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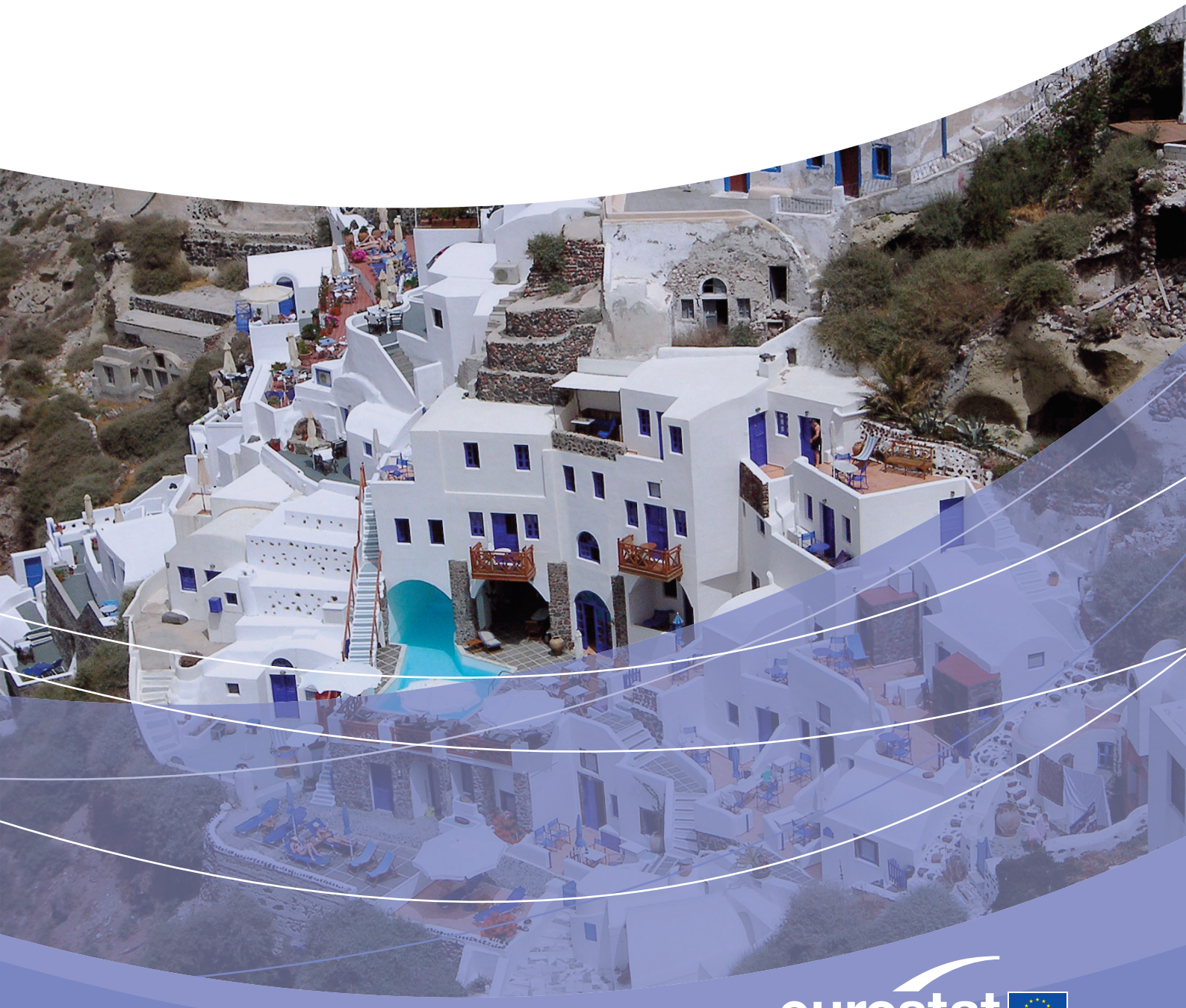

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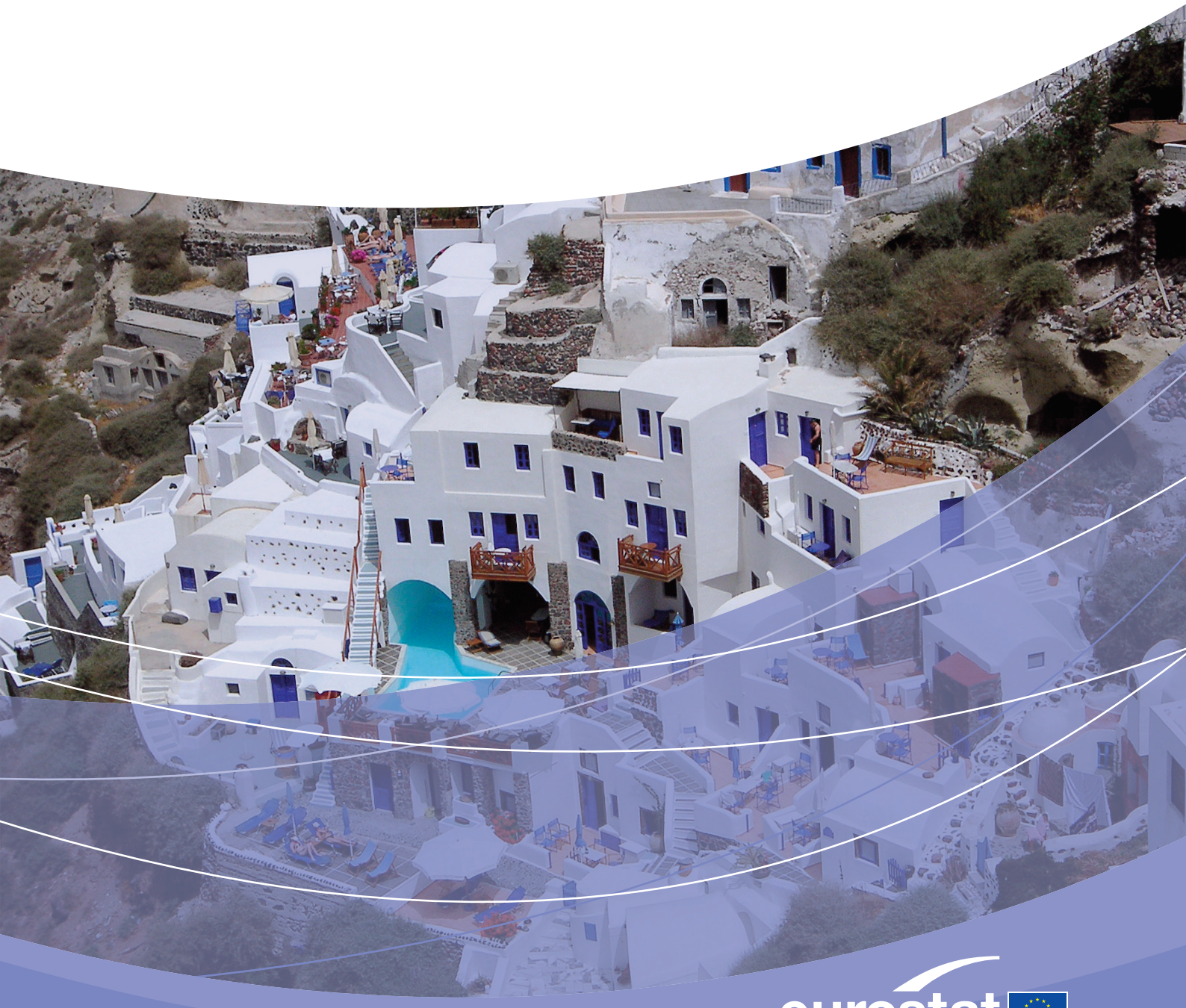

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Science, technology and innovation

8

Introduction

The Lisbon European Council (2000) and the Barcelona European Council (2002) both highlighted the important role of research and development (R & D) and innovation in the EU. Against this background, the 2005 initiative 'Working together for growth and jobs' relaunched the Lisbon strategy. 'Knowledge and innovation for growth' thus became one of the three main areas for action in the new Lisbon partnership for growth and jobs, which put science, technology and innovation at the heart of EU national and regional policies.

The concept of a European research area (ERA), introduced in 2000 as the contribution by research policy to the broader Lisbon strategy, has also been a highly successful tool for moving research higher up on the political agenda. Eight years of developing ERA have transformed it from a theoretical concept to a practical policy approach for improving the efficiency and effectiveness of fragmented research efforts and systems in Europe, increasing the attractiveness of Europe to researchers and research investment, and raising the coherence and synergies between research policy and other EU policies in order to implement the renewed Lisbon strategy.

This chapter presents statistical data and indicators based on a number of data sources available at Eurostat, which provide statistical information in order to compare the evolution and composition of science, technology and innovation (STI) in European regions and their position relative to other regions. The domains covered are: research and development (R & D); patents; high technology; and human resources in science and technology (HRST).

More regional indicators for science, technology and innovation are available on the Eurostat webpage under 'Science and technology'.

Research and development

Increasing investment in R & D is one of the key objectives of the Lisbon strategy. A substantial increase in investment in R & D is important as a means of providing a significant boost to the industrial competitiveness of the European Union.

Some 20 of the regions shown in Map 8.1 have an R & D intensity above the 3 % target specified in the Lisbon strategy for the EU as a whole. Although this target remains the EU objective for 2010, most countries have specified their own targets in national reform programmes. The national targets range from 0.75 % in the case of Malta to 4 % for Finland and Sweden, and — if met — they will bring the average R & D performance in the EU to around 2.6 % by 2010.

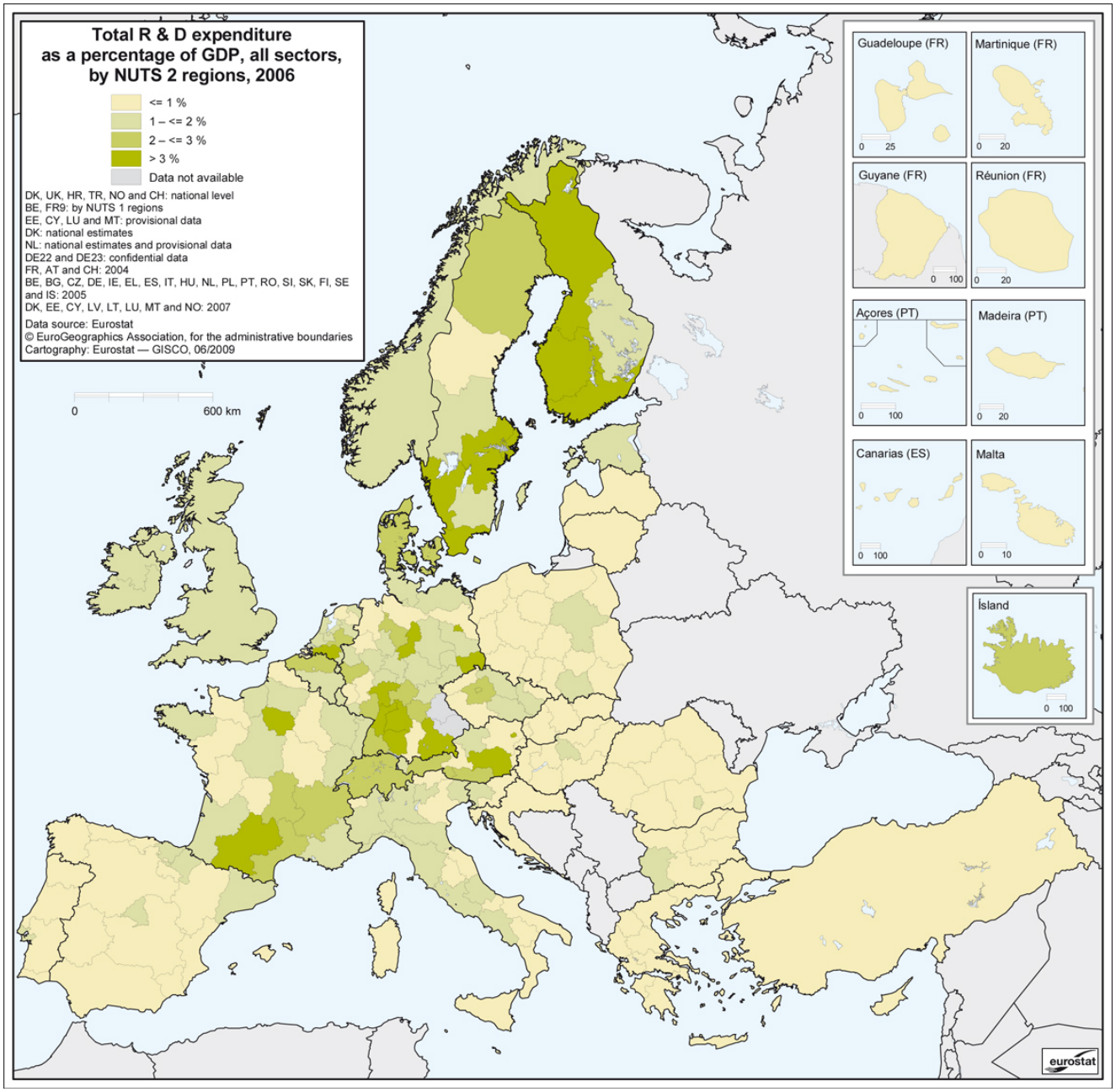
On the map, the largest cluster of regions with a relatively high R & D intensity, i.e. above 2 %, can be found in southern Germany, spreading out to Austria and through Switzerland into France all the way to the Pyrenees. It is also clear from the map that regions containing capital cities tend to be relatively R & D intensive. The regions containing the capitals Sofia, București, Budapest, Warszawa, Wien, Madrid and Roma are the most R & D intensive regions in their respective countries. This fact is further illustrated by the region that surrounds Praha, and to some extent by the region containing Paris, which is the second most R & D intensive of the French regions. However, when ranking the German regions, Berlin comes only sixth, even though its R & D intensity is well above 3 %.

Regions with a lower R & D intensity are found mainly in the southern and eastern parts of the EU. It is also here that we find many of the regions with the fastest-growing R & D intensities. Of the 30 regions that have recorded an annual average growth rate of over 10 % since 2000, six are Greek, two are Czech, two are Spanish, one is Portuguese and one is Romanian. Estonia, Malta and Slovenia are also among these fast-growing regions.

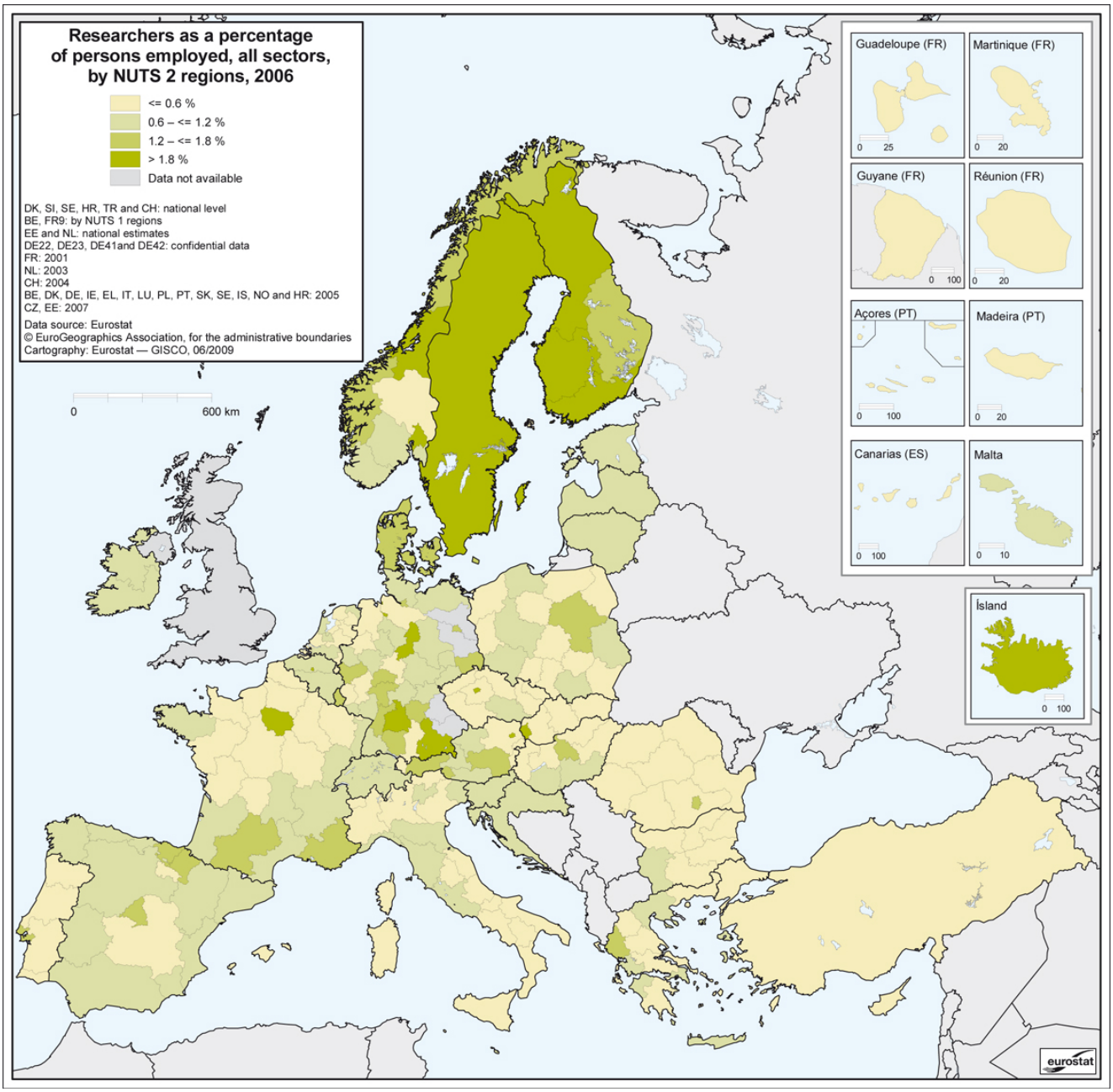
R & D personnel is the other basic R & D input indicator (besides R & D expenditure) that measures the human resources going directly into R & D activities. R & D personnel comprise three categories: researchers, technicians and other support staff. Of these, researchers are the most important in terms of R & D activities. They are professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems, and in the management of the projects concerned.

Map 8.2 shows the regional pattern of distribution of researchers (expressed as a percentage of total employment) across Europe. In 15 European regions over 1.8 % of all persons employed are researchers. Trøndelag (Norway) is the leading region, with a share of 3.16 %, which is more than three times higher than the EU-27 average. This group also comprises one other Norwegian region, four German regions, three Finnish regions

Map 8.1: Total R & D expenditure as a percentage of GDP, all sectors, by NUTS 2 regions, 2006



Map 8.2: Researchers as a percentage of persons employed, all sectors, by NUTS 2 regions, 2006



and one region each from the Czech Republic, Austria, Slovakia, Belgium, Iceland and France. Sweden, for which only data at the country level is available, also has more than 1.8 % researchers in total employment. In a further 48 regions, the concentration of researchers is above the EU-27 average (0.9 %) and, once again, most of these regions (18) are in Germany.

The number of researchers as a percentage share of all persons employed in the foremost region of nine countries is below the EU-27 average (0.9 %): these countries are Bulgaria, Cyprus, Latvia, Lithuania, Malta, the Netherlands, Slovenia, Croatia and Turkey. The regions with the lowest concentration of researchers are in Bulgaria (Severozapaden, with 0.08 %), Romania (Sud-Est, with 0.13 %), the Netherlands (Friesland, with 0.13 %) and the Czech Republic (Severozápad, with 0.15 %).

Regional disparities exist not only between countries but also between regions of the same country. The largest difference between the leading region and the bottom region is observed in the Czech Republic (2.88 percentage points between Praha and Severozápad). Austria, Germany, Finland, Slovakia and Norway also present disparities of more than 2 percentage points. At the other end of the scale, the smallest gap is in Ireland, with 0.03 percentage points, followed by the Netherlands with 0.73 percentage points.

Human resources in science and technology

Without sufficient amounts of human resources there can be no growth. As science and technology have been recognised as key fields for European development, it is therefore of considerable importance for policymakers at a regional level (as well as at EU and national levels) to analyse the stock of highly qualified people.

One way to measure the concentration of highly qualified people in the regions is by looking at the human resources in science and technology (HRST). HRST defines those who have completed a tertiary level of education and/or are employed in a science and technology occupation where a tertiary level of education is normally required. HRSTO is a sub-group of HRST denoting those employed in a science and technology occupation.

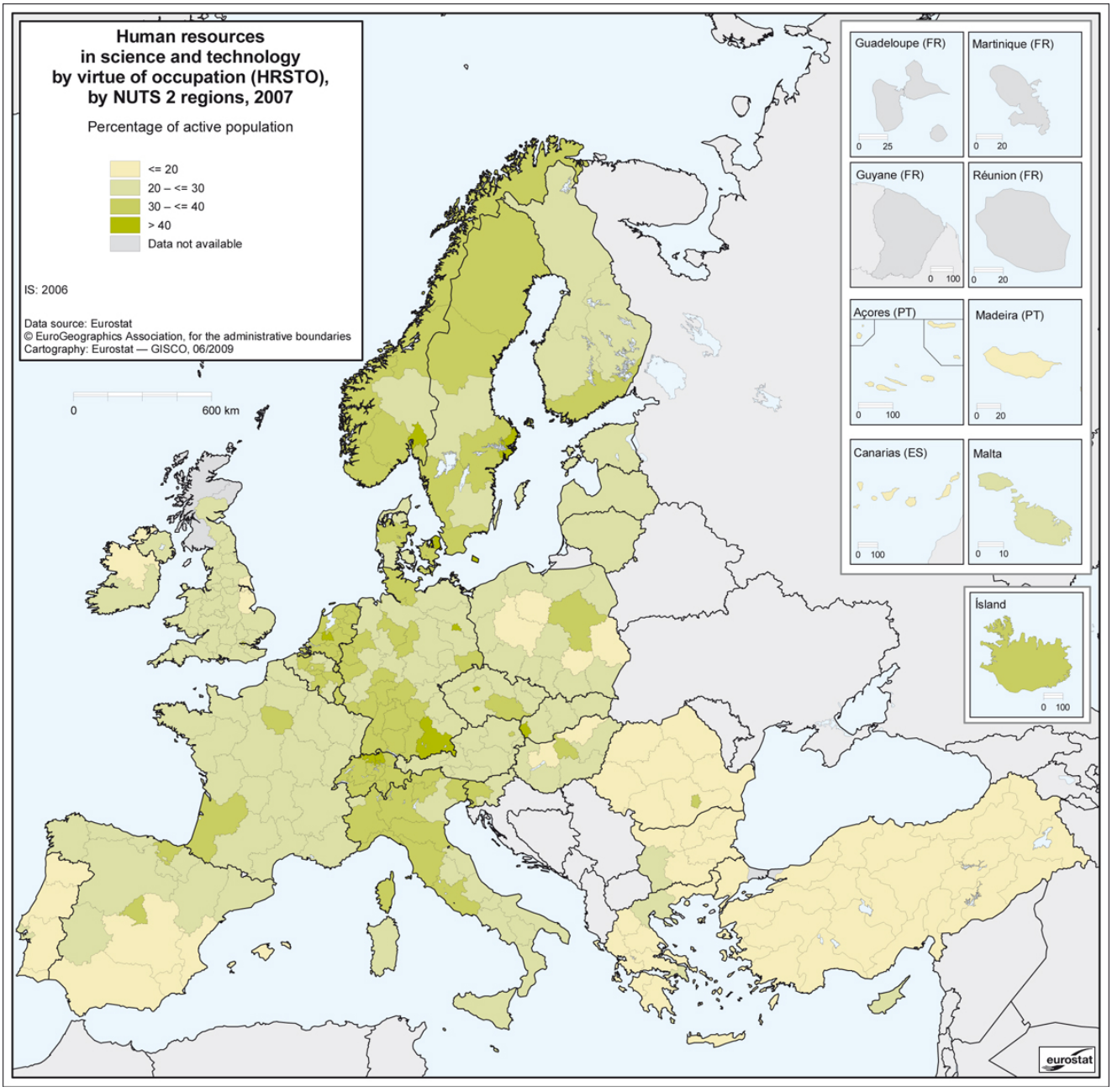
As Map 8.3 shows, there is an urban concentration of HRSTO in particular around the capital regions. In such regions there is often a high concentration of highly qualified jobs, for example owing to the presence of the head offices of companies and government institutions. However, another factor is that capitals are often big cities that naturally contain large groups of higher education facilities, and thus a large number of highly educated people. This makes these and the nearby regions safe places for new companies to open up businesses, thanks to the supply of highly skilled human resources that are already present in the region. At the same time, highly skilled people can be attracted to larger cities as they are also more likely to find a skilled job that meets their requirements in a region where there are many companies.

This urban concentration of human resources employed in science and technology can be seen in Map 8.3, by looking at the capital regions and also at two of the three large regional clusters with shares of HRSTO exceeding 30 %. This particular cluster stretches from the Italian region Lazio in the south up through Switzerland to the south-western parts of Germany. In the main, the regions in this cluster are very densely populated, as are the regions in the second distinct cluster which contains the regions of the Benelux countries. The third cluster is in the Scandinavian countries, where the regions — apart from the capital regions — are very sparsely populated. In Scandinavia we also find the regions with the second, third and fourth-highest share of HRSTO; they are Stockholm in Sweden (48 %), Oslo og Akershus in Norway (48 %) and Hovedstaden in Denmark (44 %) respectively. The highest share, however, is found in Praha (Czech Republic), where 52 % of the labour force are HRSTO. It is interesting to note that, two years previously, the top three regions were the same and that their shares have since increased. The share for Praha has increased the most, up from 47 % of HRSTO two years ago. Stockholm and Oslo og Akershus have each increased their shares by 2 percentage points during the past two years.

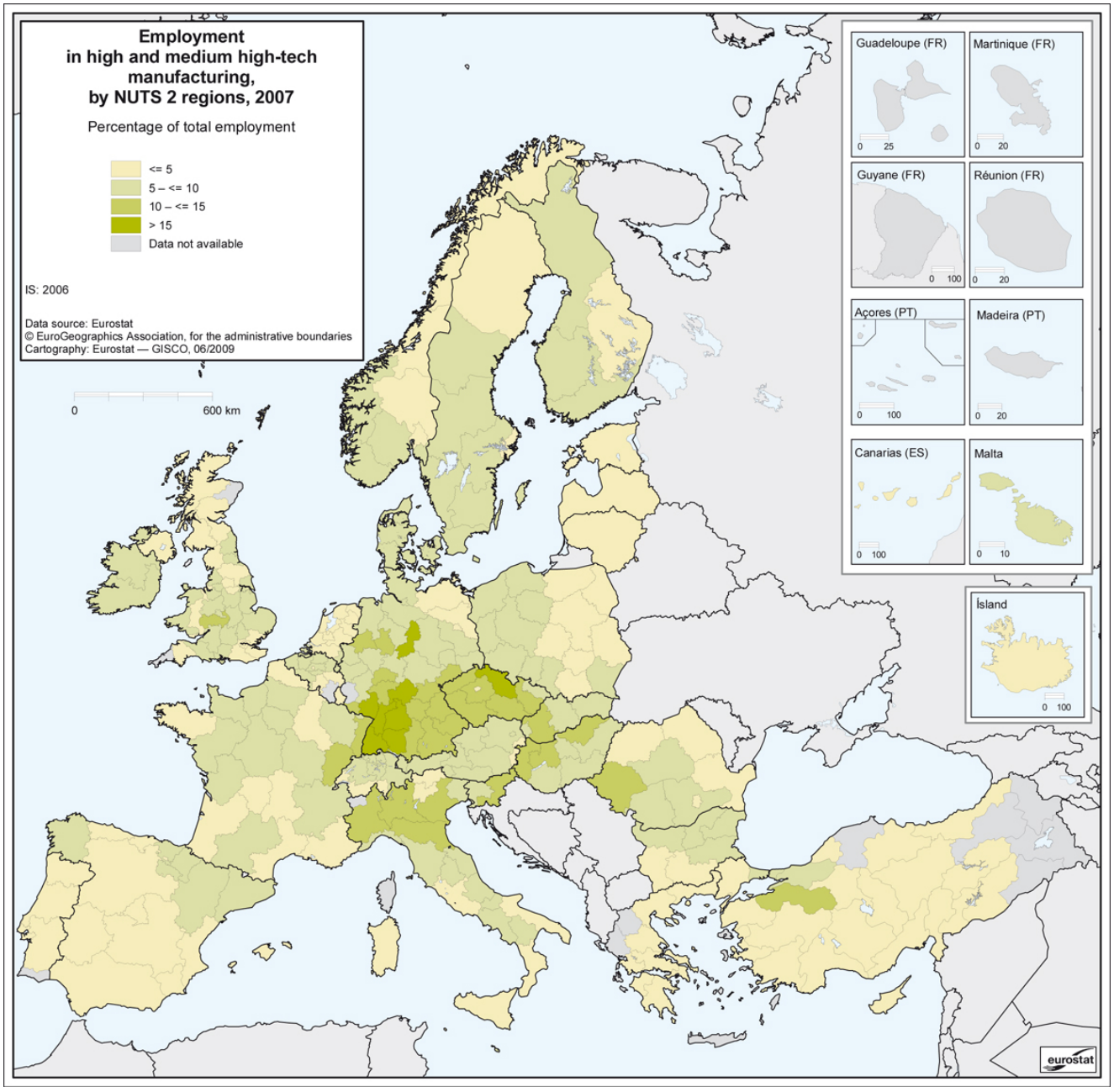
High-tech industries and knowledge-intensive services

The statistics on high-tech industries and knowledge-intensive services include employment data by sectors of economic activity. Based on the ratio of R & D expenditure to GDP (R & D intensity), sectors can be classified into more specific subsectors so as to analyse employment in science and technology. Two subsectors that are of great importance to science and technology are the high-tech manufacturing and medium high-tech manufacturing sectors, even though they

Map 8.3: Human resources in science and technology by virtue of occupation (HRSTO), by NUTS 2 regions, 2007
Percentage of active population



Map 8.4: Employment in high- and medium high-tech manufacturing, by NUTS 2 regions, 2007
Percentage of total employment



accounted for only 1.1 % and 5.6 % respectively of EU employment in 2007. High-tech manufacturing includes, for example, manufacture of computers, televisions and medical instruments, while medium high-tech manufacturing includes, for example, manufacture of chemicals, machinery and transport equipment.

Map 8.4 shows employment in the two subsectors — high-tech and medium high-tech manufacturing — as a percentage of total employment. Employment in these two subsectors is very high in the central European regions, in a band stretching from Franche-Comté (France) in the west to Észak-Magyarország (Hungary) in the east. Stuttgart and Braunschweig (both Germany) are the only regions with more than one in five employed persons working in these subsectors; both regions have a share of 22 %. In fact, the seven leading regions are all German (in addition to Stuttgart and Braunschweig, they include Karlsruhe, Tübingen, Rheinhessen-Pfalz, Unterfranken and Freiburg).

Furthermore, Map 8.4 shows a cluster of four Italian regions (Piemonte, Emilia-Romagna, Lombardia and Veneto) with relatively high shares

Table 8.1: 25 leading regions in employment in knowledge-intensive services and high-tech knowledge-intensive services, 2007

Knowledge-intensive services (KIS)			High-tech knowledge-intensive services (High-tech KIS)		
	% of total employment	Total number (1 000s)	Total number (1 000s)	% of total employment	
Inner London (UK)	59.7	785	101	8.9	Berkshire, Buckinghamshire and Oxfordshire (UK)
Stockholm (SE)	55.8	564	84	8.3	Stockholm (SE)
Oslo og Akershus (NO)	54.1	317	43	7.4	Oslo og Akershus (NO)
Hovedstaden (DK)	51.7	451	44	7.0	Praha (CZ)
Åland (FI)	49.9	7	204	6.7	Comunidad de Madrid (ES)
Zürich (CH)	49.7	365	52	6.6	Bedfordshire and Hertfordshire (UK)
Berlin (DE)	49.5	738	56	6.4	Hovedstaden (DK)
Noord-Holland (NL)	49.1	674	21	6.4	Bratislavský kraj (SK)
Utrecht (NL)	48.0	299	33	6.2	Auvergne (FR)
Övre Norrland (SE)	47.9	119	29	6.2	Prov. Vlaams Brabant (BE)
Surrey, East and West Sussex (UK)	47.9	614	77	6.2	Közép-Magyarország (HU)
Sydsverige (SE)	47.4	306	135	6.1	Lazio (IT)
Östra Mellansverige (SE)	47.3	347	56	6.1	Hampshire and Isle of Wight (UK)
Région de Bruxelles-Capitale/ Brussels Hoofdstedelijk Gewest (BE)	47.2	180	133	6.1	Outer London (UK)
Mellersta Norrland (SE)	47.2	85	11	6.0	Flevoland (NL)
Outer London (UK)	47.2	1 037	36	5.9	Utrecht (NL)
Nord-Norge (NO)	47.0	109	76	5.8	Inner London (UK)
Groningen (NL)	46.8	132	103	5.8	Darmstadt (DE)
Berkshire, Buckinghamshire and Oxfordshire (UK)	46.5	529	297	5.7	Île de France (FR)
Prov. Brabant Wallon (BE)	46.1	71	74	5.7	Etelä-Suomi (FI)
Gloucestershire, Wiltshire and Bristol/ Bath area (UK)	46.1	529	70	5.6	Karlsruhe (DE)
Västsverige (SE)	45.8	420	62	5.4	Gloucestershire, Wiltshire and Bristol/ Bath area (UK)
Région lémanique (CH)	45.5	330	110	5.4	Oberbayern (DE)
Île de France (FR)	45.5	2 356	79	5.3	Berlin (DE)
Trøndelag (NO)	45.4	99	8	5.2	Prov. Brabant Wallon (BE)

of employment in high- and medium high-tech manufacturing. In the other parts of Europe only three regions have more than 10 % of their employment in high- or medium high-tech manufacturing; they are Vest (Romania), Bursa (Turkey) and Herefordshire, Worcestershire and Warwickshire (United Kingdom).

Another subsector of interest is knowledge-intensive services (KIS). KIS can be further split into different categories, of which high-tech knowledge-intensive services (high-tech KIS) is a subsector of special interest when analysing employment in science and technology. Examples of services in high-tech KIS include computer and related activities, and research and development. KIS, on the other hand, is broader and, in addition to high-tech KIS, also includes water and air transport, financial intermediation, education and health and social work, for example.

Table 8.1 shows the 25 leading regions in KIS and in high-tech KIS. As KIS generally attracts highly educated persons, there is a similar pattern to that seen in Map 8.3 for human resources in science and technology (HRST), namely that urban regions, especially capital regions, often exhibit high shares of employment in KIS and high shares of HRST.

Looking at Table 8.1, the four leading regions were all capital regions, with Inner London (United Kingdom) showing the highest percentage of KIS (59.7 %). By far the majority of the leading regions are urban, or within commuting distance of an urban region. The one exception is Åland, an autonomous province of Finland consisting of islands. As shipping is an important part of this region's economy, it is one of the major reasons behind the high share of KIS in Åland.

Another feature that stands out is the fact that six of Sweden's eight regions are represented among the 25 regions with the highest shares of KIS. This can be explained in part by the fact that Sweden has a large public sector, which includes the education and healthcare sectors. Looking at the right-hand side of the table, which shows the 25 leading regions in high-tech KIS, only one Swedish region remains. This region, the Swedish capital region Stockholm, had 8 % of its employment in high-tech KIS, which is the second-highest share after Berkshire, Buckinghamshire and Oxfordshire (United Kingdom), with 9 %. Further examination shows that 13 of the 25 regions with the highest percentage of employment in high-tech KIS were capital regions (including both Inner London and Outer London).

One interesting feature here is that three of the five regions with the highest shares of employment in high-tech KIS in 2007 were also among the five highest in 2002, when Stockholm (Sweden) was the leading region, followed by Berkshire, Buckinghamshire and Oxfordshire (United Kingdom). Bratislavský kraj (Slovakia) followed in third place and Île-de-France (Paris) in fourth — which was somewhat surprising compared to its 19th position in 2007. Oslo og Akershus was in fifth place in 2002.

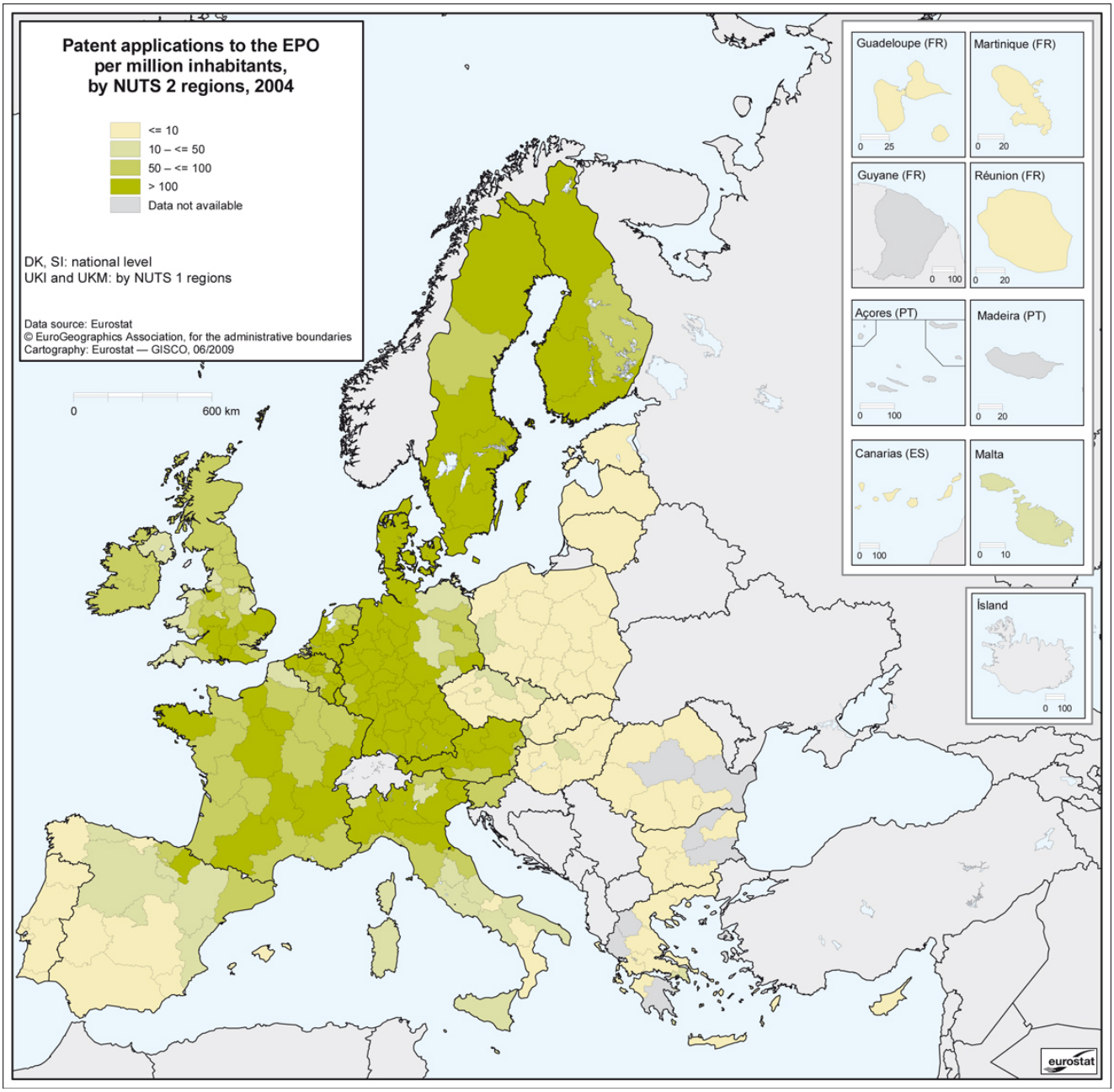
Patents

Indicators based on patent statistics are widely used in order to assess the inventive and innovative performance of a country or a region. The current emphasis on innovation as a source of industrial competitiveness has raised awareness of patents. Patents are used to protect R & D results, but they are just as significant as a source of technical information, which may avoid reinventing and redeveloping ideas because of a lack of information. Patent statistics at regional level are confined to applications to the European Patent Office (EPO). The data are regionalised by linking postcodes or city names to the nomenclature of territorial units for statistics (NUTS).

Map 8.5 illustrates the regional patenting activity in the EU. In most European countries, national patenting is concentrated in certain regions. Regions that are active in patenting are often situated close together, i.e. they form economic clusters. This is the case, for example, in the southern part of Germany, the south-east of France and the north-west of Italy. The most active patenting regions (with 100 to 300 applications and more than 300 applications per million inhabitants) are situated in the Nordic countries and in the centre of the EU-27.

Patent activity varies not only across countries but also across regions. In 2004, Île-de-France (France) was the foremost EU region in terms of total number of patent applications (3 297), while Noord-Brabant (Netherlands) was in the lead for patent applications per million inhabitants (761). In Germany large disparities were observed between the leading region of Stuttgart in the south and the lowest-performing region of Sachsen-Anhalt in the east. Regional discrepancies are even wider in the Netherlands, between Noord-Brabant and Friesland. Regional disparities, however, are much lower in countries with comparable national averages, such as Finland and Sweden.

Map 8.5: Patent applications to the EPO per million inhabitants, by NUTS 2 regions, 2004



Conclusion

Relevant and meaningful indicators on science, technology and innovation are of paramount importance for informing policymakers about where European regions stand on the path towards more knowledge and growth. This information is also necessary in order to gain a better picture of how regions are evolving, compared between themselves both at European level and worldwide.

With the aid of the relevant statistics and indicators, this chapter has demonstrated the progress made in recent years on research and development activities in European regions. Wide use is also made of statistics on high-tech industries and knowledge-intensive services, patents and human resources in science and technology in order to complete this regional picture.

Methodological notes

The data in the maps and tables in this chapter are, wherever possible, by NUTS 2 regions. Data are extracted from the 'Science, technology and innovation' domain and, more specifically, from the sub-domains 'Research and development', 'Human resources in science and technology', 'High-technology industries and knowledge-intensive services' and 'Patents'.

Statistics on research and development are collected by Eurostat under the legal requirements of Commission Regulation (EC) No 753/2004, which determines the data set, breakdowns, frequency and transmission delays. The methodology for national R & D statistics is further laid down in the *Frascati manual*: *proposed standard practice for surveys on research and experimental development* (OECD 2002), which is also used by many non-European countries.

The statistics on **Human resources in science and technology (HRST)** are compiled annually, based on microdata extracted from the EU labour force survey (EU LFS). The basic methodology for these statistics is laid down in the *Canberra manual*, which lists all the HRST concepts.

The data on **High-technology industries and knowledge-intensive services** are compiled annually, based on data collected from a number of official sources (EU LFS, structural business statistics, etc.). The high-technology employment aggregates are defined in terms of R & D intensity, calculated as the ratio of R & D expenditure on the relevant economic activity to its value added, and based on the Statistical Classification of Economic Activities in the European Community (NACE). Recently, the NACE was revised from Rev. 1.1 to Rev. 2, which led to changes in the high-technology and knowledge-intensive sectors. However, the statistics in this chapter are still based on NACE Rev. 1.1.

Finally, the data on **Patent applications to the EPO** are compiled on the basis of microdata received from the European Patent Office (EPO). The patent data reported include the patent applications filed at the EPO during the reference year, classified by the inventor's region of residence and in accordance with the international patents classification of applications. Patent data are regionalised using procedures linking postcodes and/or place names to NUTS 2 regions.

Patent statistics published by Eurostat are almost exclusively based on the European Patent Office (EPO) Worldwide Statistical Patent Database, Patstat, developed by the EPO in 2005, using its patent data collection and its knowledge of patent data. The data are largely taken from the EPO's master bibliographic database, DocDB, which is also known as the EPO Patent Information Resource. It includes bibliographic details on patents filed at 73 patent offices worldwide and contains more than 50 million documents. It covers a large number of fields included in patent documents, such as application details (claimed priorities, application and publication), technology categories, inventors and applicants, title and abstract, patent citations and non-patent literature text.