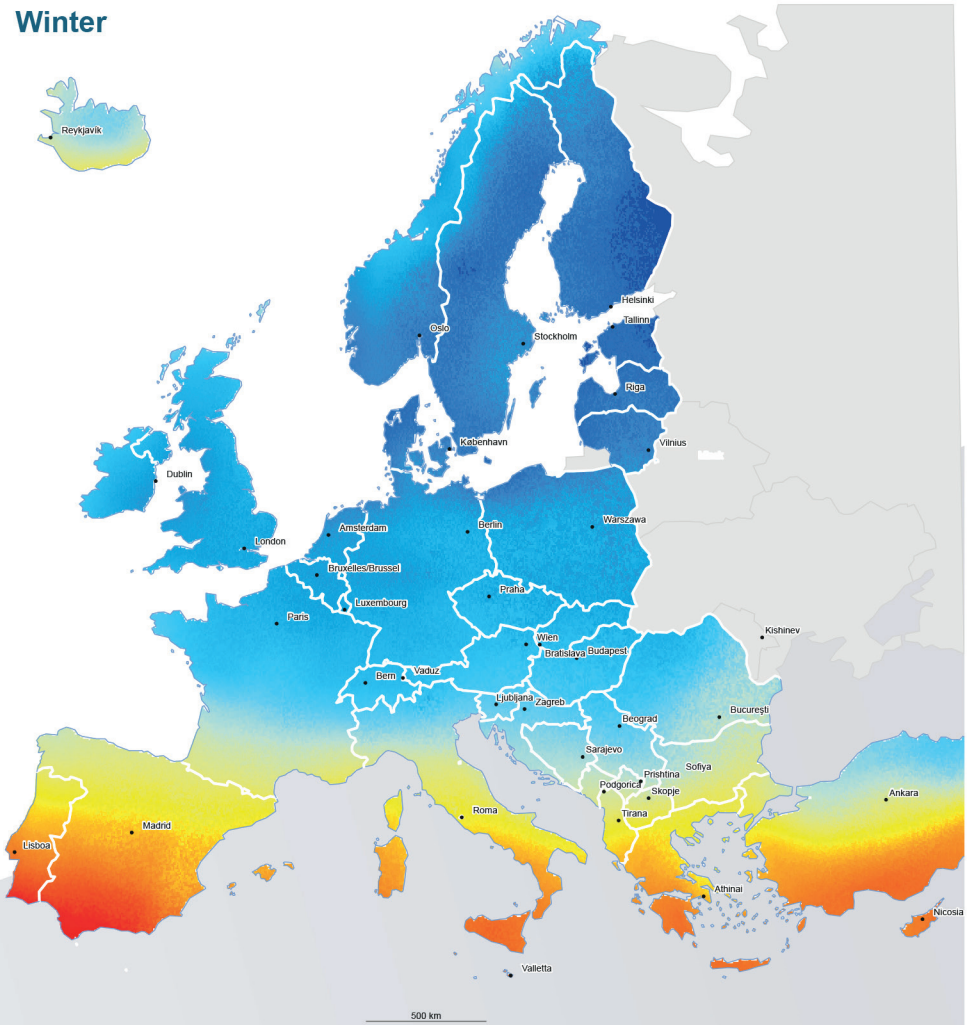
Data source: Anna Hellings, 2020; data origin: Worldclim

Change of precipitation in per cent 2081–2100

Summer

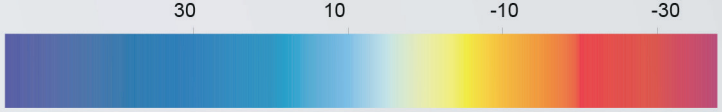


Winter



Regional level: 2.5 minutes (approx. 5km)
Data source: Anna Hellings, 2020
Data origin: Worldclim
EuroGeographics for the administrative boundaries

Change of precipitation (SSP585 scenario) compared to 1971–2000 in %



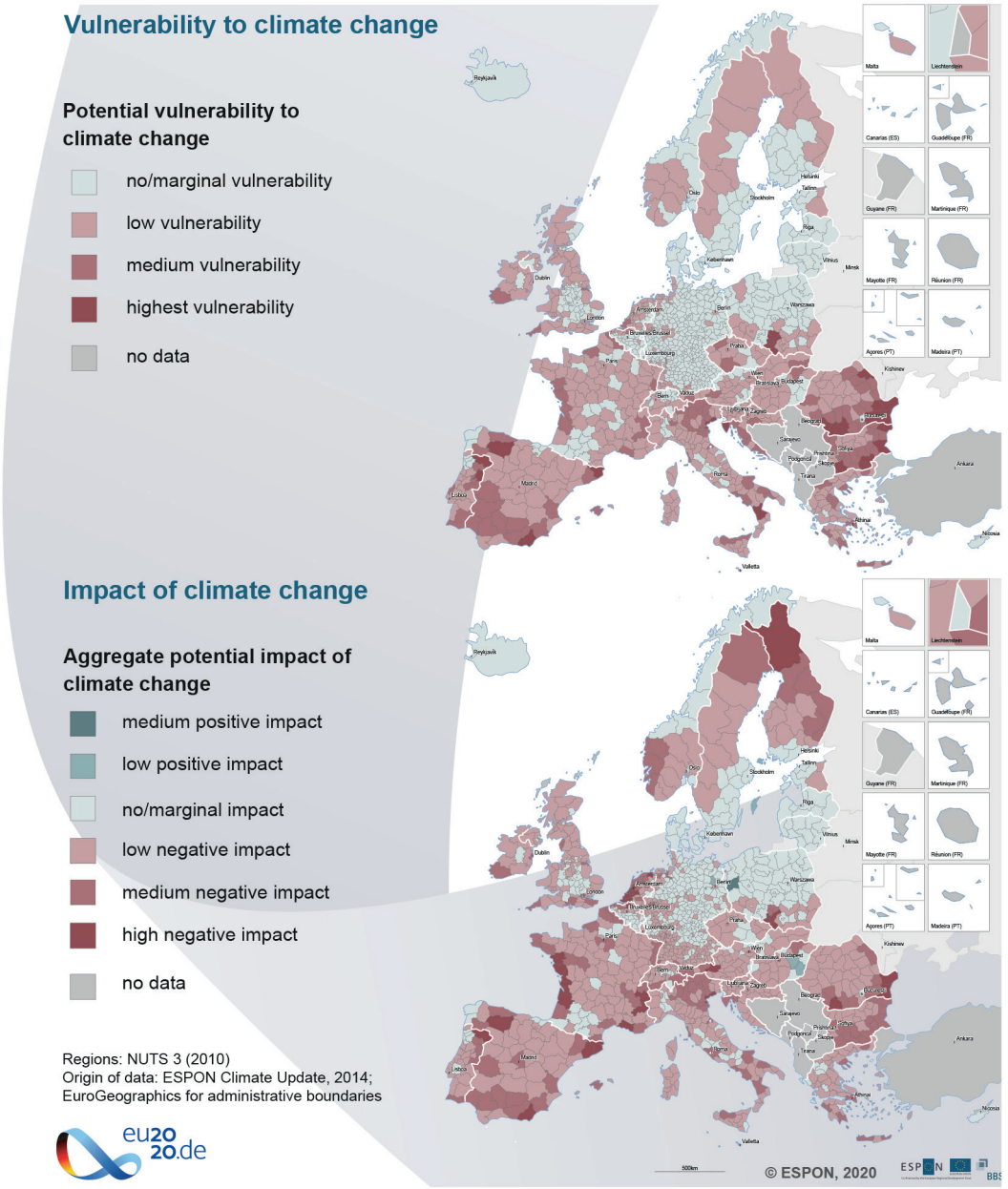
The detailed composition of the climate models can be found in the annex

Climate impacts and climate adaptation

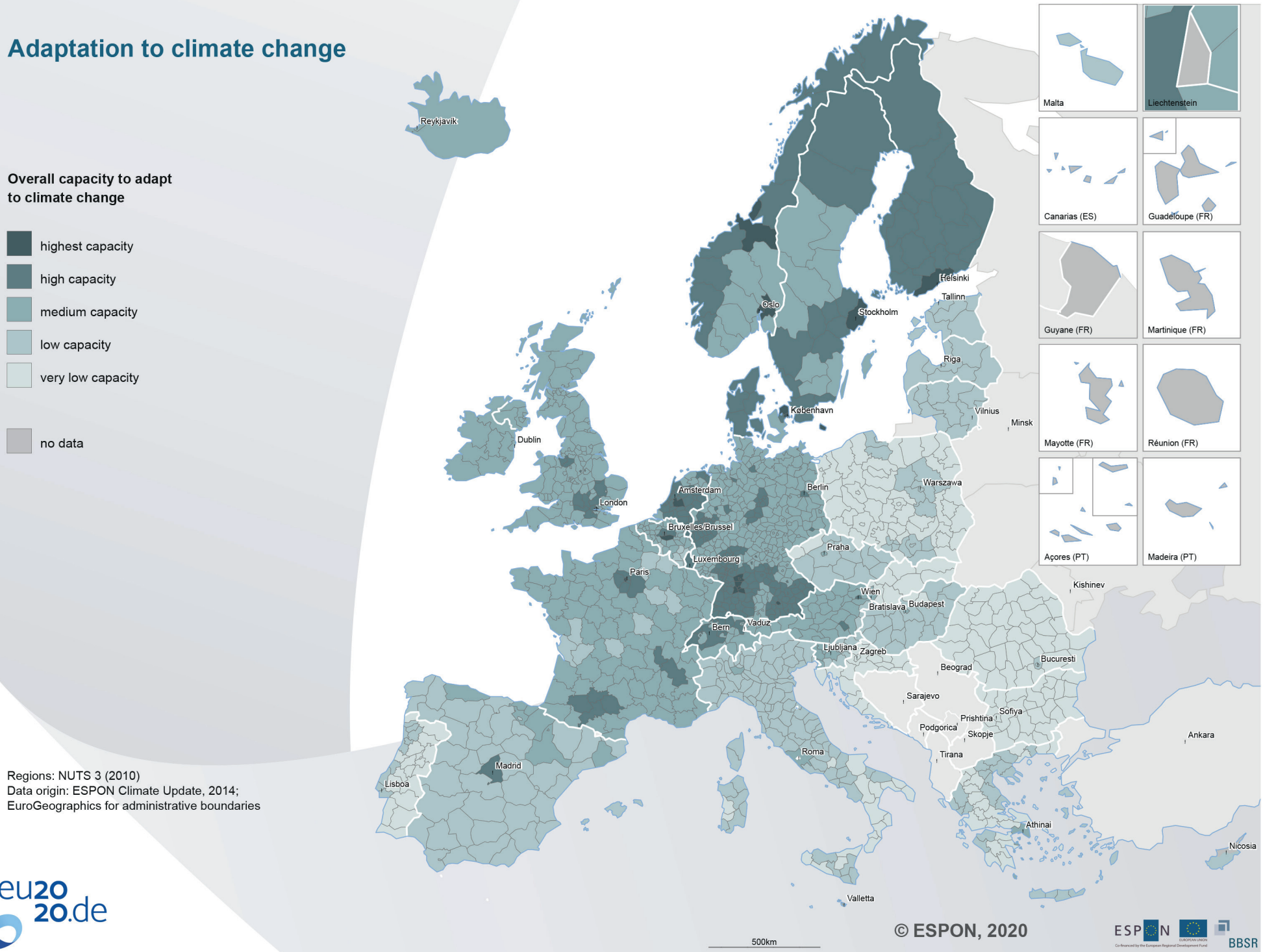
Regions in Europe have a different vulnerability to climate change, depending on the impact as well as on the adaptive capacity. Potential climate change impacts are determined on the degree of exposure to climate change – region's geographic position – and on the distinct set of physical, environmental, social, cultural and economic characteristics which result in different sensitivities. For example, forest sensitive to fire relate to summer days and summer precipitation, heritage sites to areas at flood risk, elderly population living in urban heat islands to number of heatwave days. Adaptive capacity of the regions describes the potential for regions to enhance positive or counteract negative impacts, e.g. by increasing dykes, green areas in cities or diversifying the economy.

The same stimulus may affect the system territorially differently: the same change in summer temperature may affect the tourist sector positively or negatively, the agricultural sector may benefit from an in increase in precipitation or not. In general, northern, northwestern, southern and southeastern European regions are projected to have on average higher negative impacts resulting from climate change than central European regions. For example, settlements and infrastructure are especially sensitive to changes in extreme events in northwestern Europe. Furthermore, highly urbanised regions have high impacts mostly due to their high damage potential. Finally, many coastal regions are also expected to have medium to high impacts, which results from their relatively high urbanisation rates and their exposure to sea level rise induced coastal flooding and storm surges. Positive impacts are mainly associated with increased crop yields and tourism potential in the Baltic Sea Region.

While metropolitan areas, northern and western European regions are highly impacted by climate change, they also show a good potential to manage these impacts and adjust themselves to the new situation in comparison to many southern and southeastern European regions. Metropolitan and economically advanced regions of each country typically have higher adaptive capacity than their rural counterparts, and are thus less vulnerable. These patterns are a reflection of differences in economic, infrastructural, technological, institutional as well as knowledge and awareness related characteristics.



Adaptation to climate change



Regions: NUTS 3 (2010)
Data origin: ESPON Climate Update, 2014;
EuroGeographics for administrative boundaries

Land consumption for urban use

The growth of the population living in cities and their commuting zones in particular is necessarily reflected in the use of open space for settlement purposes. From 2000 to 2018, some 1.27 million hectares of land were developed as settlement areas in the 27 member states of the European Union. This roughly corresponds to the area of the region of Granada, Spain or the province of Tyrol, Austria.

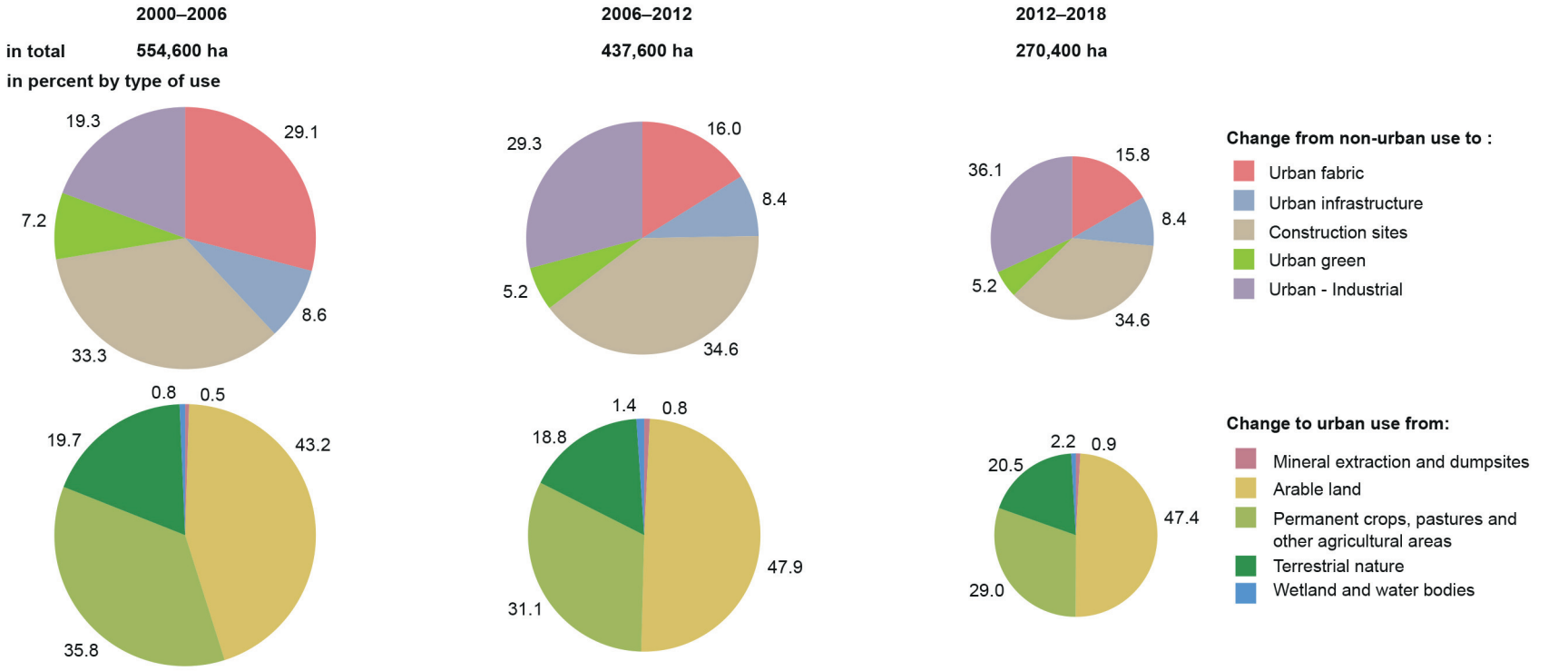
The change to use for buildings, streets and industry is declining. Whereas 554,600 hectares changed between 2000 and 2006, this figure was about 437,600 hectares for the period from 2006 to 2012 and halved to 270,400 hectares for the period 2012–2018. The economic and financial crisis of 2008/2009 may have played a role here. The comparison in time periods shows a shift in the use of settlement areas. From 2000 to 2006, 29% of land-use changes were to urban use, i.e. building construction and sealing of corresponding surfaces. In the following periods, this figure amounted to only 16%.

Land-use changes to industrial and commercial use increased to 36% from 19%. This change likely reflects positive economic growth, at least in some EU member states.

Almost half of land-use changes involve fertile arable land. Grassland and other agricultural areas account for some 30% and forests for 20%. In the period under observation from 2000 to 2018, about 25 m² of arable and agricultural land, forests and semi-natural areas per inhabitant were built on or sealed for settlement purposes in the EU.

In some countries, such as Spain, the Netherlands, Iceland and Cyprus, the land-use changes were above the EU average almost all across the board. In countries such as France and Ireland, land-use changes are also above average overall although they differ by region. In the other countries, the largest percentages are found either in direct proximity to cities and metropolitan areas or in the larger surrounding region.

Land changes to urban use by periods from 2000 to 2018 in the European Union



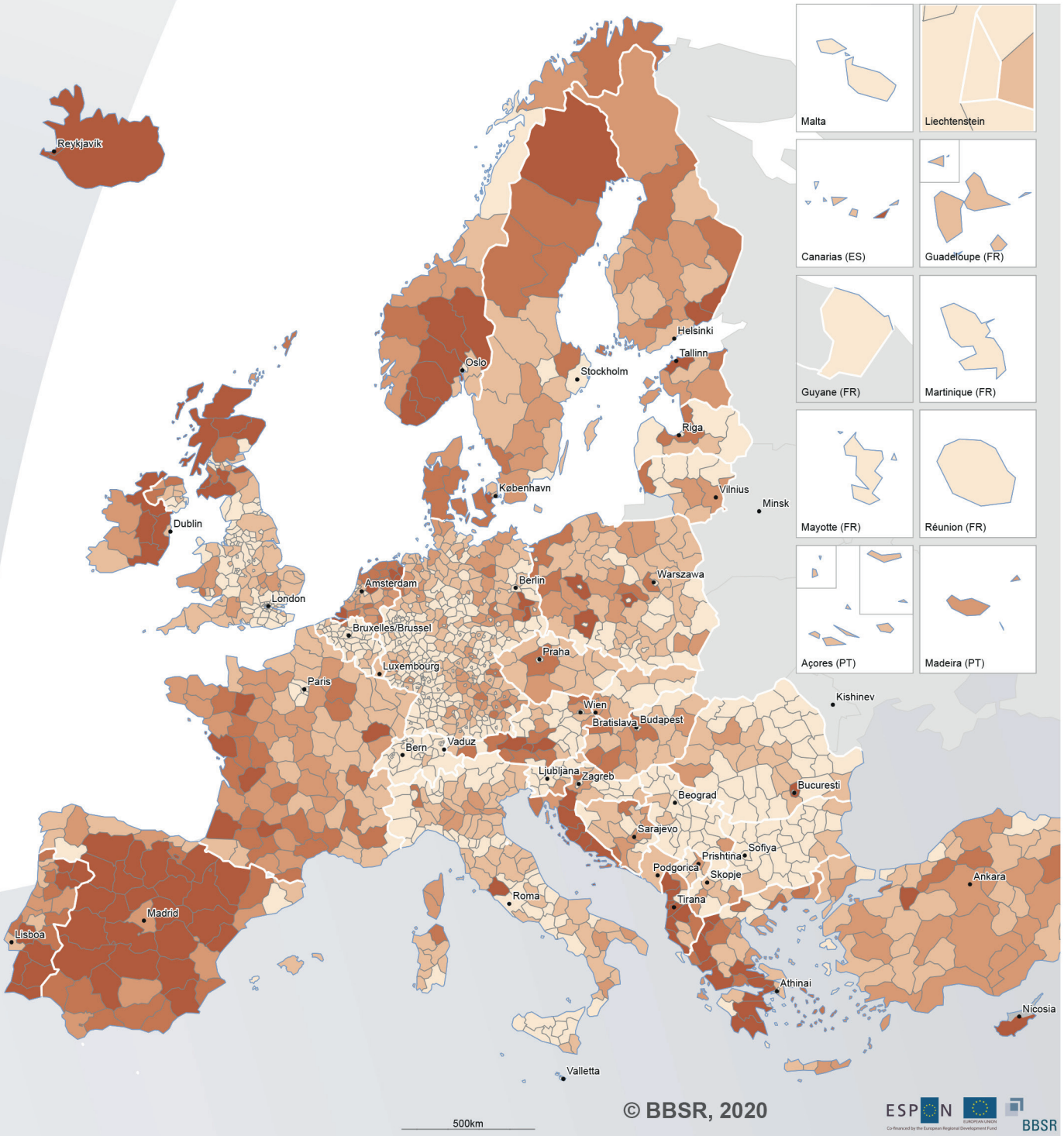
Data base: ESPON SUPER Projekt, data origin: Corine Landcover - CLC Changes 2000/2006, 2006/2012, 2012/2018; v2018_20

Land change into urban use

Change of areas into urban use*
from 2000 to 2018 in m²
per inhabitant

- to under 15
- 15 to under 30
- 30 to under 45
- 45 to under 60
- 60 and more
- no data

*Change of agricultural areas, forests, and semi-natural areas, marshland, water areas, mining areas and dumps into urban areas, industrial, commercial and transport areas and urban green areas



Regional level: NUTS 3 (2016)
Data source: ESPON SUPER project
Data origin: Corine Landcover - CLC Changes 2000/2006, 2006/2012, 2012/2018; v2018_20
EuroGeographics for the administrative boundaries

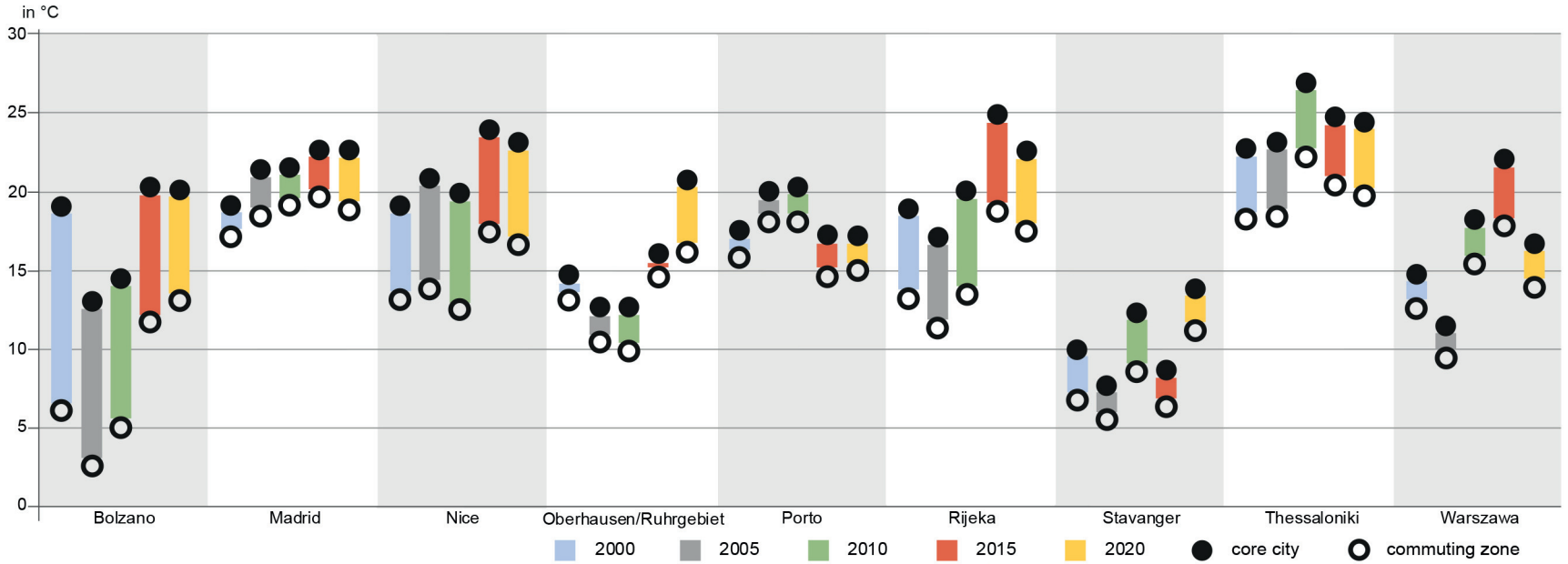
Urban heat islands

Since the 1950s, large areas of Europe have experienced intensive heatwaves of long duration which affected human health and socio-economic conditions. This was also true for the heatwave in the first two weeks of August 2020. The land surface temperature in large parts of Europe was significantly higher than the long-term average, with averages of more than 45 °C in some cities in Spain, Italy and Cyprus.

Along with climate change, increasing urbanisation reinforces the growing impact of hot weather. As a result of more densely built-up urban areas and a higher degree of impervious surfaces, one finds changed wind flows and higher surface and air temperatures in cities than in the surrounding area. The larger the city and the more compact its settlement pattern, the higher the temperatures in comparison to the surrounding area, producing what is called an urban heat island. Heat is perceived subjectively; the perception of excessive heat is reinforced by minimal cooling at night and persistent weather conditions. Dense construction hinders overnight cooling particularly in summer. High night-time temperatures ("tropical nights" of more than 20 °C) and heatwaves of long duration are not only a physical strain; they can also become an acute health risk. However, the assessment of the local situation depends on a city's geographical situation and its urban structure.

In the case of Bolzano, for example, which is located in a valley, there are very large differences in temperature between the city and surrounding areas; in the case of Porto, by contrast, temperature differences between the city and its surroundings are not as marked due to its location on the Atlantic coast. Night-time temperatures in the centre of Madrid are not significantly higher than in the city's densely built outskirts. In southern European cities with construction that is adapted to the local climate, e.g. Madrid, Nice, Porto, Rijeka and Thessaloniki, temperature differences between the city and surrounding areas remain relatively constant even at different temperatures. By contrast, Oberhausen, Stavanger and Warsaw are examples of cities where the temperature differences between city and surroundings increase with rising temperatures, i.e. when there is less cooling at night. Since 2010, the number of tropical nights in the first half of August has steadily increased, and seven of the last ten years have ranked among the top ten with the most tropical nights, in addition they occurred more than twice as often in the city centre than on the outskirts.

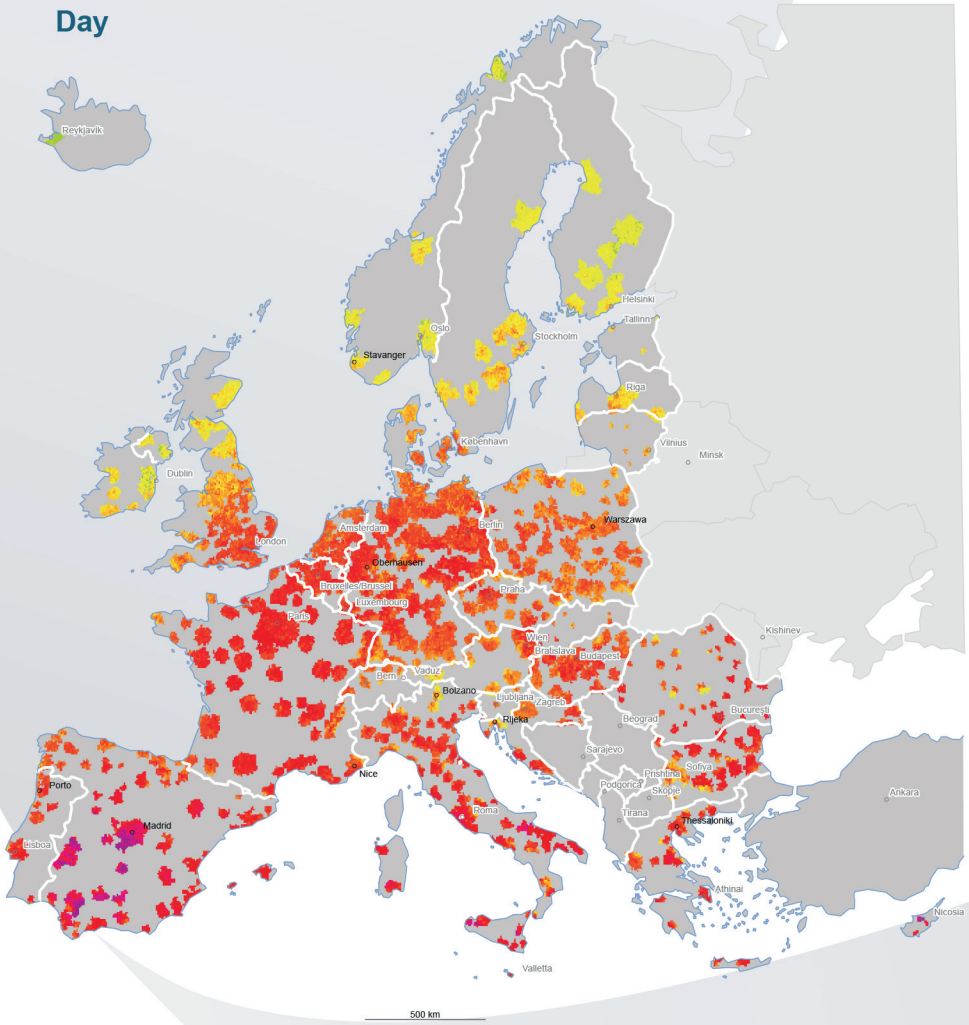
Average Land Surface Temperature by night: 1 to 14 August



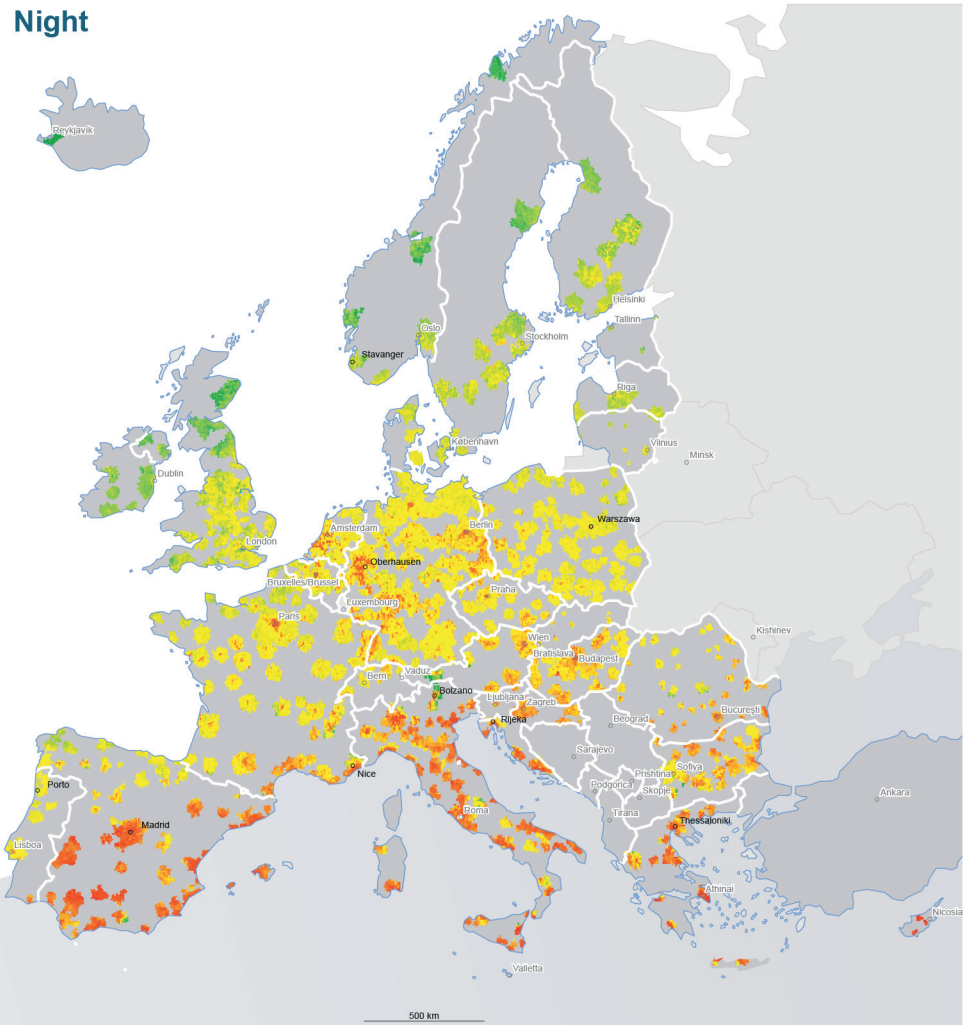
Data source: Anna Hellings; data origin: NASA EOSDIS Land Processes DAAC

Average temperature in cities and commuting zones on 1-14 August 2020

Day

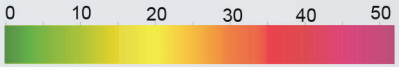


Night

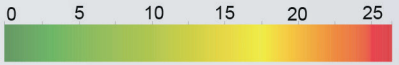


Regional level: functional urban areas;
Data source: Anna Hellings, 2020
Data origin: NASA EOSDIS Land Processes DAAC
EuroGeographics for the administrative boundaries

Average Land Surface Temperature in °C by day with 1km resolution



Average Land Surface Temperature in °C by night with 1km resolution



O select cities for the figure

The definition of city and commuting zone is based on the definition of functional urban areas (FUA) of the EU Commission and the OECD

Green infrastructure

Green Infrastructure (GI) is based on the principle that 'protecting and enhancing nature and natural processes are consciously integrated into spatial planning and territorial development'. Accordingly, the Green Infrastructure Strategy of the EU defines GI 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' in both rural and urban settings.

The percentage cover of potential green infrastructure is unevenly distributed across Member States in Europe. A noticeable spatial pattern can be distinguished in the map: (i) the very low percentage cover of green infrastructure in the regions of north-western France and Germany, south-eastern UK and Ireland, Belgium and Denmark (light yellow regions); and (ii) the very high percentage cover of green infrastructure in the Nordic countries, the Balkan countries along the Adriatic Sea and the eastern Alpine region (dark green regions).

The spatial pattern that stands out is mainly the result of climatic and topographic conditions, population density, land management and associated landscape fragmentation. These factors are drivers of land use and land cover changes that have halt the link between important natural ecosystems across European regions, and consequently are impeding the connectivity between Natura 2000 and comparable areas outside the European Union. Landscape fragmentation is prominent in north-western France and south-eastern UK regions and can be mainly attributed to urbanization, extensive agricultural expansion, or both. France has the largest agricultural area, followed by Spain, the UK and Germany.

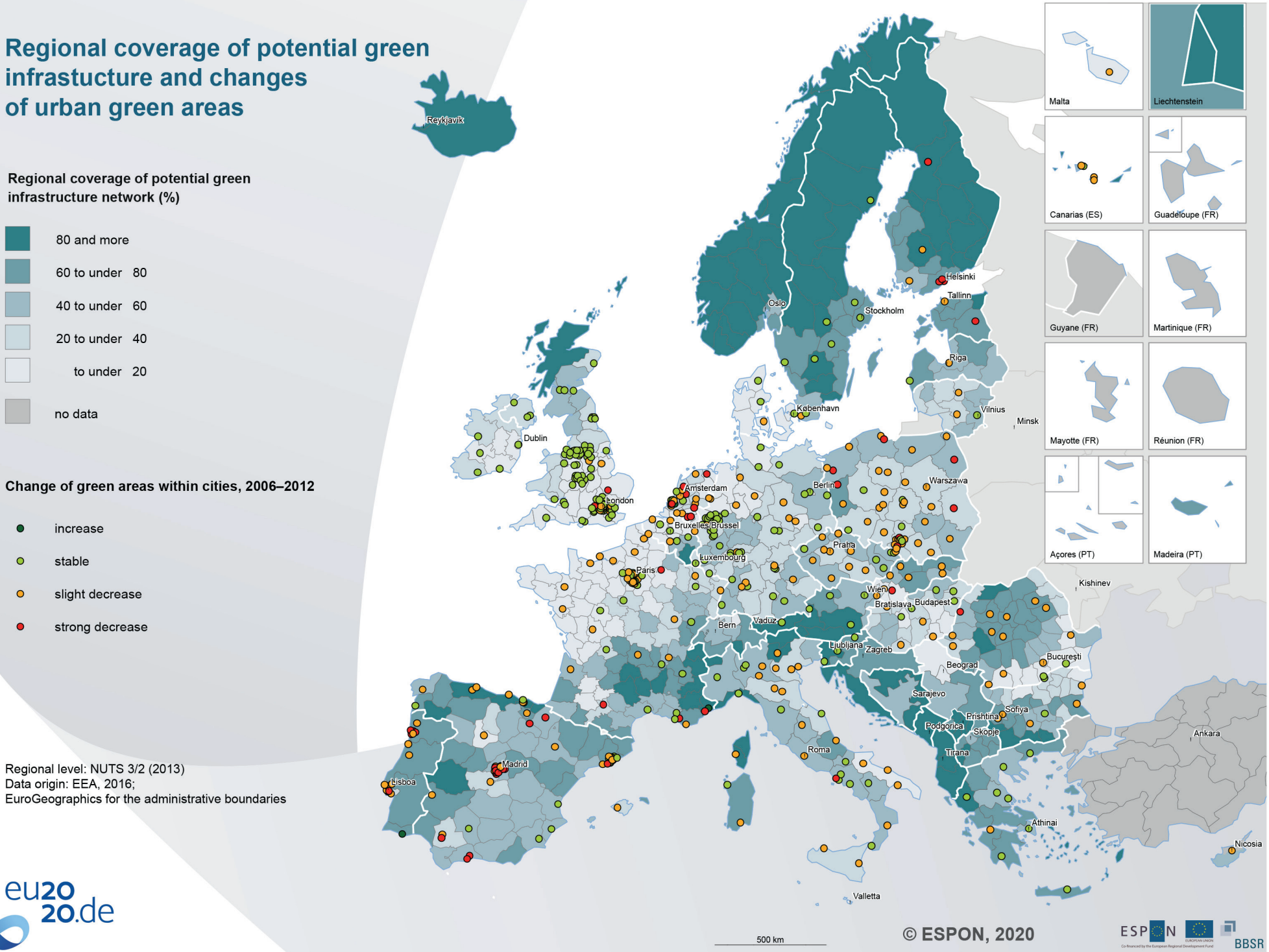
In Central European countries, landscape fragmentation is less marked but still high as compared to peripherial regions. It is mainly due to the closely meshed motorway network, which exhibits simultaneously one of the highest volumes of passengers and freight transport in Europe. Its central location, high levels of industrialization, and the lack of major topographical obstacles explain the development of such "grey" infrastructure.

On average, 60% of Natura 2000 areas are connected through more than 80% of natural and semi-natural areas existing within each region at NUTS 2/3 level in Europe. Exceptions to this general pattern occur mainly in north-western France and south-eastern UK, where green infrastructure coverage is below 20%.

The implementation of nature-based solutions by GI is particularly relevant in towns and cities, where almost 70% of Europe's population live. At the urban scale, the coverage of green infrastructure areas is generally decreasing. The European territory is dominated by cities in which green areas have remained stable (central and north-western Europe and Alpine countries) or have decreased (eastern and southern Europe). The reasons for this development are mainly urbanisation and economic development after accession to the EU or for touristic purposes in southern Europe. This development can also be observed in Finland and the Netherlands. Only a few cities show an increase in green space coverage.

Cities with higher GI accessibility are scattered throughout Europe, but tend to be dominant in Austria, the Baltic countries, Czech Republic, Finland, Germany, Portugal and Sweden. Conversely, cities in Denmark, Ireland and the United Kingdom are at the lower range of urban GI accessibility. Differences in accessible urban GI depend on several factors such as the quantity of GI, its distribution (concentrated, patchy, dispersed, etc.) and its proximity to transport infrastructure. Therefore, having available GI (or a percentage of GI in the peri-urban area) does not necessarily ensure it is accessible.

Regional coverage of potential green infrastucture and changes of urban green areas



Regional level: NUTS 3/2 (2013)
Data origin: EEA, 2016;
EuroGeographics for the administrative boundaries

eu2020.de

Electricity from wind turbines

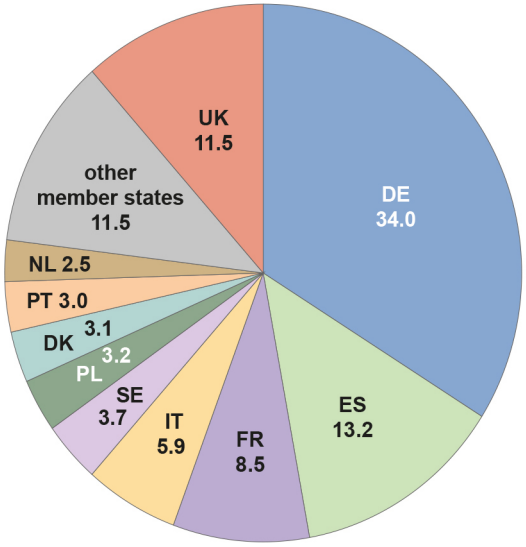
Producing energy from renewable sources is a way to mitigate and adjust to climate change and can offer new possibilities for regional development. Renewables help reduce emissions to reach the goal of a climate-neutral EU by 2050. Investments in the production of renewable energy are outlined in the European Green Deal's roadmap for key actions, pointing the way forward for the whole of Europe.

With a share of 11%, electricity generated from wind power made a not-insignificant contribution to the EU's total gross electricity production in 2018. In Germany, wind power accounts for 17%, in Spain for 19%, in Ireland for almost 30% and in Denmark for 46% of total electricity generation. The share of wind power of total electricity generation has almost doubled in the EU in the last ten years.

In 2018, electricity production from wind power amounted to about 321,000 gigawatt hours (GWh) in the EU, which roughly corresponds to three times the total annual electricity consumption of the Netherlands. Germany produced a little more than one third, Spain one sixth and France one tenth of this energy. In the same year, the United Kingdom generated 57,000 GWh of electricity from wind power plants.

In spring 2019, electricity from wind power was generated by some 96,700 wind turbines with an installed capacity of 177 gigawatt (GW). 4,600 turbines with an installed capacity of nearly 11 GW stood in Europe's offshore wind farms.

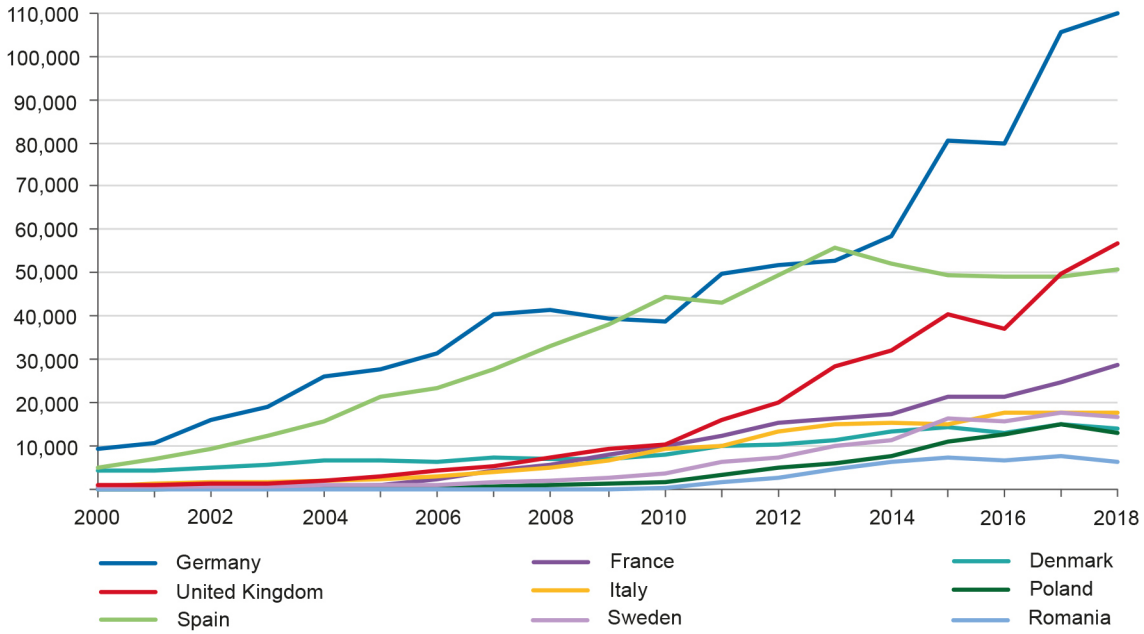
Proportion of the installed wind power capacity of the EU member states and the United Kingdom in %, 2019



Total installed capacity in July 2019: 177 GW

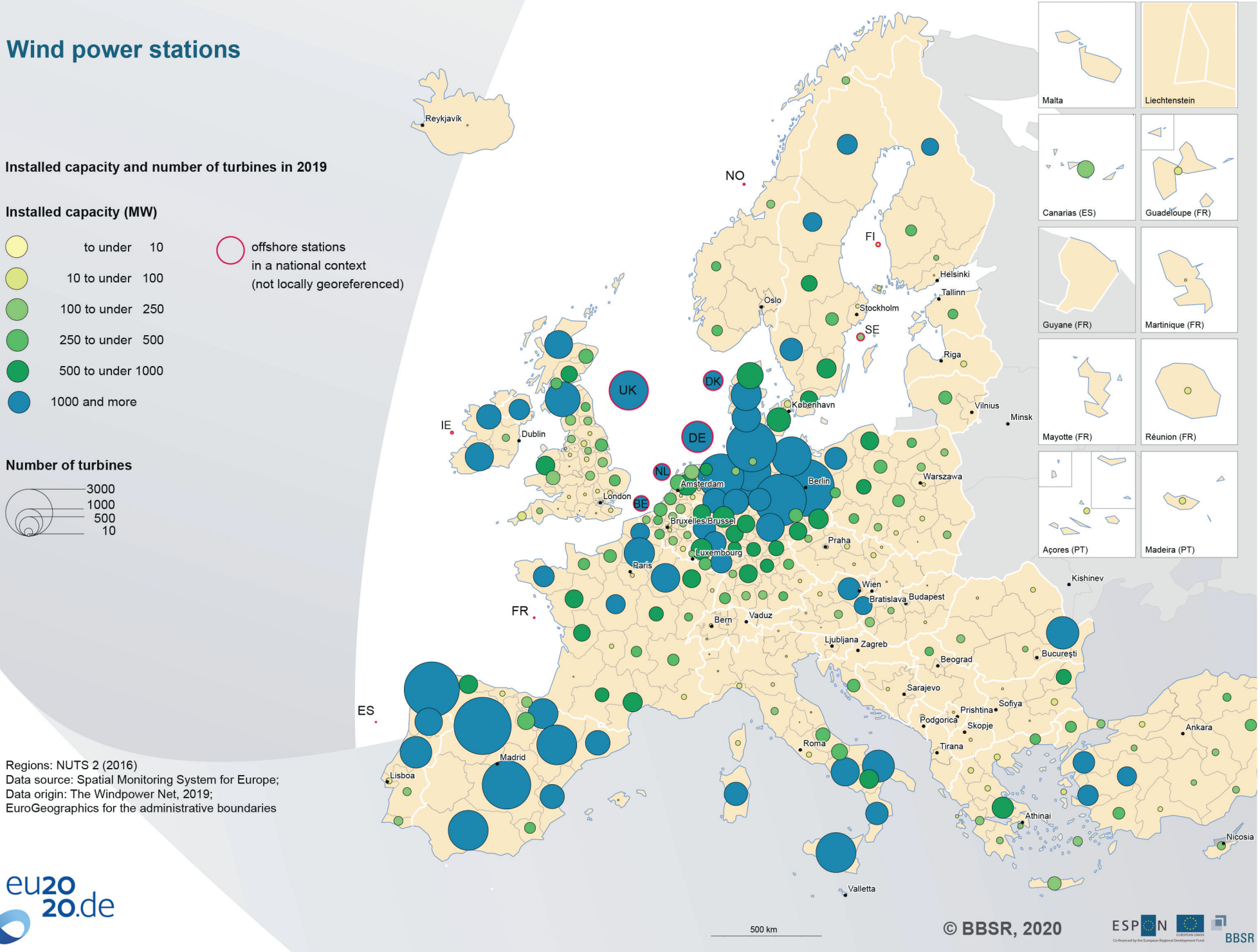
Data source: Spatial Monitoring System for Europe
Data origin: The Windpower Net

Gross electricity generation in GWh from wind energy



Data source: Spatial Monitoring System for Europe; data origin: Eurostat

Wind power stations



Groundwater quality

Water is the earth's most precious natural resource. In Europe, about 75% of the population is dependent on groundwater and access to it. Groundwater is not only a source of drinking water for the population, however; it is also an important resource for agriculture and industry and therefore needs to be available in sufficient quantity and quality.

If the available groundwater resource has good quantitative status, it will not be affected in the long term by moderate removal per year; that is, human activity does not directly impact the water table. In all 27 EU member states except Cyprus, significantly more than 70% of groundwater bodies have good quantitative status. Overall, nearly 95% of all groundwater bodies have sufficient quantities of water.

Only 86% of the groundwater bodies in the EU27 have good chemical status. The European Union's Directive 2000/60/EC, known as the EU Water Framework Directive, calls for ensuring good chemical status for all freshwater ecosystems in the EU by 2027 to secure the supply of drinking water. Of the 14% of groundwater bodies that do not have good chemical status, 83% will probably achieve this goal, while 17% will not, even though the deadline has been extended to 2027 from 2020.

The proportion of measured groundwater bodies having poor quality is especially high in Malta (80%), the Czech Republic (73%) and Belgium (59%). By contrast, all groundwater bodies in Latvia and Lithuania are of good quality, followed by Sweden with nearly 98%.

Poor quality groundwater affects not only human health, but also ecosystems. Groundwater is an important part of the hydrological cycle, as it maintains wetlands and rivers and provides a buffer during droughts. It should therefore be protected as a valuable ecological resource.

The main sources of chemical pollution of groundwater are urban centres, large-scale industrial areas, transport facilities, air pollution, and in particular agriculture. Regions where groundwater bodies have unsatisfactory status usually also have a large proportion of agricultural land.

Quantitative state of groundwater bodies in Europe

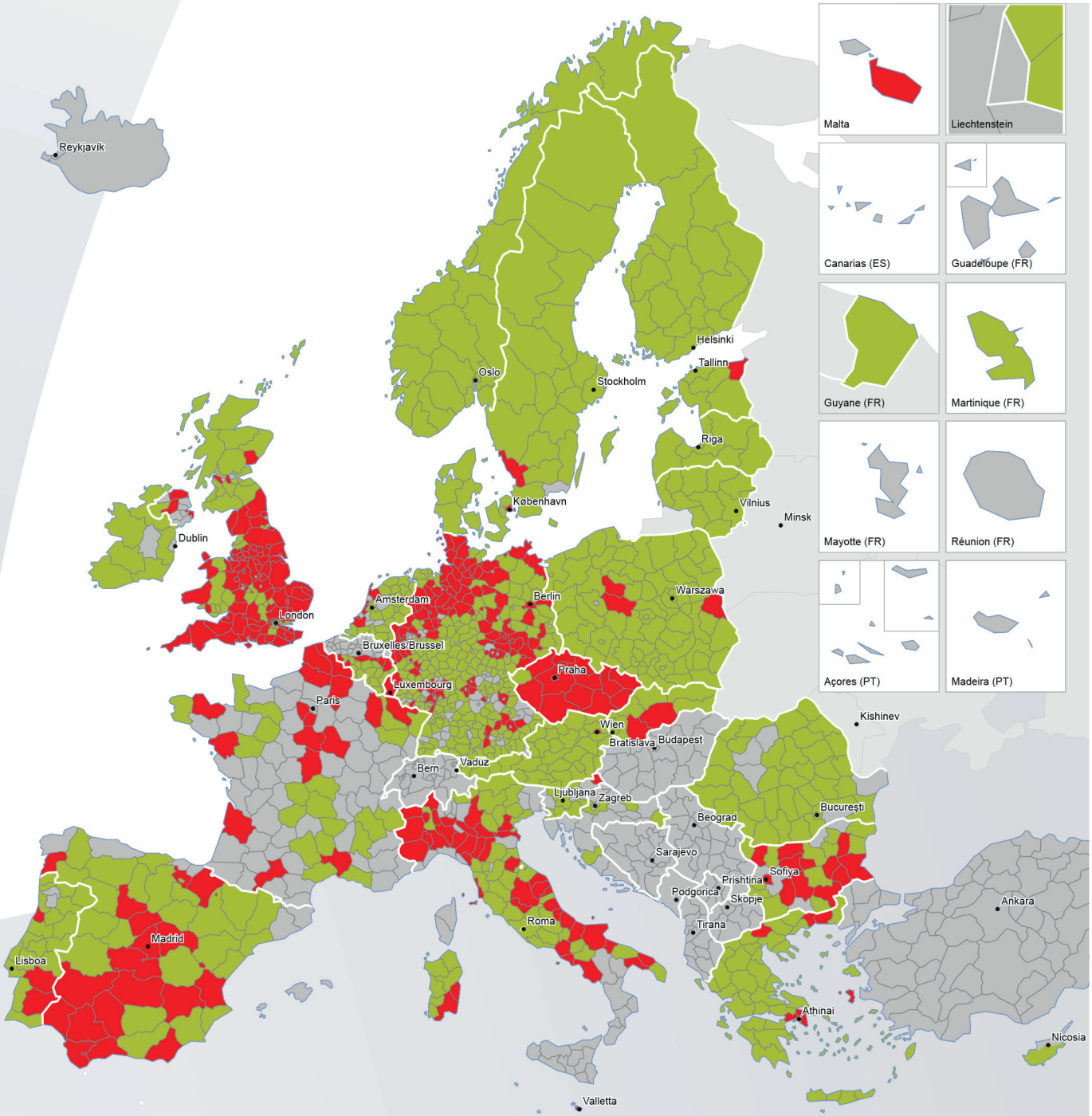
Data source: Spatial Monitoring System for Europe; data origin: EEA 2020

Groundwater quality

Chemical state of groundwater bodies 2016

- predominantly* good state
- predominantly* bad state
- no data

*average value of groundwater bodies in NUTS 3 regions



Regional level: NUTS 3 (2016)
Data source: Spatial Monitoring System for Europe
Data origin: EEA 2020
EuroGeographics for the administrative boundaries

Air quality

Air quality in Europe has significantly improved in recent years. Between 2015 and 2020, the emission of nitrogen oxides in the 27 EU member states dropped by an average of 55.6%.

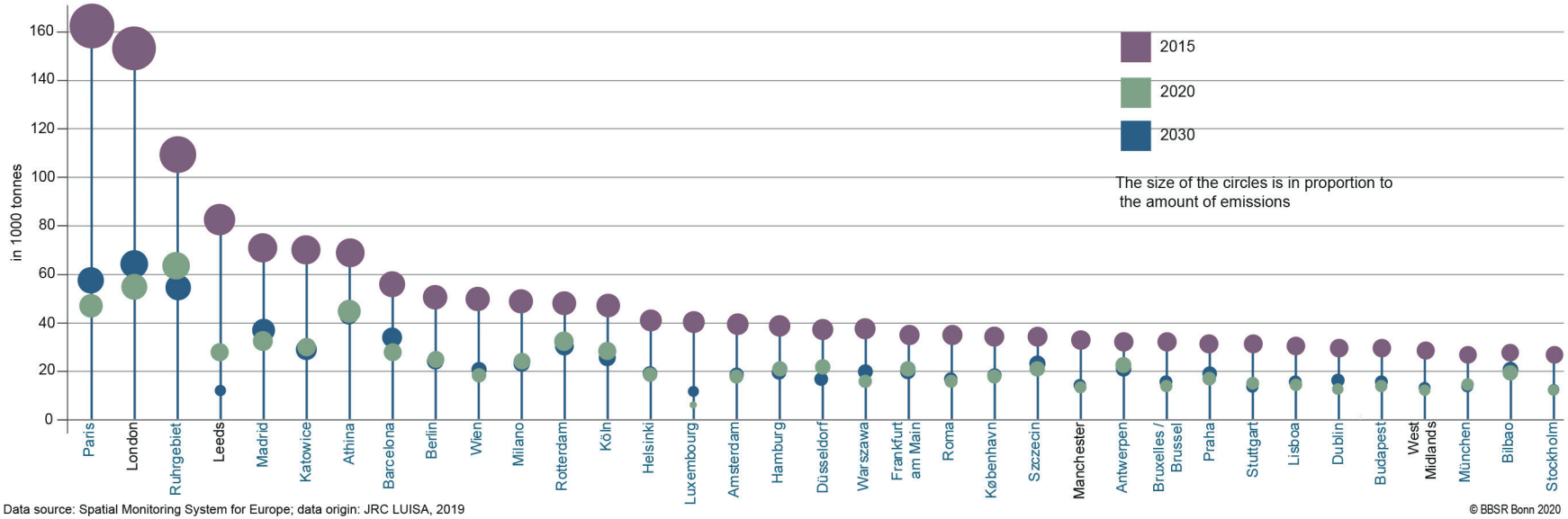
The group of nitrogen oxides NOx includes nitric oxide and nitrogen dioxide which are very relevant for assessing air quality. Nitrogen dioxide, a highly reactive irritant gas, and other air pollutants increase the risk of respiratory and cardiovascular diseases. Over a period of years or decades, high levels of pollutants have harmed the health of some segments of the population and reduced life expectancy. It is very difficult to predict the risk for each individual. However, it is possible to measure the effects of exceeding the acceptable limits on specific days more precisely, as such excesses have a direct impact and can seriously affect older people, children and people with pre-existing health conditions (such as asthma) in particular.

The largest producer of nitrogen oxide emissions is motor vehicles, accounting for about 40% of the total, followed by industry, with more than 25% of the total. As a result, densely populated areas in particular are a focus of attention. In 2015, more than 50% of the 8.5 million tonnes of NOx was emitted in cities and their surroundings in the 27 EU member states.

With emissions of 166,000 tonnes, Paris leads the list of the 35 largest urban areas having emissions of more than 25,000 tonnes. It is followed by London (159,000) and the Ruhr region (111,000 tonnes).

Measures taken in the past to reduce emissions of pollutants, such as the use of catalytic converters and other exhaust purification systems in passenger cars, accompanied by the creation of measuring systems and emission standards, have reduced emissions in cities and their surroundings by a significant 50.6% since 2015. In contrast to the rest of Europe, emissions in cities are likely to continue to fall slightly from 2020 to 2030 (by about 0.2% over ten years). Overall, the reduction in emissions in cities is forecast to lag the average European reduction of 54% from 2015 to 2030.

Development of nitrogen oxides, 2015 to 2030



Data source: Spatial Monitoring System for Europe; data origin: JRC LUISA, 2019

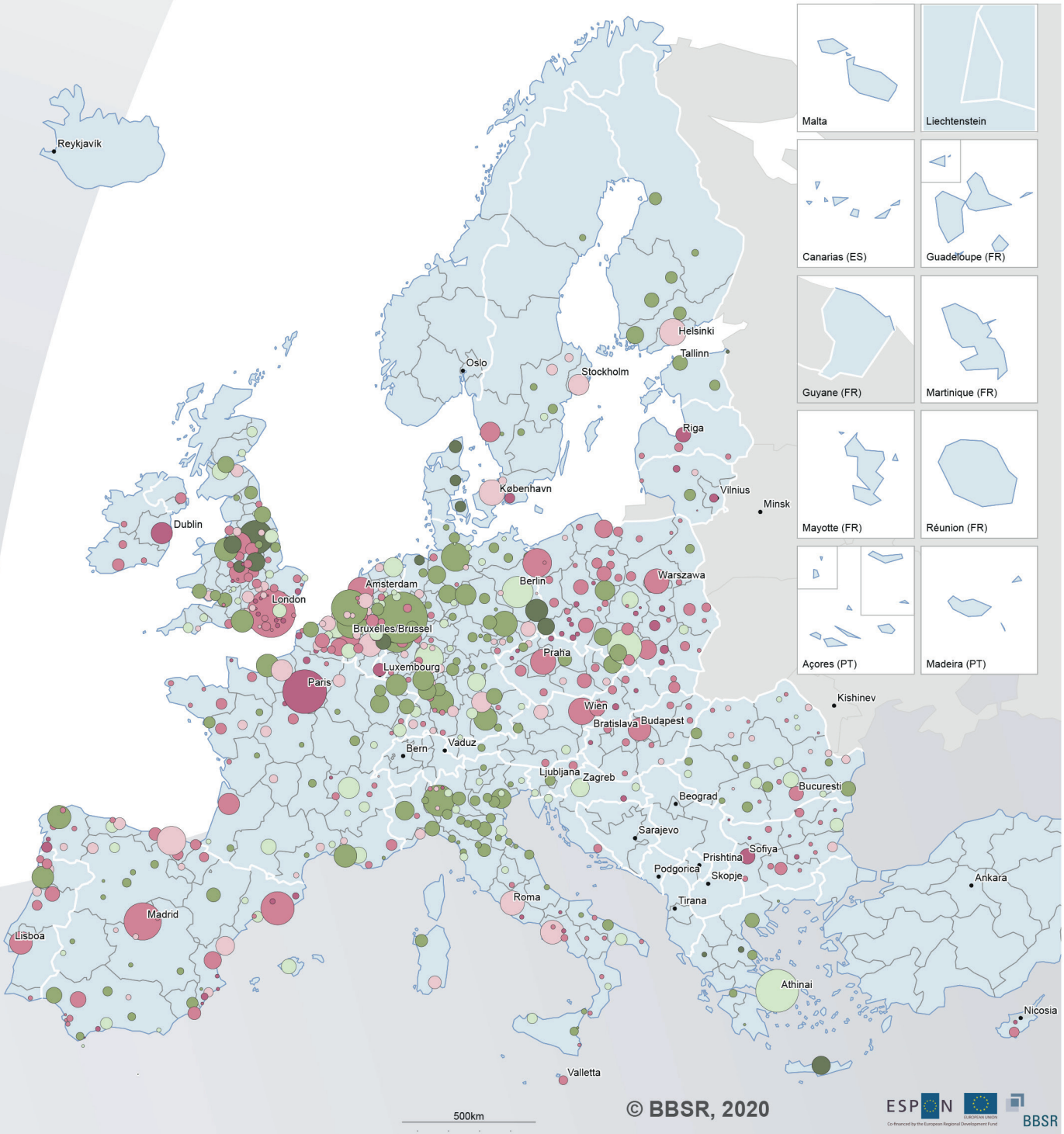
Nitrogen oxide emissions

Estimated change of nitrogen oxide (NO_X) emissions from 2020 to 2030 in %

- 25 and more
- 5 to under 25
- 0 to under 5
- –5 to under 0
- –25 to under –5
- to under –25

NO_X emissions in 2000 in 1000t

50
25
5
0.1



Regional level: functional urban areas
Data source: Spatial Monitoring System for Europe
Data origin: JRC LUISA, 2019
EuroGeographics for the administrative boundaries

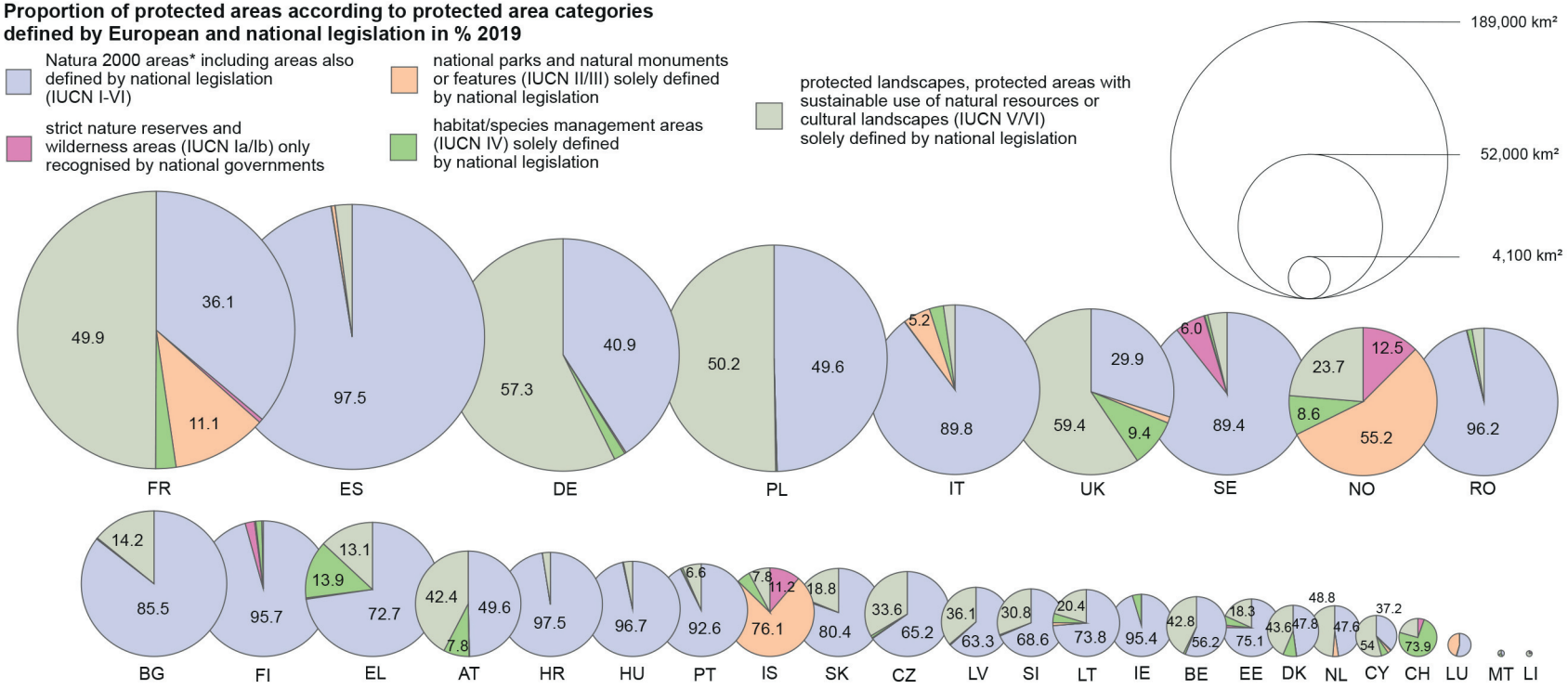
Protection of nature

Europe's natural landscapes are unique and varied. They deserve protection as part of European identity and diversity. Because Europe is embedded in global processes and systems, and because areas of human settlement are expanding, it is necessary to find a balance between nature conservation, the sustainable use of natural resources and economic development. The European Union's nature conservation policy plays a crucial role in maintaining biodiversity. Its Natura 2000 network is the backbone of this policy and is the largest network of protected areas in the world. Natura 2000 defines minimum standards for the protection of nature and species in the EU's 27 member states.

In 2019, the Natura 2000 protected areas covered some 800,000 km², accounting for nearly 20% of the EU's total area. Although the Natura 2000 areas make up only part of the total protected area in Europe, in some countries they represent a decisive share. Sometimes they overlap with nationally designated nature reserves, which are usually larger than the Natura 2000 protected areas.

In the EU27, roughly 1,200,000 km², or about 27% of the EU's total area, are designated as nature or landscape conservation areas. About 70% of those conservation areas are also Natura 2000 protected areas.

Proportion of protected areas according to protected area categories defined by European and national legislation in % 2019



IUCN (International Union for Conservation of Nature) categories classify the objectives of the protected areas and the degree of intervention into nature. The IUCN definitions cannot be applied to Natura 2000. Natura 2000 areas may correspond to different or even none of the IUCN categories.

Data origin: World Database on Protected Areas, November 2019 *marine protected areas not included

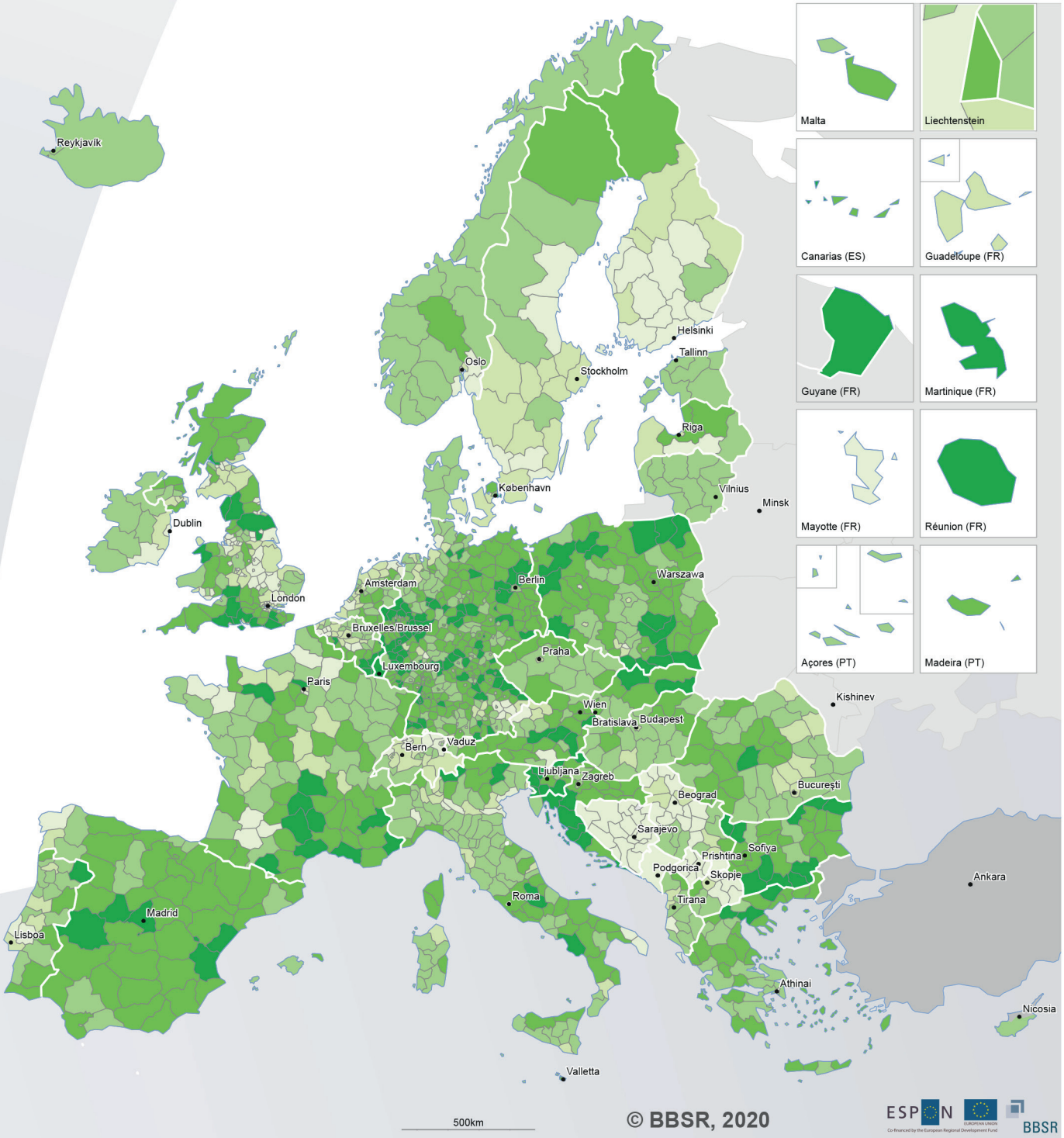
Protected areas

Proportion of proteced areas* defined by European and national legislation in % 2019

- to under 5
- 5 to under 10
- 10 to under 25
- 25 to under 50
- 50 and higher
- no data

* Natura 2000 areas and nature reserves, national parks, habitat/species management areas, protected landscapes and protected areas defined by national legislation

Overlapping areas defined by European and national legislation and Natura 2000 areas were taken into account



Regional level: NUTS 3 (2016)
Data source: Spatial Monitoring System for Europe
Data origin: World Database on Protected Areas, (November 2019)
EuroGeographics for the administrative boundaries

Employment in circular economy

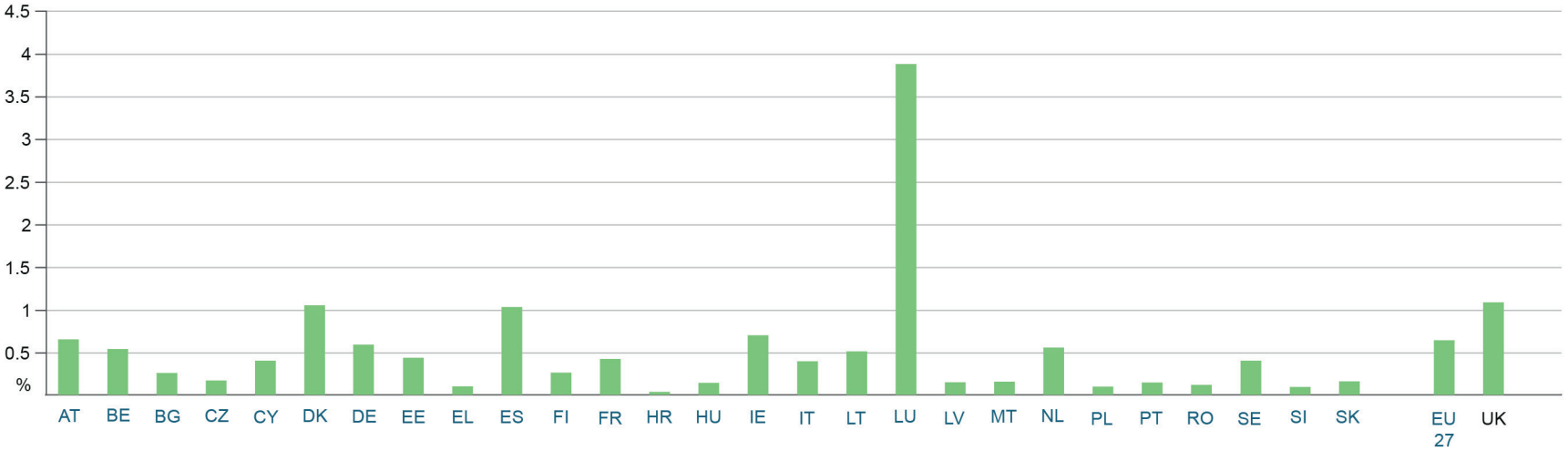
Transitioning from a linear economy towards a circular economy requires not only a shift in the materials used and technologies provided, but also a systemic change in the way materials, components and products are offered and consumed. Circular Business Models (CBM) facilitate the up-take of circular processes through innovative services and new forms of consumption by connecting businesses to businesses (B2B), businesses to consumers (B2C) and consumers to consumers (C2C).

Circular Business Models (CBM) include: (1) long life design of products, such as eco-design; (2) the extension of product and resource value at end of life stages though various strategies, like remanufacturing or upcycling; (3) various forms of product-service-systems and servitisation schemes, like chemical leasing – an incentive to reduce the waste and environmental burden of chemicals by changing the business model from selling the quantities to selling the effects; (4) and the exploitation of sharing economies, like car-pooling.

Across Europe, over 9,000 companies can be identified as operating CBS, with 1 million employees and a turnover of €266 billion covering all company sizes: Very large companies 43%; medium-sized companies, 27%; small companies, 30%. The companies with highest turnovers and employment rates in CBM concentrate in highly populated regions, such as capitals, and urban regions, as well as industrial agglomerations and knowledge-hubs. Proximity factors provide businesses in industrial agglomerations with benefits due to shared access to information, networks, suppliers, distributors and resources.

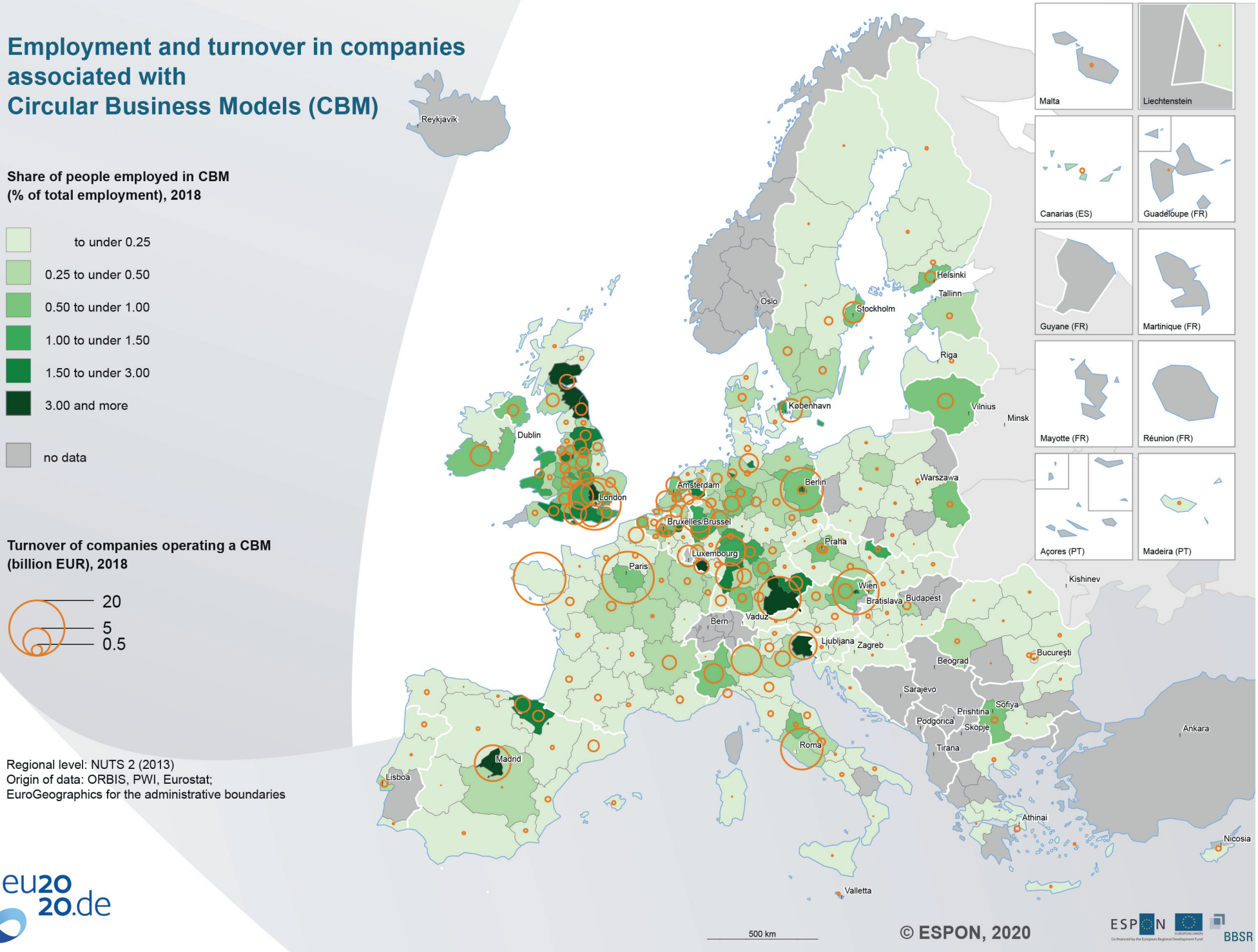
While companies following sharing models are almost exclusively operating in larger cities, other models have received a more widespread adoption. Companies focusing on extending product and resource value are prominent in industrial regions and regions in transition, those focussing on long-life design are prominent in service oriented regions. Companies identified to encourage sufficiency and shift utilisation patterns are the most visible in "Four Motors of Europe" (namely Lombardy, Catalunya, Baden-Württemberg and Auvergne-Rhône Alpes) and the capital regions in general.

Share of people employed in Circular Business Models (CBM) (% of total employment), 2018



Data source: ORBIS, PWI, Eurostat

Employment and turnover in companies associated with Circular Business Models (CBM)



Regional level: NUTS 2 (2013)
Origin of data: ORBIS, PWI, Eurostat;
EuroGeographics for the administrative boundaries

Digitisation of industry

The 4.0 technological transformation rests on the creative recombination of basic and general technologies with specific domains of application. Basic hardware and software technologies and basic connectivity systems, support wide-ranging technological fields. Mobile digital devices, cloud computing, artificial intelligence are only some of them.

The recombinatorial nature of 4.0 technologies leads to a radical reconfiguration of technology markets. It opens the possibilities to obtain profits from creative inventions also for small and new firms, also located in laggard regions. In countries leading 4.0 technology trends almost all regions do contribute to the production of recombinatorial 4.0 patents with a specific application. However, the phenomenon is not confined to leading regions. Inventing areas also emerge in Eastern countries and the Baltics. They are generally regions hosting the capital city or second-tier cities within the national context.

Most of the high performing regions in 4.0 technologies exploit an existing edge in traditional ICT (3.0 technologies), accumulated in previous times, showing that the degree of cumulative technological is pretty high. Moreover, more than 40% of the regions are not contributing to substantial inventing efforts in the development of 4.0 technologies, highlighting the difficulties in closing a pre-existing technological gap.

However, the evidence shows that regions are able to leapfrog on the 4.0 technological frontier even in the absence of a strong knowledge base in 3.0 technologies. These regions are the new islands of creative innovation and they exist thanks to zero marginal costs and low entry barriers in the market of new technologies. These areas are located both in relatively less innovative regions in leading countries but also in follower countries. Even more importantly, they can be found in Eastern countries and not only in capital regions. Interestingly enough, the results also demonstrate that these islands of innovation are able to achieve productivity growth advantages thanks to their creative capacity.

Once 4.0 technologies are produced and applied, significant transformations occur in the economy and society. One of the most commonly cited transformations is the advent of 'Industry 4.0', or the 'smart factory', based on cyber-physical systems (CPS). CPS comprises smart machines, storage systems, and production facilities, able to exchange information, initiate actions, and mutually control each other. Their interconnection via the Internet, also termed as the Industrial Internet of Things (IIoT), generates technological leaps in engineering, manufacturing, material flow, and supply chain management. A second well known transformation is 'Servitisation': it refers to the supply of services or products offered on virtual markets via digital platforms (like Uber, Amazon, BlaBla Car, Ebay,etc) that, managing billions of data, allow people to share their spare resources, offer new services and develop new businesses

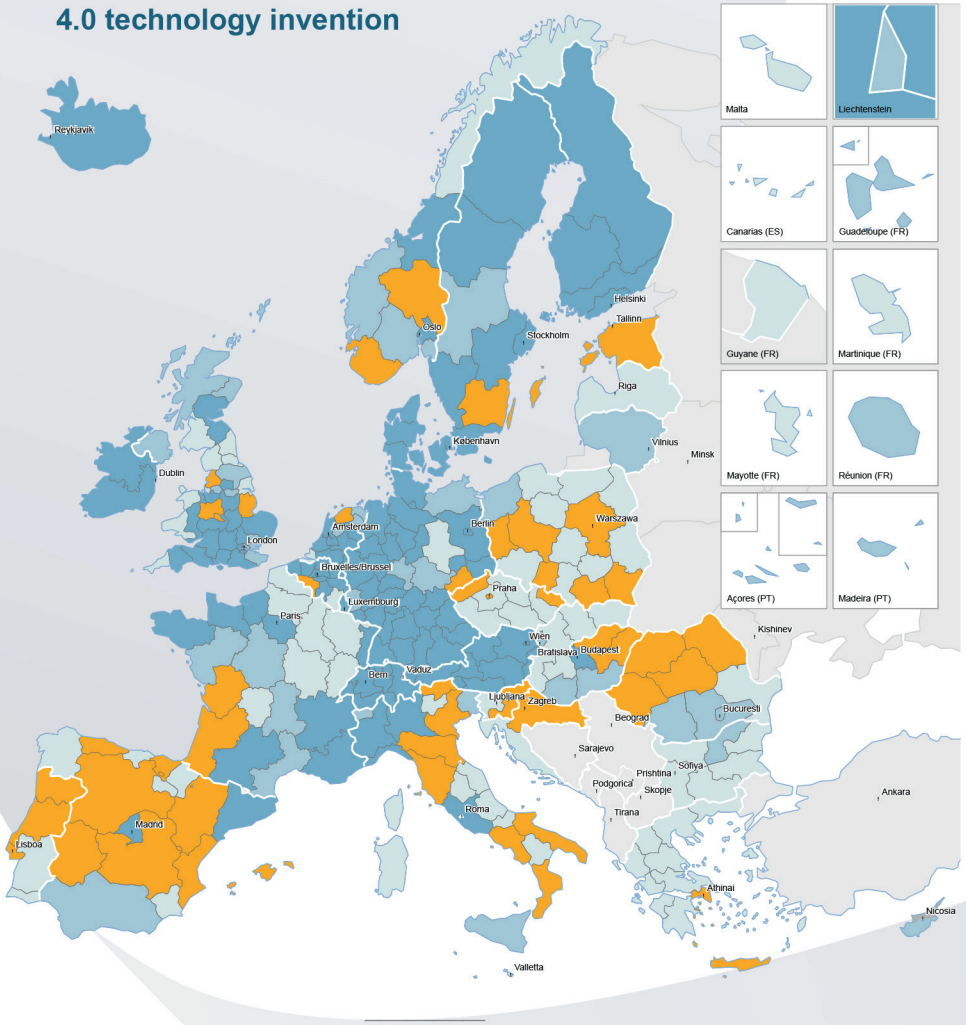
Servitisation is a typical urban phenomenon. Industry 4.0, instead, takes place in a few regions in Europe, located mainly in Germany andin Northern Italy.

Robotisation of traditional manufacturing is diffused in most regions in Europe, and it is a typical lagging region phenomenon. These regions either register relatively high adoption of robots in traditional manufacturing sectors, as well as niches of robotisation. Generally, they show a very low adoption of 4.0 technologies and are specialised in tiny industrial sectors, and, last but not least, have a very high risk of job automation.

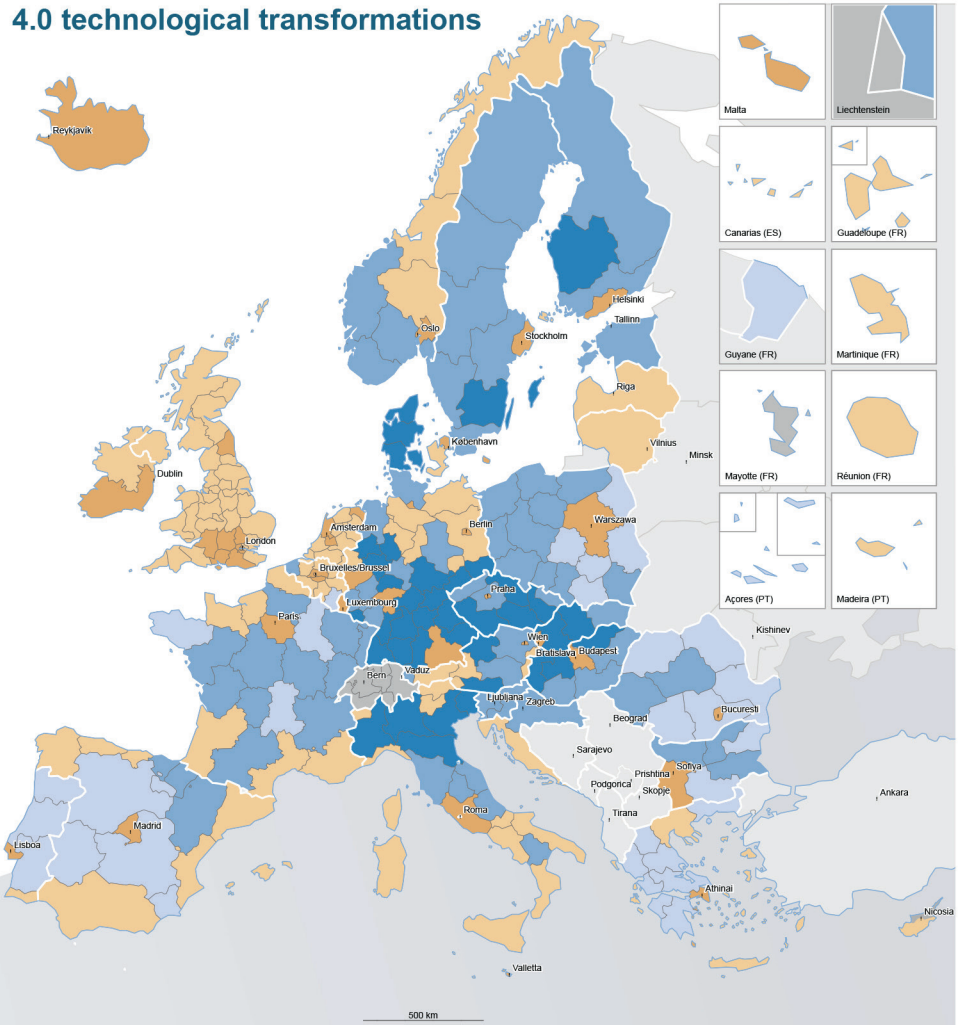
The adoption of 4.0 technologies generates growth opportunities. Through higher competitiveness across a large number of manufacturing industries, Industry 4.0 regions correlate strongly with a steady and strong increase in GDP. The same applies for regions with advanced digital service markets. Through the enlargement of both high-skilled business opportunities (e.g. developers of apps for large digital intermediaries) and low-skilled opportunities (e.g. taxi drivers for Uber, riders for home delivery) provided by digital markets, 'servitisation' regions are also showing strong correlations with GDP growth.

Trends in 4.0 technological invention and transformation

4.0 technology invention



4.0 technological transformations



Taxonomy of 4.0 technology inventing regions 2010–2015

- Low tech
- New islands of innovation
- Technology falling behind
- Technology leaders
- no data

Main manifestations of 4.0 technological transformations 2009–2016

Transformations most profound in the service sector

- Servitisation
- Digitalisation of traditional services

Transformations most profound in the manufacturing sector

- Industry 4.0
- Robotisation of traditional manufacturing
- Niches of robotisation

Regions: NUTS 2 (2013)
Origin of data: OECD-REGPAT, ORBIT, EUROSTAT, 2019
EuroGeographics for the administrative boundaries

Access to fast internet

Broadband is available to all households in the EU, when considering all major technologies such as cable, LTE or satellite. Primary internet access at home is provided mainly by fixed technologies like DSL capable of delivering download speeds up to 30 Mbps, which remained stable at 96% since 2013.

Fixed coverage is highest in the Member States with well-developed DSL infrastructures. In 12 Member States, more than 99% of households are covered. Poland, Lithuania, Romania and Slovakia are lagging behind with less than 90% of households covered.

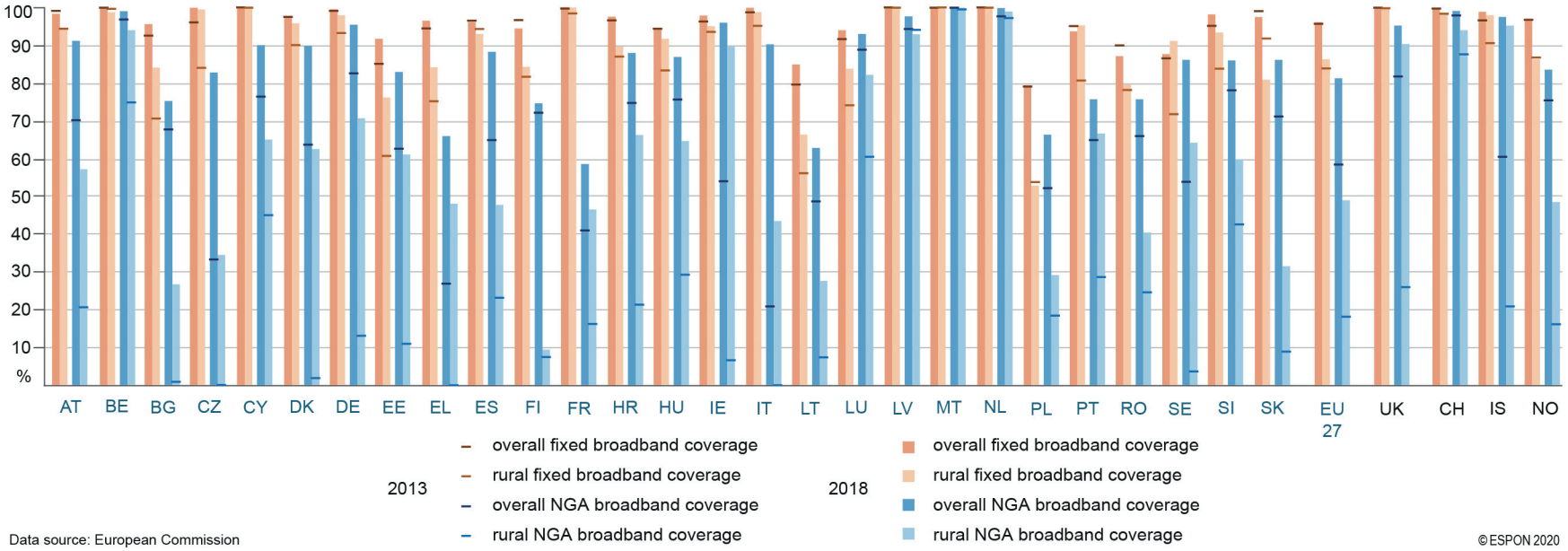
Coverage of next generation access (NGA) technologies (VDSL, VDSL2 vectoring, FTTP, DOCSIS 3.0, DOCSIS 3.1) capable of delivering download speeds of at least 30 Mbps reached 81% in 2018, up from 58% 5 years prior, with a total of 184 million EU homes passed by fixed broadband networks.

Cyprus, Malta and Belgium, Switzerland, the Netherlands, Denmark and the UK are the leaders in NGA. In 13 Member States, fast broadband is available to at least 90% of households, whereas in France and Lithuania less than 70% of households have access to such networks

Broadband coverage of rural areas remains challenging as 14% of households are not covered by any fixed network and 42% are not covered by any NGA technology. While, rural fixed coverage increased marginally from 84% to 86%, the upgrade to NGA technology has happened the fastest, growing from 18% in 2013 to 50% in 2018, covering 15 million homes.

The most significant urban-rural disparities can be seen in Poland, Lithuania, France, Spain, Greece, Bulgaria, Romania, Croatia and sparsely populated areas in Northern Europe. The significant gap between overall and rural coverage shows the regional disparities in digital opportunities and confirms that more investment is needed in rural areas in order to catch up.

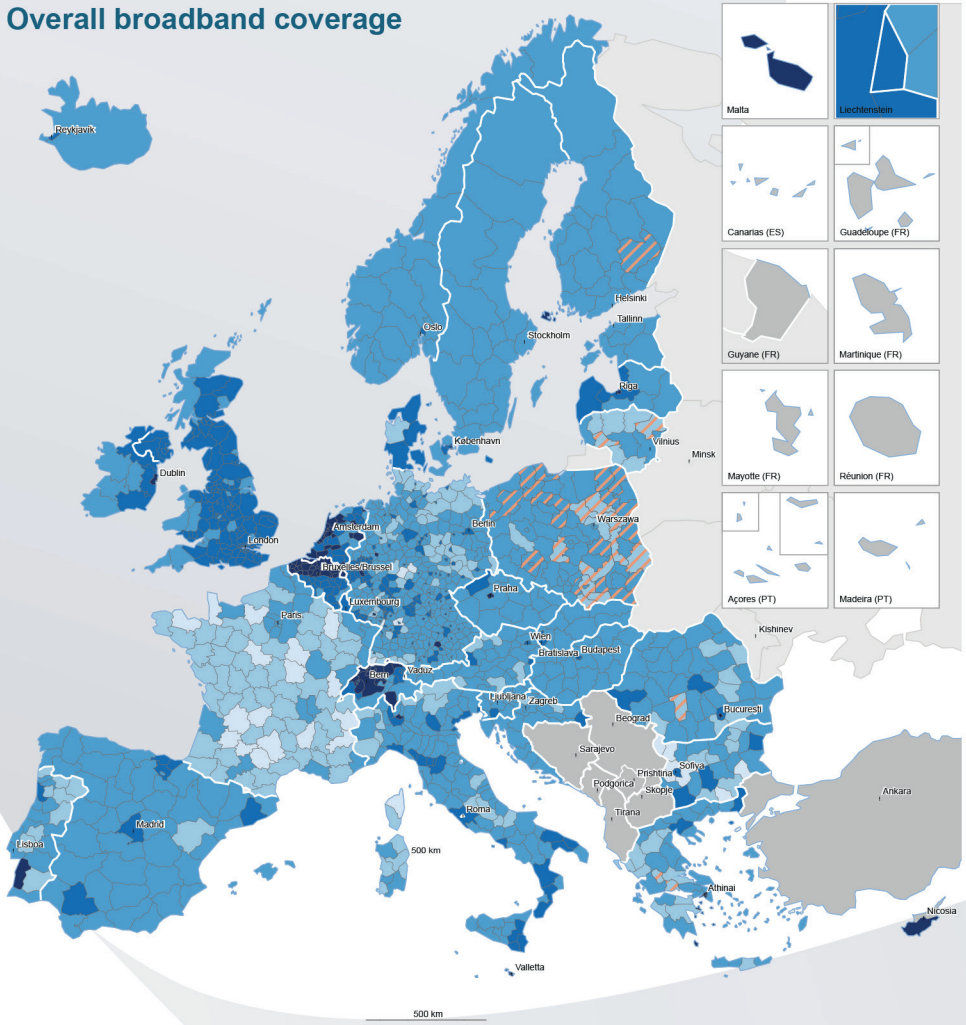
Broadband coverage, fixed and next generation access (NGA), 2013–2018



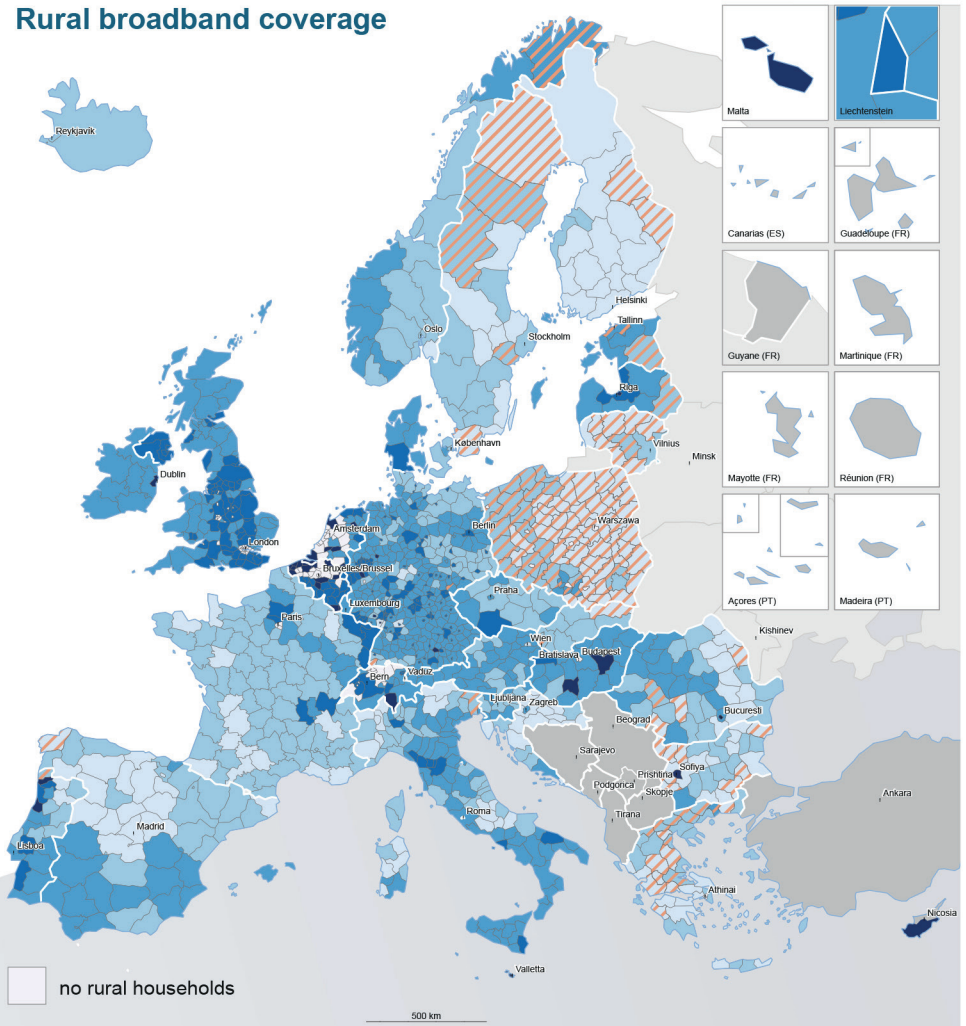
Data source: European Commission

Broadband coverage

Overall broadband coverage



Rural broadband coverage



Next generation access broadband coverage (% of households), 2019

- to under 35
- 35 to under 65
- 65 to under 95
- 95 to under 100
- 100
- no data

Least developed fixed broadband coverage (% of households), 2018

- to under 75

Regions: NUTS 3 (2010)
Data origin: European Commission, 2019, 2020; EuroGeographic for administrative boundaries

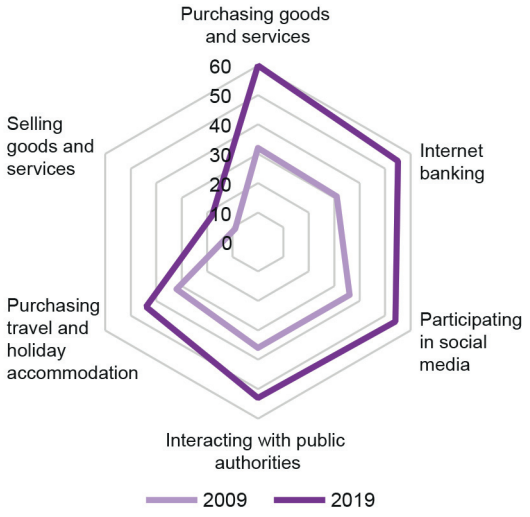
Internet use

In 2019, more than three quarter of the EU-27's adult population reported having used the internet on a daily basis which is 31 percentage points higher than a decade before (46% in 2009). The number of individuals who purchased goods and services online rose from 32% in 2009 to 60% in 2019 and the share of individuals who sold goods and services increased by half over the same period. Significant growth can be observed also in the share of individuals who booked holiday travel arrangements online, interact with public authorities via the internet, use social media or online banking. Around half of the population in the EU has engaged in these activities in 2019.

There were widespread disparities between EU regions in terms of daily use of the internet in 2009 and although the digital divide is narrowing, many of the disparities are still present. Northern and western regions generally recording higher levels and people are more active than in southern or eastern regions. In the latter, the proportion of people who have never used internet remains also relatively high still. The disparities are especially visible in the case of Romania and Bulgaria.

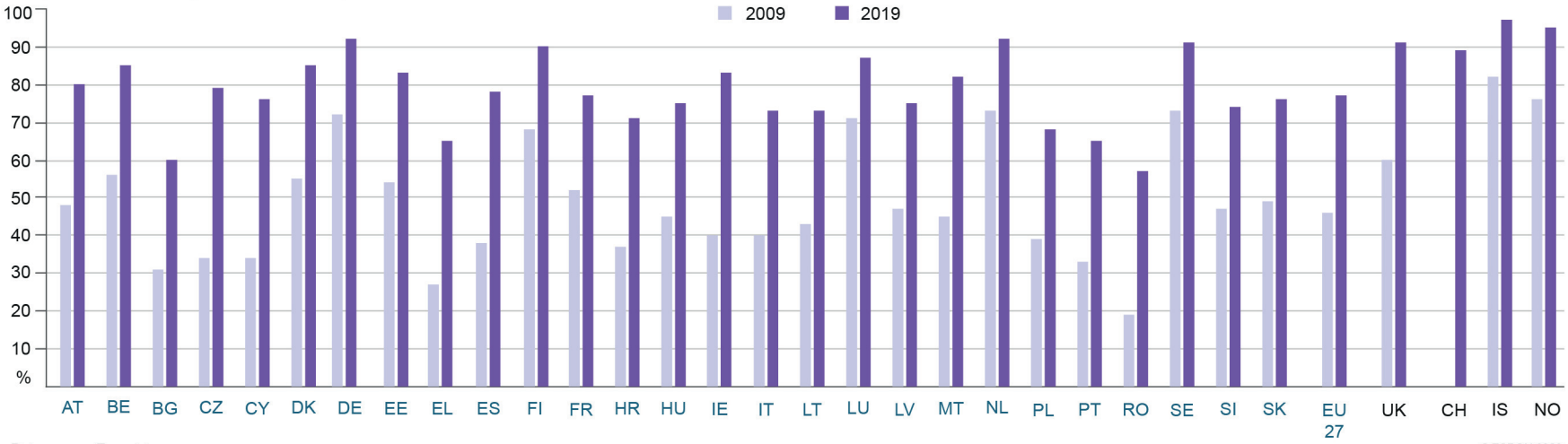
Although the internet is an almost constant part of the lives of many Europeans, some people are excluded to a greater or lesser extent, resulting in a digital divide. Market forces and a lack of public infrastructure investment in remote regions lead to access and/or performance, and thus to exclusion of the people living there. Particularly older generations, may not have the necessary e-skills to take full advantage of various services that are provided via the internet. The overall socioeconomic situation plays also a role, when looking at the different activity types, most notably, eCommerce. With a growing share of day-to-day tasks being carried out online, the ability to use modern technologies becomes increasingly important to ensure everyone can participate in the digital society. This digital divide is likely to be further challenged in the next few years, as people living in Europe's main cities are given the opportunity to move on to 5G internet services (the fifth generation of cellular network technology).

Internet use in the EU by type of activity (% of individuals), 2009–2019



Data source: Eurostat

Daily internet users (% of individuals), 2009–2019



Data source: Eurostat

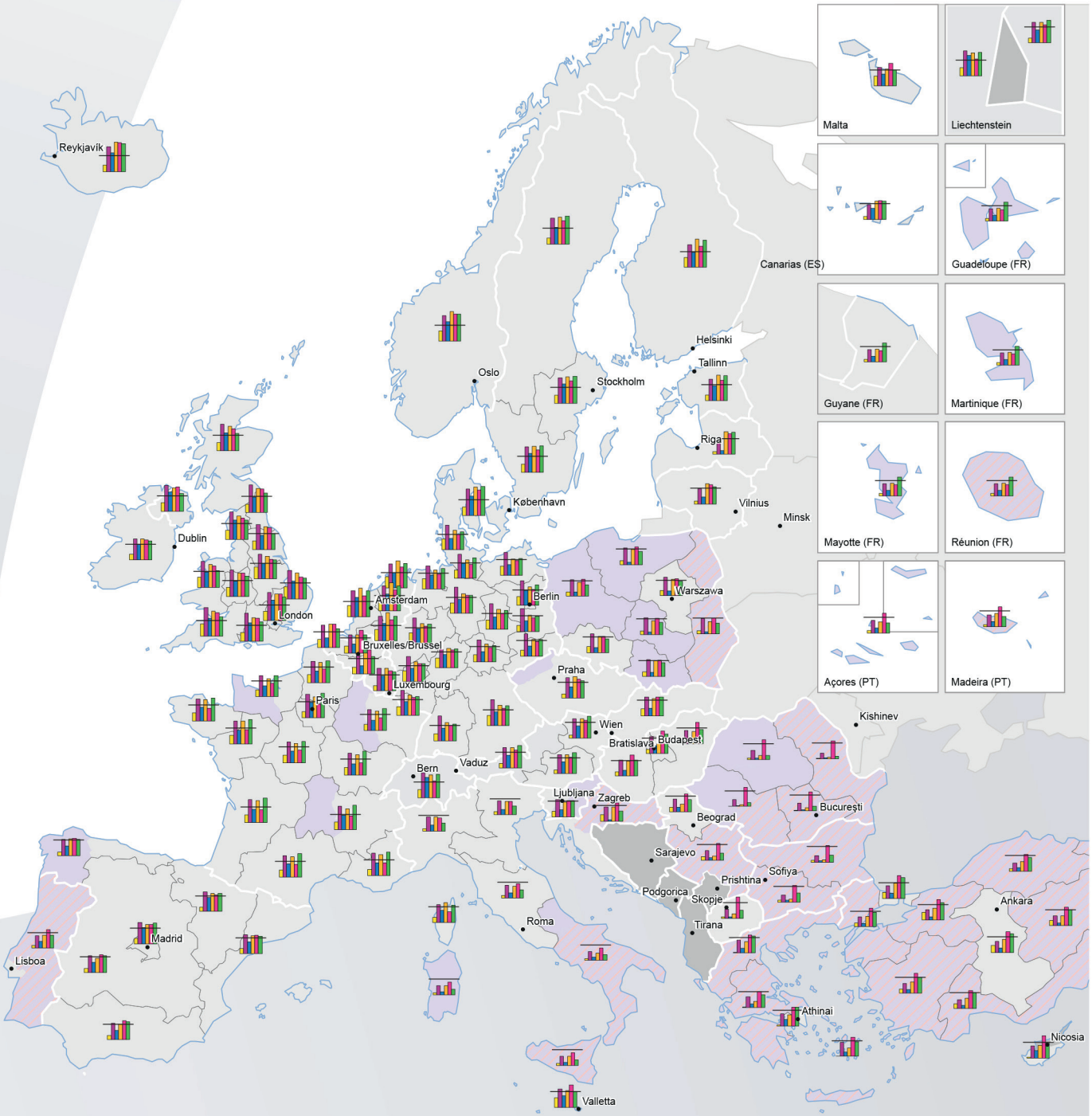
Internet use

Share of people who were using internet for various activities (%), 2019

- Interacting with public authorities
- Participating in social media
- Internet banking
- Purchasing travel and holiday accommodation
- Purchasing goods or services
- Selling goods or services
- no data

Low frequencies in the use of internet, 2019

- less than 70% daily
- more than 20% never



Regional level: NUTS 1/NUTS 2 (2016)
Origin of data: Eurostat;
EuroGeographics for the administrative boundaries

Notes

Dependency ratio

The dependency ratio reflects the ratio of the working-age and non-working-age population and is calculated by summing up the young-age and the old-age dependency ratios. Usually, the number of people under the age of 15 or 20 is added to the population aged over 60 or 65 and divided by the population of the age groups in-between. As with the young-age or old-age dependency ratio, there are no stipulated age limits; these result either from the data availability or are based on content-related criteria such as the retirement age.

Foreign direct investments

Foreign direct investments (FDI) refer to investments made by a company (or a government) to gain a long-term stake in a foreign-based company. The basic criterion is a participation of at least 10% of the voting shares.

Employment rate

The employment rate is a measure of the opportunities for participation in the labour market and of the demand for employment. It is the share of those in employment in the population or in the population of working age.

European territorial cooperation

The European Territorial Cooperation (ETC), better known as Interreg, is one of the two cohesion policy objectives and provides a framework for the implementation of joint measures and for the political exchange between national, regional and local actors from different member states. It is financed by the European Regional Development Fund (ERDF).

With a direct regional reference, there are two forms of cooperation in the context of Interreg: cross-border (Interreg A) and transnational (Interreg B) cooperation.

Cross-border cooperation (Interreg A) serves to advance the economic and social cooperation in neighbouring border regions.

Transnational cooperation (Interreg B) promotes the cooperation between national, regional and local partners in transnational cooperation areas in order to increase the territorial integration of these areas.

There is also interregional cooperation (Interreg C) with four interregional cooperation programmes such as Interreg Europe, INTERACT, URBACT and ESPON.

Land change

The area categories are based on the Corine Landcover classification. The definition of areas for urban use follows the classification of the ESPON SUPER project, which assigns all artificial areas to this category except mineral extraction sites (131) and dump sites (132) and thus includes the following Corine Landcover (CLC) classes: 111, 112 (urban fabric); 121 (industrial or commercial units); 122, 123, 124 (transport areas); 133 (construction sites) as well as 141 and 142 (green urban areas). Arable land includes classes 211, 212 and 213, while permanent crops, pastures and heterogeneous agricultural areas include the remaining categories of agriculture: 221, 222, 223, 231, 241, 242, 243, 244. Forests and semi-natural areas include the classes 311, 312, 313, 321, 322, 323, 324, 331, 332, 333, 334, 335, wetlands and water bodies cover the classes 411, 412, 421, 422, 423 and 511, 512, 521, 522 and 523.

Functional urban areas:

A city is a Local Administrative Unit (LAU) in which at least 50% of the population live in one or more urban centres.

The surrounding area or commuter zone includes the catchment areas of a city in which at least 15% of the employed population work in the related city.

A “functional urban area (FUA)” consist of a densely populated city and its less densely populated surrounding area, which is a commuter zone and whose labour market is strongly integrated into the city.

Groundwater body

According to DIN 4049, groundwater is defined as subterranean water which continuously fills the cavities in the earth and whose movement is almost exclusively determined by gravity. One speaks of a groundwater body if it is a delimited volume of groundwater within one or more aquifers.

Horizon 2020

The Horizon 2020 programme aims to create sustainable growth and jobs in Europe and to strengthen Europe’s competitiveness by promoting research. In addition to research, it also has a strong focus on innovation.

The programme is divided into three pillars. The first pillar promotes excellent science and, among other things, supports the best minds in Europe in all phases of their scientific careers. The second thematic focus is specifically aimed at industrial research and also has a special focus on small and medium-sized enterprises (SMEs). The third pillar deals with major societal challenges such as demographic change or a clean, affordable energy supply.

The basic idea of the programme is also a Europe-wide networking of research. Several institutions that have formed a consortium (cooperative projects) as well as individual researchers may apply. As a rule, the research has to be carried out across national borders, i.e. with partners from different European, but also non-European countries.

International Union for Conservation of Nature (IUCN)

The IUCN is an international non-governmental organisation and umbrella organisation for numerous international governmental and non-governmental organisations. The focus is on the protection of nature and species. Among other things, it creates the Red List of Threatened Species and categorises protected areas.

IUCN protected area categories system:

Category Ia/Ib: Strict Nature Reserve/Wilderness Area - a protected area that is mainly managed for research purposes or to protect large, unaffected wilderness areas

- Category II: National Park - a protected area that is mainly managed to protect ecosystems and for recreational purposes
- Category III: Natural Monument or Feature - a protected area that is mainly managed to protect a particular natural phenomenon
- Category IV: Habitat/Species Management Area - a protected area for the management of which targeted interventions are made
- Category V: Protected Landscape/Seascape - an area whose management is primarily aimed at protecting a landscape or a marine area and which serves recreational purposes
- Category VI: Protected Area with Sustainable Use of Natural Resources - an area whose management serves the sustainable use of natural ecosystems and habitats

Climate scenarios:

In the 5th Assessment Report of the Intergovernmental Panel on Climate Change, the climate projections were developed with the help of the "Representative Concentration Pathways" (RCP), which defined a change in radiative forcing (measure of the change in the earth's energy balance due to the change in the radiation effect from space in W/m²) by 2100 compared to the pre-industrial (1850) forcing in an easy way. For the 6th Assessment Report though, they are extended by socio-economic scenarios (Shared Socioeconomic Pathways SSP). They focus on social, demographic and economic changes on a global scale and also take political decisions into account. The former RCP2.6, RCP4.5, RCP6.0 and RCP8.5 have been updated to SSP1-2.6, SPP2-4.5, SSP4-6.0 and SSP5-8.5 and represent a combination of both approaches.

Climate models of the SSP1-2.6 and the SSP5-8.5 were used as data origin. They represent the average monthly maximum and minimum temperature as well as the average amount of precipitation for a month of the 2081-2100 period. The models used are as follows:

- BCC-CSM2-MR
- CNRM-CM6-1
- CNRM-ESM2-1
- CanESM5
- IPSL-CM6A-LR
- MIROC-ES2L
- MIROC6
- MRI-ESM2-0

The median was determined based on these models and an average was calculated for the summer months of June, July, August and for the winter months of December, January and February. They were compared with the historical monthly climate data of WorldClim version 2.1.

Quality of Life

Among the elements of quality of life, the indicators used are each assigned from a personal, socio-economic and ecological point of view.

Life maintenance

This area covers personal health and safety, e.g. life expectancy, traffic accidents; economic and societal health, e. g. household income, unemployment and risk of poverty; ecological health, e.g. air quality and impacts of climate change.

Life flourishing

The personal life flourishing e.g. includes suicide rate and openness towards people with disabilities, the community flourishing includes interpersonal trust and social commitment (e.g. voluntary work, community participation) as well as institutional and political trust, the ecological flourishing is measured by biodiversity and ecosystem services.

Good life enablers

In a personal sphere, this dimension includes aspects of housing, health and education (including furniture, costs of housing, accessibility of health infrastructure); in the socio-economic sphere, access to public transport and the availability of public services and cultural offers are taken into account; in the ecological sphere, green infrastructure and nature conservation are considered.

Local Administrative Units (LAU)

System of local administrative units compatible with the NUTS. These LAU are the building blocks of the NUTS and comprise local authorities of the European Union. By 2017, there were two local levels, since 2017, only one LAU level has been existing.

In 2017, there were 99,759 LAUs in the EU (the United Kingdom included).

Natura 2000

Natura 2000 is the EU-wide network of protected areas launched in 1992 to conserve endangered or typical habitats and species. It consists of the protected areas of the Birds Directive (Directive 2009/147/EC) and of the Habitats Directive (Directive 92/43/EEC).

The Natura 2000 sites are legally secured, for example, as nature reserves or protected landscapes. However, the use of the areas is still possible and even desirable if it does not affect the species and habitats concerned or contributes to their conservation. The point is to reconcile the interests of nature conservation with economic and social interests.

NEET

The term "NEET" is the abbreviation for "neither in education, employment or training" and refers to the group of adolescents and young adults who do not attend school, have no job and are not in vocational training. NEET expands the group of young unemployed to include the "economically inactive young people".

Next Generation Access - NGA

Next Generation Access (NGA), put simply, is the way in which currently existing telecommunications networks are converted into Internet Protocol (IP) technologies. It is a network technology in the context of which traditional circuit-switched telecommunications networks are replaced by a packet-switched network infrastructure and architecture that is compatible with the older telecommunications networks.

NUTS regions

The NUTS classification (Nomenclature of Territorial Units for Statistics) is a hierarchical system defined by regulation of the European Parliament and of the Council of the European Union to subdivide regions of the European Economic Area for the following purposes:

- collection, development and harmonisation of European regional statistics;
- socio-economic analyses of the regions.

It is divided into three regional levels:

- NUTS 1: major socio-economic regions
- NUTS 2: basic regions for the application of regional policies
- NUTS 3: small regions for specific diagnoses.

The definitions are usually based on national regional statistical units. They are revised every three years.

In the Atlas, the NUTS versions from 2016 and 2013 were used in accordance with the data origins.

Regional imbalance

The gross domestic product (GDP) is a measure of the total size of an economy and comprises the total value of all goods and services produced within an area after deducting intermediate consumption.

Measuring the GDP per inhabitant (per capita) enables to compare economies and regions of considerably different absolute sizes. Especially in purchasing power standards (PPS), this value is used adjusted for price levels to enable a comparison of the standard of living or the observation of the economic convergence or divergence in the European Union (EU). The GDP per capita in PPS is the central variable to determine the eligibility of the NUTS 2 regions in the context of the structural policy of the European Union.

Servitization

"Servitization" describes the change of a company away from the sole sale of a material product towards a combination of product offer and suitable service.

Groups of states (with German abbreviations)

- SAM: South America = Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Guyana, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Suriname, Uruguay, Venezuela, Caribbean, Bermuda
- WBA: Western Balkans = Albania, Bosnia-Herzegovina, North Macedonia, Kosovo, Montenegro, Serbia
- NOS: Middle East = Bahrain, Iran, Iraq, Israel, Yemen, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, United Arab Emirates
- OEU: Eastern Europe = Belarus, Moldova, Georgia, Russia, Ukraine
- ZAS: Central Asia = Afghanistan, Armenia, Azerbaijan, Kazakhstan, Kyrgyzstan, Mongolia, Nepal, Pakistan, Tajikistan, Turkmenistan, Uzbekistan
- SAS: South Asia = Bangladesh, Bhutan, India, Indonesia, Maldives, Myanmar, Seychelles, Sri Lanka
- OAS: East Asia = China, Japan, Cambodia, Laos, Malaysia, North Korea, Philippines, Singapore, South Korea, Taiwan, Thailand, Vietnam
- NAM: North America = Canada, United States of America
- OZE: Oceania = Australia, Fiji, Marshall Islands, Micronesia, Nauru, New Zealand, Palau, Papua New Guinea, Samoa, Solomon Islands, Timor-Leste, Tuvalu, Vanuatu
- NAF: North Africa = Egypt, Algeria, Libya, Morocco, Tunisia

AFR: Africa excluding North Africa (NAF)

Urban-rural typology

The classification is based on the determination of urban and rural cells within a 1km² grid. Urban grid cells meet two requirements: the population density is at least 300 inhabitants/km2 and neighbouring cells with the minimum population density have a total of at least 5,000 inhabitants. Other cells are rural.

The NUTS 3 regions, based on the proportion of the population in rural areas, are classified as follows:

"predominantly rural" when the proportion of the population living in rural areas is higher than 50%;

"intermediary" if the proportion of the population in rural areas is between 20% and 50%;

"predominantly urban" when the proportion of the population living in rural areas is less than 20%.

In order to avoid distortions caused by extremely small NUTS 3 regions, regions, that are smaller than 500 km2, are grouped together with one or more neighbouring regions for the purposes of classification.

Migrations

Net migration: the difference between the number of immigrations and emigrations in a certain area and a certain period (usually calendar year).

Migration rate: The migration rate corresponds to the net migration of a territorial unit per 1,000 inhabitants.

Abbreviations

BBSR	Federal Institute for Research on Building, Urban Affairs and Spatial Development
NUTS	Nomenclature of Territorial Units for Statistics
GDP	gross domestic product
OECD	Organisation for Economic Co-operation and Development
EFTA	European Free Trade Association
EEA	European Economic Area
MW	megawatt
GW	gigawatt
GWh	gigawatt hour
PPS	purchasing power standards
LAU	Local Administrative Units
m	million
bn	billion
CO_2	carbon dioxide
°C	Celsius degree
mm	millimetre
km	kilometre
EEA	European Environment Agency
JRC	Joint Research Centre
UN	United Nations
EU27	member states of the European Union (the United Kingdom excluded)
FUAs	functional urban areas
Interreg	European territorial cooperation
Interreg A	cross-border cooperation
Interreg B	transnational cooperation
ESPON	European Observation Network for Territorial Development and Cohesion
IUCN	International Union for Conservation of Nature
CORDIS	Community Research and Development Information Service

Country codes

AF	Afghanistan
AL	Albania
AM	Armenia
AT	Austria
AZ	Azerbaijan
BA	Bosnia and Herzegovina
BE	Belgium
BG	Bulgaria
BY	Belarus
CH	Switzerland
CY	Cyprus
CZ	Czechia
DE	Germany
DK	Denmark
EE	Estonia
EL	Greece
ES	Spain
FI	Finland
FR	France
GE	Georgia
HR	Croatia
HU	Hungary
IE	Ireland
IS	Iceland
IT	Italy
KS	Kosovo
LI	Liechtenstein
LT	Lithuania
LU	Luxembourg
LV	Latvia
MD	Moldova (the Republic of)
MK	North Macedonia
MN	Mongolia
MT	Malta
NL	Netherlands (the)
NO	Norway
PK	Pakistan
PL	Poland
PT	Portugal
RO	Romania
RS	Serbia
RU	Russian Federation (the)
SE	Sweden
SI	Slovenia
SK	Slovakia
SY	Syrian Arab Republic (the)
UA	Ukraine
UK	United Kingdom of Great Britain and Northern Ireland
TR	Turkey

World regions (with German abbreviations)

NOS	Middle East
WBA	Western Balkans
OEU	Eastern Europe
AFR	Africa
ZAS	Central Asia
SAS	South Asia
NAM	North America
OAS	East Asia
OZE	Oceania
NAF	North Africa
SAM	South America

Data origins

Settlements
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Transport network
- Eurogeographics, Euroglobalmap 2019

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- Copernicus Programme: Corine Landcover - CLC; 2018; v2018_20

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- Eurostat regarding urban-rural typology

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- The definition of cities and surrounding areas is based on the definition of functional urban areas (FUA) of the European Commission and the OECD

Components of population development
- Eurostat, OECD, national statistical offices

Regional migrations
- Eurostat

Countries of destination and origin of the migrations
- OECD, Eurostat

The diagram was created using SankeyMATIC

Older population
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Development of employment
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Regional differences
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Analysis of economic differences
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Air passenger flows
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The diagram was created using SankeyMATIC

Transnational cooperation
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