



Regional Innovation Scoreboard 2021

Methodology Report



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as part of the **European Innovation Scoreboards (EIS) project** for the European Commission, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs.

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1. Introduction

The Regional Innovation Scoreboard (RIS) is the regional extension of the European Innovation Scoreboard. The European Innovation Scoreboard (EIS) provides a comparative assessment of the innovation performance at the country level of the EU Member States and other European countries. The RIS 2021 uses as many indicators as possible from the EIS, including regional data from the Community Innovation Survey (CIS).

The RIS 2021 follows the revised methodology of the EIS 2021 and uses data for 240 regions across Europe for 21 of the 32 indicators used in the EIS 2021. Compared to the RIS 2019, regional coverage has changed for Croatia from two to four regions following a revision from the 2016 edition to the 2021 edition of the NUTS classification. Compared to the RIS 2019, four new indicators have been included: Individuals who have above basic overall digital skills, Innovation expenditures per person employed, Employed ICT specialists, and Air emissions in fine particulates (PM_{2.5}) in Industry. More details on the revised EIS measurement framework are available in the EIS 2021 Methodology report.

The RIS Methodology Report describes the indicators included in the RIS 2021, data availability, and methods used for estimating missing data. Section 2 provides details on the indicators used in the RIS 2021. Section 3 explains the imputation techniques used for estimating missing data. Section 4 discusses the methodology used for calculating regional composite indicators and the methodology used for determining regional performance group membership. Regional innovation performance is measured using a composite indicator – the Regional Innovation Index – which summarises the performance of the indicators used in the RIS 2021. Section 5 presents the definitions for the structural indicators used in regional profiles.

2. Regional Innovation Scoreboard indicators

In the RIS, regional innovation performance should, if possible, be measured using the full measurement framework of the European Innovation Scoreboard (EIS), i.e. using regional data for the same indicators applied to measure innovation performance at the country level. However, for many indicators used in the EIS, regional data are not available.

The RIS is limited to using regional data for 21 of the 32 indicators used in the EIS 2021 (Table 1). For several indicators, slightly different definitions have been applied, as regional data would not be available if the definitions were the same as in the EIS:

- Regional data are not available for *Individuals who have above basic overall digital skills*. The indicator correlates highly at the country level with Households with broadband access, and regional data for the latter are used to calculate regional estimates for this indicator as follows:

Regional score for Individuals who have above basic overall digital skills
= Regional score for Households with broadband access / Country score
for Households with broadband access * Country score for Individuals
who have above basic overall digital skills

- For the indicators using expenditure data from the Community Innovation Survey (CIS) – *Non-R&D innovation expenditures*, *Innovation expenditures per person employed in innovation-active enterprises*, and *Sales of new-to-market and new-to-enterprise innovations* – the data refer only to SMEs and not to all enterprises.
- Regional data are not available for *Employed ICT specialists*. The indicator correlates highly at the country level with Employment in information and communication (NACE J), and regional data for the latter are used to calculate regional estimates for this indicator as follows:

Regional score for Employed ICT specialists = Regional score for
Employment in information and communication (NACE J) / Country score
for Employment in information and communication (NACE J) * Country
score for employed ICT specialists

- For *PCT patent applications*, regional data have been extracted from the OECD's REGPAT database.
- For *Design applications*, the EIS uses data on individual design applications, for which regional data are not available. The RIS instead uses data on design applications, where a design application can include more than one individual design application.
- For *Employment in knowledge-intensive activities*, regional data are also not available, The RIS instead uses data on Employment in medium-high and high-tech manufacturing and knowledge-intensive services.

In this report the indicator names of the EIS will be used also for the indicators for which either alternative indicators will be used or where regional data have been estimated.

Table 1: A comparison of the indicators included in the European Innovation Scoreboard and the Regional Innovation Scoreboard

	EIS 2021	RIS 2021
FRAMEWORK CONDITIONS		
Human resources	<i>Doctorate graduates per 1000 population aged 25-34</i>	<i>No regional data</i>
	Percentage of population aged 25-34 having completed tertiary education	Identical
	Lifelong learning, the share of population aged 25-64 enrolled in education or training aimed at improving knowledge, skills and competences	Identical
Attractive research systems	International scientific co-publications per million population	Identical
	Scientific publications among the top-10% most cited publications worldwide as percentage of total scientific publications of the country	Identical
	<i>Foreign doctorate students as percentage of all doctorate students</i>	<i>No regional data</i>
Digitalisation	<i>Broadband penetration (Share of enterprises with a maximum contracted download speed of the fastest fixed internet connection of at least 100 Mb/s)</i>	<i>No regional data</i>
	Individuals who have above basic overall digital skills	Own estimates using Households with broadband access
INVESTMENTS		
Finance and support	R&D expenditure in the public sector as percentage of GDP	Identical
	<i>Venture capital expenditure as percentage of GDP</i>	<i>No regional data</i>
	<i>Direct government funding and government tax support for business R&D</i>	<i>No regional data</i>
Firm investments	R&D expenditure in the business sector as percentage of GDP	Identical
	Non-R&D innovation expenditures as percentage of total turnover	Data for SMEs
	Innovation expenditures per person employed in innovation-active enterprises	Data for SMEs
Use of information technologies	<i>Enterprises providing training to develop or upgrade ICT skills of their personnel</i>	<i>No regional data</i>
	Employed ICT specialists	Estimates using Employment in information and communication
INNOVATION ACTIVITIES		
Innovators	SMEs introducing product innovations as percentage of SMEs	Identical
	SMEs introducing business process innovations as percentage of SMEs	Identical
Linkages	Innovative SMEs collaborating with others as percentage of SMEs	Identical
	Public-private co-publications per million population	Identical
	<i>Job-to-job mobility of Human Resources in Science & Technology</i>	<i>No regional data</i>
Intellectual assets	PCT patent applications per billion GDP (in Purchasing Power standards)	Identical
	Trademark applications per billion GDP (in Purchasing Power standards)	Identical
	Individual design applications per billion GDP (in Purchasing Power standards)	Design applications

	EIS 2021	RIS 2021
IMPACTS		
Employment impacts	Employment in knowledge-intensive activities as percentage of total employment	Employment in medium-high and high-tech manufacturing and knowledge-intensive services
	Employment in innovative enterprises	Data for SMEs
Sales impacts	<i>Medium and high-tech product exports as percentage of total product exports</i>	<i>No regional data</i>
	<i>Knowledge-intensive services exports as percentage of total service exports</i>	<i>No regional data</i>
	Sales of new-to-market and new-to-enterprise product innovations as percentage of total turnover	Data for SMEs
Environmental sustainability	<i>Resource productivity</i>	<i>No regional data</i>
	Air emissions in fine particulates (PM2.5) in Industry	Exposure to fine particulates (PM2.5)
	<i>Development of environment-related technologies</i>	<i>No regional data</i>

2.2 Indicator definitions

This section presents detailed definitions for each of the indicators used in the RIS 2021. For each indicator, the following information is provided: definitions of the numerator and denominator, a short rationale, the source of the data, and data availability. The numbering of the indicators follows that of the indicators in the EIS 2021, as shown in Table 1 above.

Percentage population aged 25-34 having completed tertiary education	
Numerator	Number of persons in age class with some form of post-secondary education
Denominator	The reference population is all age classes between 25 and 34 years inclusive
Rationale	This is a general indicator of the supply of advanced skills. It is not limited to science and technical fields, because the adoption of innovations in many areas, including the service sectors, depends on a wide range of skills. The indicator focuses on a narrow share of the population aged 25 to 34 and will relatively quickly reflect changes in educational policies leading to more tertiary graduates
Included in EIS	Same definition
Data source	Eurostat, regional statistics
Data availability	NUTS 2: 2012 - 2019

Percentage population aged 25-64 participating in lifelong learning	
Numerator	Number of persons in private households aged between 25 and 64 years who have participated in the four weeks preceding the interview, in any education or training, whether or not relevant to the respondent's current or possible future job
Denominator	Total population aged between 25 and 64 years
Rationale	Lifelong learning encompasses all purposeful learning activity, whether formal, non-formal or informal, undertaken on an ongoing basis with the aim of improving knowledge, skills and competence. The intention or aim to learn is the critical point that distinguishes these activities from non-learning activities, such as cultural or sporting activities
Included in EIS	Same definition
Data source	Eurostat, regional statistics
Data availability	NUTS 2: 2012 - 2019

International scientific co-publications per million population	
Numerator	Number of scientific publications with at least one co-author based abroad
Denominator	Total population
Rationale	International scientific co-publications are a proxy for the quality of scientific research as collaboration increases scientific productivity
Included in EIS	Same definition
Data source	Numerator: Scopus. Data calculated by Science-Metrix as part of a contract to the EC Denominator: Eurostat
Data availability	NUTS 2: 2013 - 2020

Scientific publications among the top-10% most cited publications worldwide	
Numerator	Number of scientific publications among the top-10% most cited publications worldwide
Denominator	Total number of scientific publications
Rationale	The indicator is a measure for the efficiency of the research system as highly cited publications are assumed to be of higher quality. There could be a bias towards small or English-speaking countries given the coverage of Scopus' publication data
Included in EIS	Same definition
Data source	Scopus. Data calculated by Science-Metrix as part of a contract to the EC
Data availability	NUTS 2: 2011 - 2018

Individuals who have above basic overall digital skills	
Numerator	Number of individuals with above basic overall digital skills
Denominator	Total number of individuals aged 16 to 74
Rationale	Above basic overall digital skills represents the highest level of the overall digital skills indicator, which is a composite indicator based on selected activities performed by individuals aged 16-74 on the internet in four specific areas (information, communication, problem solving, content creation) during the previous 3 months
Included in EIS	Alternative for the indicator used in the EIS
Data source	Own estimates combining EIS country level with regional data (Eurostat) on Households with broadband access
Data availability	NUTS 2: 2015 - 2019

R&D expenditures in the public sector as percentage of GDP	
	All R&D expenditures in the government sector (GOVERD) and the higher education sector (HERD)
Denominator	Regional Gross Domestic Product
Rationale	R&D expenditure represents one of the major drivers of economic growth in a knowledge-based economy. Trends in the R&D expenditure indicator provide key indications of the future competitiveness and wealth of a region. R&D spending is essential for making the transition to a knowledge-based economy as well as for improving production technologies and stimulating growth
Included in EIS	Same definition
Data source	Eurostat, regional statistics
Data availability	NUTS 2: 2011 - 2018

R&D expenditures in the business sector as percentage of GDP	
Numerator	All R&D expenditures in the business sector (BERD)
Denominator	Regional Gross Domestic Product
Rationale	The indicator captures the formal creation of new knowledge within firms. It is particularly important in the science-based sector (pharmaceuticals, chemicals and some areas of electronics), where most new knowledge is created in or near R&D laboratories
Included in EIS	Same definition
Data source	Eurostat, regional statistics
Data availability	NUTS 2: 2011 - 2018

Non-R&D innovation expenditures in SMEs as percentage of turnover	
Numerator	Sum of total innovation expenditure for SMEs, excluding intramural and extramural R&D expenditures
Denominator	Total turnover for SMEs
Rationale	This indicator measures non-R&D innovation expenditure as percentage of total turnover. Several of the components of innovation expenditure, such as investment in equipment and machinery and the acquisition of patents and licenses, measure the diffusion of new production technology and ideas
Included in EIS	Proxy for EIS indicator including all enterprises
Data source	Community Innovation Survey: Eurostat and National Statistical Offices
Data availability	NUTS 1 and 2 for different countries for CIS 2012, CIS 2014, CIS 2016, CIS 2018

Innovation expenditures per person employed in innovative SMEs	
Numerator	Sum of total innovation expenditure by enterprises in all size classes in Purchasing Power Standards (PPS)
Denominator	Total employment in innovative enterprises SMEs
Rationale	The indicator measures the monetary input directly related to innovation activities.
Included in EIS	Proxy for EIS indicator including all enterprises
Data source	Community Innovation Survey: Eurostat and National Statistical Offices
Data availability	NUTS 1 and 2 for different countries for CIS 2012, CIS 2014, CIS 2016, CIS 2018

ICT specialists (as a percentage of total employment)	
Numerator	Number of employed ICT specialists
Denominator	Total employment
Rationale	Eurostat defines ICT specialists as "workers who have the ability to develop, operate and maintain ICT systems, and for whom ICT constitute the main part of their job". The indicator captures the use of Information technologies
Included in EIS	Alternative for the indicator used in the EIS
Data source	Own estimates combining EIS country level with regional data (Eurostat) on Employment in information and communication (NACE J)
Data availability	NUTS 1 and 2 for different countries for 2012 - 2019

SMEs introducing product innovations as percentage of SMEs	
Numerator	Number of Small and medium-sized enterprises (SMEs) who introduced at least one product innovation. A product innovation is the market introduction of a new or significantly improved good or service with respect to its capabilities, user friendliness, components, or sub-systems
Denominator	Total number of SMEs

Rationale	Product innovation is a key ingredient to innovation as they can create new markets and improve competitiveness. Higher shares of product innovators reflect a higher level of innovation activities
Included in EIS	Yes
Data source	Community Innovation Survey: Eurostat and National Statistical Offices
Data availability	NUTS 1 and 2 for different countries for CIS 2012, CIS 2014, CIS 2016, CIS 2018

SMEs introducing business process innovations as percentage of SMEs

Numerator	Number of Small and medium-sized enterprises (SMEs) who introduced at least one business process innovation either new to the enterprise or new to their market
Denominator	Total number of SMEs
Rationale	Many firms innovate not by improving new products but by improving their business processes. Business process innovations include process, marketing and organisational innovations.
Included in EIS	Same definition
Data source	Community Innovation Survey: Eurostat and National Statistical Offices
Data availability	NUTS 1 and 2 for different countries for CIS 2012, CIS 2014, CIS 2016, CIS 2018

Innovative SMEs collaborating with others as percentage of SMEs

Numerator	Number of SMEs with innovation co-operation activities. Firms with co-operation activities are those that have had any co-operation agreements on innovation activities with other enterprises or institutions
Denominator	Total number of SMEs
Rationale	This indicator measures the degree to which SMEs are involved in innovation co-operation. Complex innovations often depend on companies' ability to draw on diverse sources of information and knowledge, or to collaborate on the development of an innovation. The indicator measures the flow of knowledge between public research institutions and firms, and between firms and other firms. The indicator is limited to SMEs, because almost all large firms are involved in innovation co-operation
Included in EIS	Same definition
Data source	Community Innovation Survey: Eurostat and National Statistical Offices
Data availability	NUTS 1 and 2 for different countries for CIS 2012, CIS 2014, CIS 2016, CIS 2018

Public-private co-publications per million population

Numerator	Number of public-private co-authored research publications with both domestic and foreign collaborators. The definition of the "private sector" excludes the private medical and health sector
Denominator	Total population
Rationale	This indicator captures public-private research linkages and active collaboration activities between business sector researchers and public sector researchers resulting in academic publications
Included in EIS	Same definition
Data source	Numerator: Scopus. Data calculated by Science-Metrix as part of a contract to the EC Denominator: Eurostat
Data availability	NUTS 2: 2013 - 2020

PCT patent applications per billion regional GDP	
Numerator	Number of patents applied for at the European Patent Office (EPO), by year of filing. The regional distribution of the patent applications is assigned according to the address of the inventor
Denominator	Gross Domestic Product in Purchasing Power Standard
Rationale	The capacity of firms to develop new products determines their competitive advantage. One indicator of the rate of new product innovation is the number of patent applications
Included in EIS	Proxy for EIS data using different data source
Data source	Numerator: OECD, REGPAT. Denominator: Eurostat
Data availability	NUTS 2: two-year averages for 2012 - 2019

Trademark applications per billion regional GDP	
Numerator	Number of trademark applications applied for at EUIPO
Denominator	Gross Domestic Product in Purchasing Power Standard
Rationale	Trademarks are an important innovation indicator, especially for the service sector. The Community trademark gives its proprietor a uniform right applicable in all Member States of the European Union through a single procedure which simplifies trademark policies at European level. It fulfils the three essential functions of a trademark: it identifies the origin of goods and services, guarantees consistent quality through evidence of the company's commitment vis-à-vis the consumer, and is a form of communication, a basis for publicity and advertising
Included in EIS	Same definition
Data source	Numerator: European Union Intellectual Property Office (EUIPO). Data provided by Science Metrix as part of a contract to DG Research and Innovation Denominator: Eurostat
Data availability	NUTS 2: two-year averages for 2012 - 2019

Design applications per billion regional GDP	
Numerator	Number of designs applied for at EUIPO
Denominator	Gross Domestic Product in Purchasing Power Standard
Rationale	A design is the outward appearance of a product or part of it resulting from the lines, contours, colours, shape, texture, materials and/or its ornamentation. A product can be any industrial or handicraft item including packaging, graphic symbols and typographic typefaces but excluding computer programs. It also includes products that are composed of multiple components, which may be disassembled and reassembled. Community design protection is directly enforceable in each Member State and it provides both the option of an unregistered and a registered Community design right for one area encompassing all Member States
Included in EIS	Alternative for EIS indicator covering individual design applications
Data source	Numerator: European Union Intellectual Property Office (EUIPO). Data provided by Science Metrix as part of a contract to DG Research and Innovation. Denominator: Eurostat
Data availability	NUTS 2: two-year averages for 2012 - 2019

Employment in knowledge-intensive activities (percentage of total employment)	
Numerator	Number of employed persons in knowledge-intensive activities in business industries. Knowledge-intensive activities are defined, based on EU Labour Force Survey data, as all NACE Rev.2 industries at 2-digit level where at least 33% of employment has a higher education degree (ISCED 5-8)
Denominator	Total employment

Rationale	Knowledge-intensive activities provide services directly to consumers, such as telecommunications, and provide inputs to the innovative activities of other firms in all sectors of the economy
Included in EIS	This indicator is a proxy for the indicator used in the EIS. For the RIS alternative data are used for Employment in Medium-high and high-tech manufacturing and Employment in Knowledge-intensive services
Data source	Eurostat
Data availability	NUTS 2: 2012 - 2019

Employment in innovative SMEs

Numerator	Number of employed persons in innovative SMEs ('SMEs that have either introduced an innovation or have any kind of innovation activity (including SMEs with abandoned/suspended or on-going innovation activities)
Denominator	Total employment in innovative SMEs
Rationale	Innovation in enterprises has a profound impact on the employability of workers, but its effect in product- and process-innovation oriented firms varies across countries. Firm innovation proves to be specifically important during a time of economic recession. Although high-skilled employees are less affected by a recession than low-skilled employees, a notable positive effect is observed for low-skilled employees in innovative firms as well.
Included in EIS	Same definition
Data source	Community Innovation Survey: Eurostat and National Statistical Offices
Data availability	NUTS 1 and 2 for different countries for CIS 2018 Own estimates for 2012, 2014 and 2016 combining country-level data and region to country scores for 2018

Sales of new-to-market and new-to-firm product innovations in SMEs as percentage of turnover

Numerator	Sum of total turnover of new or significantly improved products for SMEs
Denominator	Total turnover for SMEs
Rationale	This indicator measures the turnover of new or significantly improved products and includes both products which are only new to the firm and products which are also new to the market. The indicator thus captures both the creation of state-of-the-art technologies (new to market products) and the diffusion of these technologies (new to firm products)
Included in EIS	Proxy for EIS indicator including all enterprises
Data source	Community Innovation Survey: Eurostat and National Statistical Offices
Data availability	NUTS 1 and 2 for different countries for CIS 2012, CIS 2014, CIS 2016, CIS 2018

Air emissions by fine particulate matter (PM2.5) in the manufacturing sector

Numerator	Air emissions by fine particulate matter (PM2.5) in the Manufacturing sector in Tonnes
Denominator	Value added in the Manufacturing sector - Chain linked volumes (2010), million euro

Rationale	Air pollution may be anthropogenic (human-induced) or of natural origin. Air pollution has the potential to harm both human health and the environment: particulate matter (PM), nitrogen dioxide and ground-level ozone are known to pose particular health risks. Long-term and peak exposures to these pollutants may be associated, among other impacts, with cardiovascular and respiratory diseases or an increased incidence of cancer. This indicator captures average concentration levels of fine particulate matter (PM _{2.5} — particles with a diameter of 2.5 micrometres or less) to which the population is exposed. The EU set an annual limit of 25 µg/m ³ for fine particulate matter in Directive 2008/50/EC ¹ on ambient air quality and cleaner air, while the World Health Organisation (WHO) set a more stringent, but non-binding guideline value, whereby annual mean concentrations should not exceed 10 µg/m ³ in order to protect human health. PM _{2.5} is considered by the WHO as the pollutant with the highest impact on human health.
Included in EIS	This indicator is an alternative for the indicator used in the EIS. For the RIS data are used measuring Exposure to fine particulates (PM 2.5)
Data source	European Environmental Agency
Data availability	NUTS 2: 2014 – 2018

2.3 Regional coverage

The Regional Innovation Scoreboard covers 240 regions in 22 EU Member States, Norway, Serbia, Switzerland, and the United Kingdom at different NUTS levels. The NUTS classification (Nomenclature of territorial units for statistics) is a hierarchical system for dividing the economic territory of the EU, which distinguishes between three levels: NUTS 1 captures major socio-economic regions, NUTS 2 captures basic regions for the application of regional policies, and NUTS 3 captures small regions for specific diagnoses. For this edition of the RIS, the NUTS 2021 classification is used for all countries, except for Norway. For Norway the NUTS 2016 classification is used as data are not available for any indicators using the latest NUTS 2021 classification.

Depending on differences in regional data availability, the RIS covers 47 NUTS 1 regions and 193 NUTS 2 regions (Table 2). In addition, the EU Member States Cyprus, Estonia, Latvia, Luxembourg, and Malta are included at the country level, as in these countries NUTS 1 and NUTS 2 levels are identical to the country territory. For the countries included at the country level, their performance levels relative to the EU27 scores from the EIS 2021 have been used.

With some countries only being covered at the NUTS 1 level, there can be significant differences in the average size of regions. For instance, the average population of a NUTS 1 region in France (total population of more than 67 million) is 4.8 million, whereas it is 2.8 million for an average NUTS 2 region in Italy (total population close to 59.5 million). The average unit of regional innovation performance analysis is 1.7 times larger in France than in Italy. These differences in unit size have implications for the variation of performance scores within countries. In general, a higher number of regions will lead to larger differences between regions in the same country.

¹ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0050>

Table 2: NUTS 1 and NUTS 2 regions included in RIS 2019 by country

Country	Number of regions at NUTS level		Average population size (2020)	Regions (NUTS code)	
	1	2			
EU countries					
BE Belgium	3		3,840,800	Région de Bruxelles-Capitale / Brussels Hoofdstedelijk Gewest (BE1)	Vlaams Gewest (BE2) Région wallonne (BE3)
BG Bulgaria		6	1,158,600	Severozapaden (BG31) Severen tsentralen (BG32) Severoiztochen (BG33)	Yugoiztochen (BG34) Yugozapaden (BG41) Yuzhen tsentralen (BG42)
CZ Czechia		8	1,336,700	Praha (CZ01) Střední Čechy (CZ02) Jihozápad (CZ03) Severozápad (CZ04)	Severovýchod (CZ05) Jihovýchod (CZ06) Střední Morava (CZ07) Moravskoslezsko (CZ08)
DK Denmark		5	1,164,600	Hovedstaden (DK01) Sjælland (DK02) Syddanmark (DK03)	Midtjylland (DK04) Nordjylland (DK05)
DE Germany	9	29	2,188,600	Stuttgart (DE11) Karlsruhe (DE12) Freiburg (DE13) Tübingen (DE14) Oberbayern (DE21) Niederbayern (DE22) Oberpfalz (DE23) Oberfranken (DE24) Mittelfranken (DE25) Unterfranken (DE26) Schwaben (DE27) Berlin (DE3) Brandenburg (DE4) Bremen (DE5) Hamburg (DE6) Darmstadt (DE71) Gießen (DE72) Kassel (DE73) Mecklenburg-Vorpommern (DE8)	Braunschweig (DE91) Hannover (DE92) Lüneburg (DE93) Weser-Ems (DE94) Düsseldorf (DEA1) Köln (DEA2) Münster (DEA3) Detmold (DEA4) Arnsberg (DEA5) Koblenz (DEB1) Trier (DEB2) Rheinhessen-Pfalz (DEB3) Saarland (DEC) Dresden (DED2) Chemnitz (DED4) Leipzig (DED5) Sachsen-Anhalt (DEE) Schleswig-Holstein (DEF) Thüringen (DEG)
IE Ireland		3	1,654,800	Northern and Western (IE04) Southern (IE05)	Eastern and Midland (IE06)
EL Greece	1	12	824,500	Attiki (EL3) Voreio Aigaio (EL41) Notio Aigaio (EL42) Kriti (EL43) Anatoliki Makedonia, Thraki (EL51) Kentriki Makedonia (EL52) Dytiki Makedonia (EL53)	Ipeiros (EL54) Thessalia (EL61) Ionia Nisia (EL62) Dytiki Ellada (EL63) Stereia Ellada (EL64) Peloponnisos (EL65)

Country	Number of regions at NUTS level		Average population size (2020)	Regions (NUTS code)	
	1	2			
ES Spain	2	17	2,491,200	Galicia (ES11) Principado de Asturias (ES12) Cantabria (ES13) País Vasco (ES21) Comunidad Foral de Navarra (ES22) La Rioja (ES23) Aragón (ES24) Comunidad de Madrid (ES3) Castilla y León (ES41)	Castilla-la Mancha (ES42) Extremadura (ES43) Cataluña (ES51) Comunitat Valenciana (ES52) Illes Balears (ES53) Andalucía (ES61) Región de Murcia (ES62) Ciudad de Ceuta (ES63) Ciudad de Melilla (ES64) Canarias (ES7)
FR France	14		4,808,600	Île de France (FR1) Centre - Val de Loire (FRB) Bourgogne - Franche-Comté (FRC) Normandie (FRD) Hauts-de-France (FRE) Grand Est (FRF) Pays de la Loire (FRG) Bretagne (FRH)	Nouvelle-Aquitaine (FRI) Occitanie (FRJ) Auvergne - Rhône-Alpes (FRK) Provence-Alpes-Côte d'Azur (FRL) Corse (FRM) RUP FR - Régions ultrapériphériques françaises (FRY)
HR Croatia		4	1,127,700	Panonska Hrvatska (HR02) Jadranska Hrvatska (HR03)	Grad Zagreb (HR05) Sjeverna Hrvatska (HR06)
IT Italy		21	2,840,100	Piemonte (ITC1) Valle d'Aosta/Vallée d'Aoste (ITC2) Liguria (ITC3) Lombardia (ITC4) Provincia Autonoma Bolzano/Bozen (ITH1) Provincia Autonoma Trento (ITH2) Veneto (ITH3) Friuli-Venezia Giulia (ITH4) Emilia-Romagna (ITH5) Toscana (ITI1)	Umbria (ITI2) Marche (ITI3) Lazio (ITI4) Abruzzo (ITF1) Molise (ITF2) Campania (ITF3) Puglia (ITF4) Basilicata (ITF5) Calabria (ITF6) Sicilia (ITG1) Sardegna (ITG2)
LT Lithuania		2	1,397,000	Sostinės regionas (LT01)	Vidurio ir vakarų Lietuvos regionas (LT02)
HU Hungary		8	1,221,200	Budapest (HU11) Pest (HU12) Közép-Dunántúl (HU21) Nyugat-Dunántúl (HU22)	Dél-Dunántúl (HU23) Észak-Magyarország (HU31) Észak-Alföld (HU32) Dél-Alföld (HU33)
NL Netherlands		12	1,450,600	Groningen (NL11) Friesland (NL12) Drenthe (NL13) Overijssel (NL21) Gelderland (NL22) Flevoland (NL23)	Utrecht (NL31) Noord-Holland (NL32) Zuid-Holland (NL33) Zeeland (NL34) Noord-Brabant (NL41) Limburg (NL42)
AT Austria	3		2,967,000	Ostösterreich (AT1) Südösterreich (AT2)	Westösterreich (AT3)

Country	Number of regions at NUTS level		Average population size (2020)	Regions (NUTS code)	
	1	2			
PL Poland		17	2,232,800	Małopolskie (PL21) Śląskie (PL22) Wielkopolskie (PL41) Zachodniopomorskie (PL42) Lubuskie (PL43) Dolnośląskie (PL51) Opolskie (PL52) Kujawsko-Pomorskie (PL61) Warmińsko-Mazurskie (PL62)	Pomorskie (PL63) Łódzkie (PL71) Świętokrzyskie (PL72) Lubelskie (PL81) Podkarpackie (PL82) Podlaskie (PL84) Warszawski stołeczny (PL91) Mazowiecki regionalny (PL92)
PT Portugal	2	5	1,470,800	Norte (PT11) Algarve (PT15) Centro (PT16) Lisboa (PT17) Alentejo (PT18)	Região Autónoma dos Açores (PT2) Região Autónoma da Madeira (PT3)
RO Romania		8	2,16,100	Nord-Vest (RO11) Centru (RO12) Nord-Est (RO21) Sud-Est (RO22)	Sud - Muntenia (RO31) Bucuresti - Ilfov (RO32) Sud-Vest Oltenia (RO41) Vest (RO42)
SI Slovenia		2	1,047,900	Vzhodna Slovenija (SI03)	Zahodna Slovenija (SI04)
SK Slovakia		4	1,364,500	Bratislavský kraj (SK01) Západné Slovensko (SK02)	Stredné Slovensko (SK03) Východné Slovensko (SK04)
FI Finland	1	4	1,105,100	Helsinki-Uusimaa (FI1B) Etelä-Suomi (FI1C) Länsi-Suomi (FI19)	Pohjois- ja Itä-Suomi (FI1D) Åland (FI2)
SE Sweden		8	1,290,900	Stockholm (SE11) Östra Mellansverige (SE12) Småland med öarna (SE21) Sydsverige (SE22)	Västsverige (SE23) Norra Mellansverige (SE31) Mellersta Norrland (SE32) Övre Norrland (SE33)
Non-EU countries					
NO Norway		7	766,800	Oslo og Akershus (NO01) Hedmark og Oppland (NO02) Sør-Østlandet (NO03) Agder og Rogaland (NO04)	Vestlandet (NO05) Trøndelag (NO06) Nord-Norge (NO07)
CH Switzerland		7	1,229,400	Région lémanique (CH01) Espace Mittelland (CH02) Nordwestschweiz (CH03) Zürich (CH04)	Ostschweiz (CH05) Zentralschweiz (CH06) Ticino (CH07)
RS Serbia²		4	1,731,700	Belgrade (RS11) Vojvodina (RS12)	Šumadija and Western Serbia (RS21) Southern and Eastern Serbia (RS22)
UK United Kingdom	12		5,598,200	North East (UKC) North West (UKD) Yorkshire and The Humber (UKE) East Midlands (UKF) West Midlands (UKG) East of England (UKH)	London (UKI) South East (UKJ) South West (UKK) Wales (UKL) Scotland (UKM) Northern Ireland (UKN)

² The NUTS codes for Serbia are not official codes as Eurostat and Serbia have not yet agreed on statistical regions but are used for ease of reference in the RIS 2021 and for producing the regional maps.

2.4 Regional data availability

Regional innovation data for four indicators are directly available from Eurostat. For Population aged 25-34 having completed tertiary education, Lifelong learning, R&D expenditures in the public sector, and R&D expenditures in the business sector, regional data have been extracted from Eurostat's online regional database.

For the seven indicators using Community Innovation Survey (CIS) data, regional data are not available from Eurostat, and a special data request has been made to National Statistical Offices to obtain regional CIS data.

For the three indicators using bibliometric data, Trademark applications and Design applications, regional data have been calculated by Science-Metrix as part of a contract with the European Commission (DG Research and Innovation).

For five EIS indicators either alternative indicators or estimates have been used:

- For Individuals who have above basic overall digital skills, estimates are calculated using the variation in regional performance on Households with broadband access, for which data are available from Eurostat.
- For Employed ICT specialists, estimates are calculated using the variation in regional performance on Employment in information and communication (NACE J), for which data are available from Eurostat.
- Regional patent data have been extracted from the OECD's REGPAT database.
- For Employment in knowledge-intensive activities as percentage of total employment alternative data are used for Employment in medium-high and high-tech manufacturing and knowledge-intensive services, which are available from Eurostat.
- For Air emissions in fine particulates (PM2.5) in Industry alternative data are used for Exposure to fine particulates (PM2.5), which have been made available by the European Environmental Agency (EEA).

Regional CIS data request

To collect regional CIS data, data requests were made by Eurostat in 2021 to National Statistical Offices of most Member States, excluding those countries for which NUTS 1 and NUTS 2 levels are identical to the country territory, and to Norway. Additional regional data requests were made by UNU-MERIT to the National Statistical Offices of Serbia and the United Kingdom.

Regional CIS 2018 data have been made available for 21 countries: Austria, Belgium, Bulgaria, Croatia, Czechia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Spain and Sweden. No regional CIS 2018 data have been made available for Denmark, the Netherlands, Slovenia, and the United Kingdom, and section 2.5 explains how results for the indicators using regional CIS 2018 data have been estimated. For Switzerland, no data request was made as the most recent Swiss innovation survey is from 2016. In addition, the statistical office of Croatia also shared revised regional CIS 2016 data following the revision of the NUTS classification for Croatia increasing the number of NUTS 2 regions from 2 to 4³. Regional data have been obtained for the following indicators:

- SMEs introducing product innovations as percentage share of all SMEs
- SMEs introducing business process innovations as percentage share of all SMEs

³ In the NUTS 2016 classification there are two NUTS 2 regions for Croatia: Jadranska Hrvatska (HR03) and Kontinentalna Hrvatska (HR04). In the NUTS2021 classification the latter region has been split into three new regions: Panonska Hrvatska (HR02), Grad Zagreb (HR05), and Sjeverna Hrvatska (HR06).

- Innovative SMEs cooperating others as percentage share of all SMEs
- Employment in innovative SMEs as percentage of total employment in SMEs
- Non-R&D innovation expenditure by SMEs as percentage of total turnover by SMEs
- Innovation expenditure per person employed in SMEs
- Sales from product innovations new-to-market and new-to-enterprise as percentage of total turnover by SMEs

Three countries shared data for NUTS 1 regions, 18 countries shared data for NUTS 2 regions (Table 3). All 21 countries shared data for all seven CIS indicators, except Italy which was not able to share data for Innovation expenditures per person employed.

Regional CIS data are not publicly available and have been made explicitly available for the Regional Innovation Scoreboard by national statistical offices. The CIS assigns the innovation activities of multi-establishment enterprises to the region where the head office is located. There is a risk that regions without head offices score lower on the CIS indicators as some of the activities in these regions are assigned to those regions with head offices, and to minimise this risk, the regional CIS data excludes large firms (which are more likely to have multiple establishments in different regions) and focuses on SMEs only.

Table 3: Summary of CIS 2018 data received by NUTS level

	SMEs introducing product innovations	SMEs introducing business process innovations	Innovative SMEs cooperating with others	Employment share in innovative SMEs	Non-R&D innovation expenditures in SMEs	Innovation expenditures per person employed in SMEs	Sales share from product innovations in SMEs
BE	1	1	1	1	1	1	1
BG	2	2	2	2	2	2	2
CZ	2	2	2	2	2	2	2
DE	2	2	2	2	2	2	2
IE	2	2	2	2	2	2	2
EL	2	2	2	2	2	2	2
ES	2	2	2	2	2	2	2
FR	1	1	1	1	1	1	1
HR	2	2	2	2	2	2	2
IT	2	2	2	2	2	--	2
LT	2	2	2	2	2	2	2
HU	2	2	2	2	2	2	2
AT	1	1	1	1	1	1	1
PL	2	2	2	2	2	2	2
PT	2	2	2	2	2	2	2
RO	2	2	2	2	2	2	2
SK	2	2	2	2	2	2	2
FI	2	2	2	2	2	2	2
SE	2	2	2	2	2	2	2
NO	2	2	2	2	2	2	2
RS	2	2	2	2	2	2	2

Data availability by indicator

For the most recent year, data availability is 89.4% with regional data being available for 4,508 out of a maximum of 5,040 observations. Data availability differs by indicator, with highest data availability for Lifelong learning and Employed ICT specialists (Table 4). Data availability is below average for Individuals who have above basic overall digital skills, R&D expenditures in the public sector, R&D expenditures in the business sector, and all seven indicators using CIS data.

Table 4: Regional data availability by indicator

Indicator	Data availability most recent year	Data not available for
Population aged 25-34 having completed tertiary education	99.6%	FI2
Population aged 25-64 participating in lifelong learning	100%	--
International scientific co-publications	98.8%	3 regions in HR
Most-cited scientific publications	98.8%	3 regions in HR
* Individuals who have above basic overall digital skills	74.2%	NUTS2 regions in DE, EL, PL; FI2
R&D expenditures in the public sector	71.3%	Most regions in AT, BE, CH, DK, FR, IE, HR, NL, NO, PL, SE
R&D expenditures in the business sector	67.1%	Most regions in AT, BE, CH, DK, FR, IE, HR, NL, NO, PL, SE
Non-R&D innovation expenditures	84.2%	All regions in CH, DK, NL, SI, UK
Innovation expenditures per person employed	75.4%	All regions in CH, DK, IT, NL, SI, UK
* Employed ICT specialists	100%	--
SMEs with product innovations	84.2%	All regions in CH, DK, NL, SI, UK
SMEs with business process innovations	84.2%	All regions in CH, DK, NL, SI, UK
Innovative SMEs collaborating with others	84.2%	All regions in CH, DK, NL, SI, UK
Public-private co-publications	98.8%	3 regions in HR
PCT patent applications	95.0%	Regions in HR, IE, RS
Trademark applications	98.8%	3 regions in HR
Design applications	98.8%	3 regions in HR
* Employment in knowledge-intensive activities	98.8%	3 regions in HR
Employment in innovative SMEs	84.2%	All regions in CH, DK, NL, SI, UK
Sales of new-to-market and new-to-enterprise product innovations	84.2%	All regions in CH, DK, NL, SI, UK
* Air emissions in fine particulates (PM2.5) in Industry	98.3%	ES7, FRY, PT2, PT3

* For these indicators either proxy data or estimates have been used compared to the same indicator in the EIS.

2.5 Imputation of missing data

The full RIS 2021 database contains 40,320 data cells (240 regions, 21 indicators, and 8 years). As shown in Section 2.4, for several indicators data are not available for all regions. To improve data availability, several imputation techniques have been used to provide estimates for all missing data in the following order:

1. At the country level if data for both the previous and following year are available:
 - 1A) the average of both years will be used $x_C^T = (x_C^{T-1} + x_C^{T+1}) / 2$

- else 1B) that of the previous year $x_C^T = x_C^{T-1}$
- else 1C) that of the following year $x_C^T = x_C^{T+1}$

where C denotes the country, T the current year, T-1 the previous year and T+1 the following year. If data are not available for the previous and following year, missing data will not be imputed.

The following steps apply for all indicators:

2. If regional data are available for the previous year, the ratio between the corresponding NUTS level and that at a higher aggregate level (NUTS 1 for NUTS 2 regions, country level for NUTS 1 regions) for the previous year is multiplied with the current value at the higher aggregate level:

$x_R^T = (x_R^{T-1} / x_C^{T-1}) * x_C^T$, where R denotes the region, C the country (as the higher aggregate level), T the current year, and T-1 the previous year.

3. If regional data for the previous year are *not* available, the same procedure as in step 2 will be applied using the ratio between the corresponding NUTS level and that at a higher aggregate level (NUTS 1 for NUTS 2 regions, country level for NUTS1 regions) for the following year:

$x_R^T = (x_R^{T+1} / x_C^{T+1}) * x_C^T$, where R denotes the region, C the country (as the higher aggregate level), T the current year, and T+1 the following year.

4. If there are no regional data for both the previous nor the following year, the higher-level aggregate will be used (NUTS 1 for NUTS 2 regions, country level for NUTS 1 regions), first that for the current year, and, if not available, that for the previous year, otherwise that for the following year:

$x_R^T = x_C^T$ or $x_R^T = x_C^{T-1}$ or $x_R^T = x_C^{T+1}$, where R denotes the region, C the country (as the higher aggregate level), t the current year, T-1 the previous year, and T+1 the following year.

5. If there are no regional and no country-level data available for the current, previous and following year, missing data will not be imputed.

Data availability after imputation improves to 99.1% with data missing for only 172 data cells. For some observations, data could not be imputed:

- Population having completed tertiary education: 1 region (FI2)
- Non-R&D innovation expenditures: all 7 Swiss regions
- Innovation expenditures per person employed in SMEs: 12 regions (ES63, ES64, ITC2, ITC3, FI2, all 7 CH regions)
- Employment in innovative enterprises: 12 regions (ES63, ES64, ITC2, ITC3, FI2, all 7 Swiss regions)
- Sales of new-to-market and new-to-enterprise innovations: all 7 Swiss regions
- Air emissions in fine particulates (PM2.5) in Industry: 4 regions (ES7, FRY, PT2, PT3)

3. Composite indicators

3.1 Normalising data

Ideally, for calculating composite indicators, the individual indicators should follow a normal distribution. Most of the indicators are fractional indicators with values between 0% and 100%, and most of these follow a normal distribution (cf. [Table 5](#)). Some indicators are unbound indicators, where values are not limited to an upper threshold. These indicators can have skewed data distributions (where most regions show low performance levels, and a few regions show exceptionally high levels of performance).

For all indicators first positive outliers are identified as those region scores which are higher than the mean across all regions plus twice the standard deviation. Negative outliers are identified as those region scores which are smaller than the mean across all regions minus twice the standard deviation. These outliers are replaced by the respective maximum and minimum values observed over all the years and all regions.

For all indicators, using the data are correcting for possible outliers, data will be transformed using a square root transformation if the degree of skewness of the raw data exceeds 1 such that the skewness of the transformed data is below 1. This transformation will be applied after the imputation of missing data. [Table 5](#) summarises the degree of skewness before and after the transformation. For the following seven indicators, the degree of skewness was above one and data have been transformed: International scientific co-publications, Non-R&D innovation expenditures, Innovation expenditures per person employed, Public-private co-publications, PCT patent applications, Design applications, and Sales of new-to-market and new-to-enterprise product innovations.

Table 5: Degree of skewness and transformation

	Degree of skewness	
	before transformation	after transformation
Population aged 25-34 having completed tertiary education	0.228	---
Population aged 25-64 participating in lifelong learning	0.817	---
International scientific co-publications	1.018	0.267
Most-cited scientific publications	-0.227	---
Individuals who have above basic overall digital skills (<i>alternative data as explained above</i>)	0.035	---
R&D expenditures in the public sector	0.720	---
R&D expenditures in the business sector	0.916	---
Non-R&D innovation expenditures	1.938	0.597
Innovation expenditures per person employed	1.390	0.210
Employed ICT specialists (<i>alternative data as explained above</i>)	0.963	---
SMEs with product innovations	-0.109	---
SMEs with business process innovations	-0.183	---
Innovative SMEs collaborating with others	0.573	---
Public-private co-publications	1.059	0.337
PCT patent applications	1.083	0.363
Trademark applications	0.902	---
Design applications	1.178	0.263
Employment in knowledge-intensive activities (<i>alternative data as explained above</i>)	0.020	---
Employment in innovative SMEs	-0.538	---

	Degree of skewness	
	before transformation	after transformation
Sales of new-to-market and new-to-enterprise product innovations	1.008	0.092
Air emissions in fine particulates (PM2.5) in Industry (<i>alternative data as explained above</i>)	0.377	---

The data are normalised using the min-max procedure. The minimum score observed for all regions across all four biennial observations is first subtracted from the (transformed) score. The result is then divided by the difference between the maximum and minimum scores observed for all regions across all four yearly observations. The maximum normalised score is equal to 1 and the minimum normalised score is equal to 0:

$$\hat{X}_r = \frac{\tilde{X}_r - \text{MIN}(\forall_r \tilde{X}_r)}{\text{MAX}(\forall_r \tilde{X}_r) - \text{MIN}(\forall_r \tilde{X}_r)}$$

3.2 Regional Innovation Index

Average innovation performance is measured using composite indicators. The Regional Innovation Index (RII) is calculated as the unweighted average of the normalised scores of the 21 indicators.

A comparison of the Regional Innovation Index at the country level with the Summary Innovation Index in the European Innovation Scoreboard shows that, due to using a more restricted set of indicators in the RIS, countries' performance relative to the EU average in the RIS is different from that in the European Innovation Scoreboard. The following correction is therefore applied to the composite indicator scores:

- 1) Calculate the ratios of the EIS 2021 Summary Innovation Index at country level with that of the EU: $\text{EIS_index_CTR} / \text{EIS_index_EU}$;
- 2) Calculate the ratios of the RIS 2021 Regional Innovation Index at country level with that of the EU: $\text{RIS_index_CTR} / \text{RIS_index_EU}$;
- 3) Calculate the correction factor by dividing the ratios 1) and 2).

These country correction factors are then multiplied with the RII for each region in the corresponding country to obtain final RII scores (Table 6).

Relative performance scores are calculated by dividing the RII of the region by that of the EU and multiplying by 100. For trend performance, RIIs for all years are divided by that of the EU in 2014.

Table 6: Country correction scores

	2014	2015	2016	2017	2018	2019	2020	2021
BE	0.952	0.969	0.967	1.001	1.028	1.009	1.005	1.018
BG	0.867	0.868	0.817	0.800	0.807	0.776	0.807	0.794
CZ	0.920	0.921	0.918	0.916	0.920	0.939	0.946	0.955
DK	1.043	1.035	1.027	1.015	1.002	1.010	1.018	0.974
DE	1.020	1.017	1.011	1.018	1.033	1.032	1.044	1.027
IE	0.985	0.982	0.994	1.030	1.062	1.078	1.054	1.004

	2014	2015	2016	2017	2018	2019	2020	2021
EL	0.809	0.819	0.818	0.811	0.787	0.818	0.848	0.832
ES	0.935	0.956	0.946	0.978	0.994	1.024	1.054	1.017
FR	1.058	1.058	1.062	1.067	1.068	1.048	1.059	1.037
HR	0.856	0.849	0.856	0.819	0.810	0.804	0.828	0.853
IT	0.871	0.900	0.895	0.907	0.911	0.916	0.949	0.927
LT	0.849	0.866	0.891	0.839	0.867	0.864	0.922	0.917
HU	0.990	0.994	0.982	1.046	1.044	0.940	0.975	0.997
NL	0.990	0.995	0.998	1.009	1.014	1.013	1.025	1.037
AT	0.974	0.975	0.970	0.962	0.950	0.939	0.932	0.943
PL	0.872	0.866	0.873	0.880	0.874	0.926	0.974	0.995
PT	0.857	0.869	0.852	0.844	0.848	0.840	0.864	0.900
RO	0.856	0.847	0.847	0.906	0.938	0.912	0.924	0.887
SI	0.946	0.954	0.934	0.943	0.946	0.957	0.921	0.907
SK	0.978	1.001	0.986	1.005	0.889	0.900	0.922	0.933
FI	0.916	0.924	0.934	0.908	0.923	0.930	0.938	0.945
SE	0.973	0.967	0.962	0.973	0.969	0.964	0.956	0.964
NO	0.934	0.939	0.934	0.908	0.910	0.900	0.896	0.915
CH	0.974	0.992	0.992	1.005	1.010	1.004	0.988	0.963
RS	0.857	0.846	0.875	0.862	0.817	0.797	0.827	0.828
UK	0.972	0.970	0.977	1.010	1.027	1.029	1.039	1.081

3.3 Regional performance group membership

The RIS 2021 uses the classification scheme used in the European Innovation Scoreboard:

- Innovation Leaders are all regions with a relative performance more than 125% of the EU average in 2021
- Strong Innovators are all regions with a relative performance between 100% and 125% of the EU average in 2021
- Moderate Innovators are all regions with a relative performance between 70% and 100% of the EU average in 2021
- Emerging Innovators are all regions with a relative performance below 70% of the EU average in 2021

The RIS 2017 introduced three subgroups within each performance group to allow for more diversity at the regional level: the top one-third regions (+), the middle one-third regions and the bottom one-third regions (-). For the RIS 2021, sub-groups are defined in a similar way to the 4 main groups using performance thresholds based on dividing the performance range in each group in three equal parts (Table 7).

Table 7: Defining performance sub-groups

Group	Top sub-group (+)	Middle sub-group	Bottom sub-group (-)
Innovation Leaders	Innovation Leaders + Above 144.8% above EU average	Innovation Leaders Between 134.9% and 144.8% of EU average	Innovation Leaders - Between 125% and 134.9% of EU average
Strong Innovators	Strong Innovators + Between 116.7% and 125% of EU average	Strong Innovators Between 108.3% and 116.7% of EU average	Strong Innovators - Between 100% and 108.3% of EU average
Moderate Innovators	Moderate Innovators + Between 90% and 100% of EU average	Moderate Innovators Between 80% and 90% of EU average	Moderate Innovators - Between 70% and 80% of EU average
Emerging Innovators	Emerging Innovators + Between 52.1% and 70% of EU average	Emerging Innovators Between 34.1% and 52.1% of EU average	Emerging Innovators - Below 34.1% of EU average

4. Structural indicators

4.1 Selected indicators to measure regional structural definitions

The RIS uses structural data in the regional profiles to help users to better understand the impact of structural differences on observed scores. Brief analyses of structural differences by region are included in the regional profiles.

Differences in economic structures are relevant. Differences in the share of industry in the GDP is an important factor that could explain why regions perform better or worse on indicators like business R&D expenditures, PCT patent applications and innovative enterprises. The regional profiles will include for each region, when data are available from Eurostat, data on the composition of regional employment, using average employment shares for the years 2015-2019, for the following industries: Agriculture & Mining, Manufacturing, Utilities & Construction, Services, and Public administration.

Enterprise characteristics are important for explaining differences in R&D spending and innovation activities. Larger enterprises are more likely to be innovative. Regional data on the average number of employees in an enterprise are used to measure differences in enterprise size effects across regions.

Densely populated areas are also more likely to be more innovative for several reasons. First, with people and enterprises being at a closer distance, knowledge diffuses more easily. Second, in urbanised areas, there tends to be a concentration of government and educational services. These services provide better training opportunities and employ above-average shares of highly educated people. Structural data also include indicators measuring the size of the regional economy, including two indicators measuring GDP per capita, both in Euros and in purchasing power standards⁴, which are a better measure for interpreting real income differences between regions.

4.2 Definitions of structural indicators

Composition of employment, %-shares, average 2018-2020

	• Agriculture & Mining (NACE Rev. 2 A-B) • Manufacturing (NACE Rev. 2 C) • Utilities and Construction (NACE Rev. 2 D-F) • Services (NACE Rev. 2 G-N) • Public administration (NACE Rev. 2 O-U)
Numerator	Employment in the respective industries
Denominator	Total employment
Calculated as	Average percentage for the years 2018 to 2020
Data source	Eurostat: Employment in technology and knowledge-intensive sectors by NUTS 2 regions (from 2008 onwards, NACE Rev. 2)

Average number of persons employed per enterprise, average 2016-2018

Numerator	Total number of persons employed by active enterprises
Denominator	Number of active enterprises
Calculated as	Average percentage for the years 2016 and 2018
Data source	Eurostat: Business demography by size class and NUTS 3 regions

⁴ The purchasing power standard (PPS) is an artificial currency unit. Theoretically, one PPS can buy the same amount of goods and services in each country. However, price differences across borders mean that different amounts of national currency units are needed for the same goods and services depending on the country. PPS are derived by dividing any economic aggregate of a country in national currency by its respective purchasing power parities.

GDP per capita, PPS, 2019

Indicator	Nominal Gross Domestic Product per capita
Unit	Purchasing power standard (PPS) per inhabitant
Data source	Eurostat: Gross domestic product (GDP) at current market prices by NUTS 2 regions

GDP per capita growth, 2013-2017

Indicator	Growth of Nominal Gross Domestic Product per capita
Unit	Purchasing power standard (PPS) per inhabitant
Calculated as	Compound average growth rate (CAGR) between 2015 and 2019: $\text{CAGR} = (\text{GDP per capita in 2019} / \text{GDP per capita in 2015})^{(1/4)} - 1$
Data source	Eurostat: Gross domestic product (GDP) at current market prices by NUTS 2 regions

Degree of urbanisation (%), 2020

Indicator	Share of households living in densely populated areas and intermediate density areas
Definition of urbanisation	"The degree of urbanisation (DEGURBA) creates a classification of all LAU2s (Local Administrative Units - Level 2/municipalities) into the following three categories: (1) Cities (densely populated areas) (Code 1) (2) Towns and suburbs (intermediate density areas) (Code 2) (3) Rural areas (thinly populated areas) (Code 3)" For more details: http://ec.europa.eu/eurostat/ramon/miscellaneous/index.cfm?TargetUrl=DSP_DEGURBA
Data source	Eurostat: Number of households by degree of urbanisation and NUTS 2 regions

Population density, 2019

Numerator	Inhabitants per km2
Data source	Eurostat: Population density by NUTS 3 region

Population size (thousands), 2020

Indicator	Population on 1 January
Data source	Eurostat: Population on 1 January by NUTS 2 region

