

## First Release

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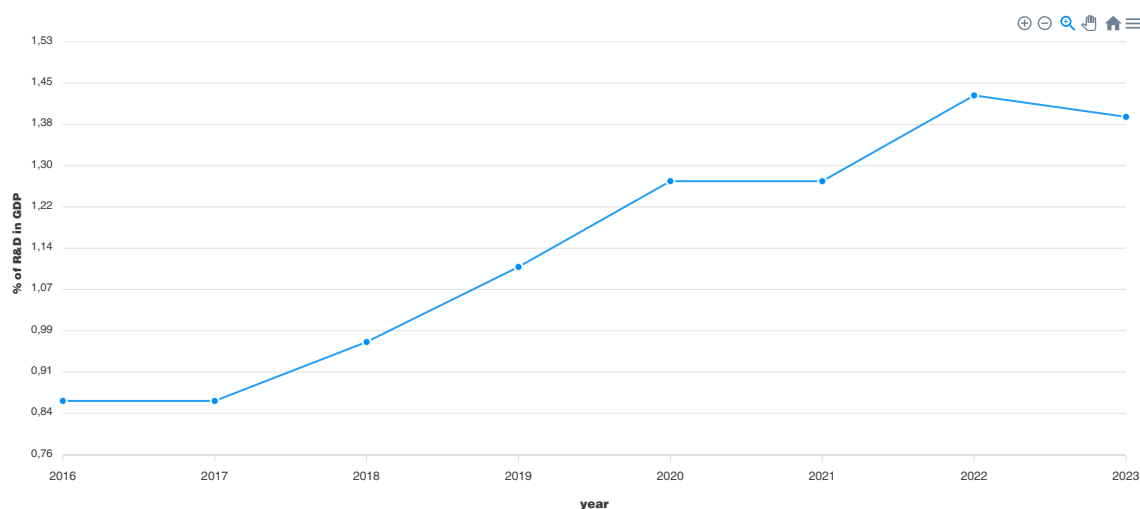
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## RESEARCH AND DEVELOPMENT, 2023 – Revised Data

The share of research and development (R&D) expenditures in GDP in 2023 was **1.39%**.

### G-1 SHARE OF RESEARCH AND DEVELOPMENT EXPENDITURES IN GDP



In 2023, a total of **1.1 billion euro** was spent on R&D activity in the Republic of Croatia, which was an increase of 12.8% compared to the previous year. Of the total funds intended for R&D, the largest amount of funds was spent in the business enterprise sector, i.e. 54.7%. It was followed by higher education with 28.0%, while the smallest amount of funds was spent in the government and private non-profit sector, i.e. 17.3%.

The largest share of expenditure on R&D was accounted for by labour costs, 56.1%. Other current costs accounted for 31.3% of total expenditure, while capital expenditure accounted for only 12.5%.

## 1 MAIN R&D INDICATORS, 2023

	Gross domestic expenditure, euro	Total R&D personnel (headcount)	Of that			Total R&D personnel (FTE)	Of that			Number of performing units
			Women	Researchers	Doctors of science		Women	Researchers	Doctors of science	
Sectors – total	1 081 917 926	28 059	13 289	17 013	11 500	16 663,6	7 640,2	9 523,7	5 800,6	651
Business enterprise sector	591 411 915	9 655	3 008	3 080	408	7 200,9	2 371,8	2 464,0	318,4	469
Government and private non-profit sector	187 490 240	5 109	2 996	3 324	2 829	3 529,5	2 072,9	2 223,5	1 884,5	75
Higher education	303 015 771	13 295	7 285	10 609	8 263	5 933,2	3 195,5	4 836,2	3 597,7	107

## 2 GROSS DOMESTIC EXPENDITURE ON R&D, BY SECTORS AND TYPES OF EXPENDITURES, 2023

euro

	Gross domestic expenditure	Capital expenditures	Current expenditures		
			Total	Labour costs	Other current costs
Sectors – total	1 081 917 926	135 484 252	946 433 674	607 256 472	339 177 202
Business enterprise sector	591 411 915	61 980 617	529 431 298	268 193 103	261 238 195
Government and private non-profit sector	187 490 240	32 561 088	154 929 152	119 427 434	35 501 718
Higher education	303 015 771	40 942 547	262 073 224	219 635 935	42 437 289

## 3 EXPENDITURE ON R&D IN BUSINESS ENTERPRISE SECTOR, TOTAL R&D PERSONNEL AND RESEARCHERS IN FULL-TIME EQUIVALENT, BY ENTERPRISE SIZE, 2023

	Expenditure on R&D, euro	Total R&D personnel	Researchers
Business enterprise sector – total	591 411 915	7 200,9	2 464,0
Up to 9	17 979 855	347,4	217,4
10 – 49	58 825 353	973,9	400,9
50 – 249	109 826 774	2 379,7	724,3
250 – 499	35 895 551	556,5	401,1
500 and more	368 884 382	2 943,4	720,3

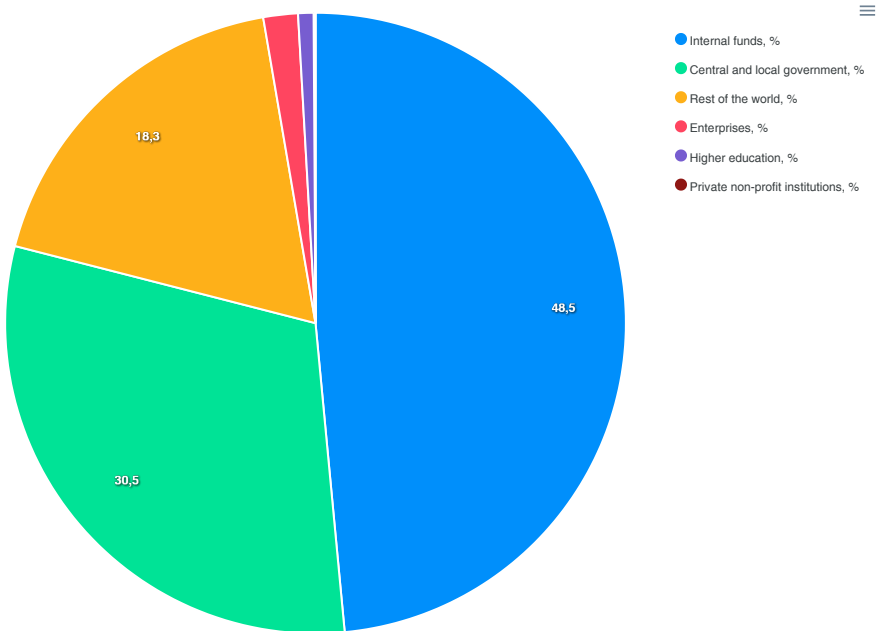
Observing the sources of funds for R&D for total sectors, the largest amount was funded by units with internal funds, 48.5%, followed by the central and local government with 30.5%. A detailed analysis by sectors shows that enterprises mostly finance R&D with internal funds (79.3%), while the government and private non-profit sector (59.2%) and higher education (69.4%) are mostly financed by the central and local government.

4 SOURCES OF FUNDS FOR R&D, 2023

euro

	Total	Internal funds	Central and local government	Enterprises	Higher education	Private non-profit institutions	Rest of the world
Sectors – total	1 081 917 926	525 634 289	329 821 245	19 575 838	8 560 016	543 888	197 782 650
Percentage	100,0	48,5	30,5	1,8	0,8	0,1	18,3
Business enterprise sector	591 411 915	468 685 701	8 526 111	6 589 722	481 441	25 958	107 102 982
Percentage	100,0	79,3	1,4	1,1	0,1	0,0	18,1
Government and private non-profit sector	187 490 240	31 616 730	111 089 962	5 915 284	908 213	420 238	37 539 813
Percentage	100,0	16,9	59,2	3,2	0,5	0,2	20,0
Higher education	303 015 771	25 331 858	210 205 172	7 070 832	7 170 362	97 692	53 139 855
Percentage	100,0	8,4	69,4	2,3	2,4	0,0	17,5

G-2 SOURCES OF FUNDS FOR R&D, 2023



The total R&D personnel in 2023 amounted to 28 059, which was 0.6% lower than in the previous year. Of the total R&D personnel, 13 289 (47.4%) were women.

The employees of units performing the R&D were mostly engaged in the R&D activity, 95.3% of them, while 4.7% of the total R&D personnel were hired under contractual agreement or author's contract. The share of researchers in the total R&D personnel was 60.6% (out of which 49.1% were women). Among the researchers, there were 65.1% of doctors of science (the share of women among the researchers with a doctoral degree was 51.8%).

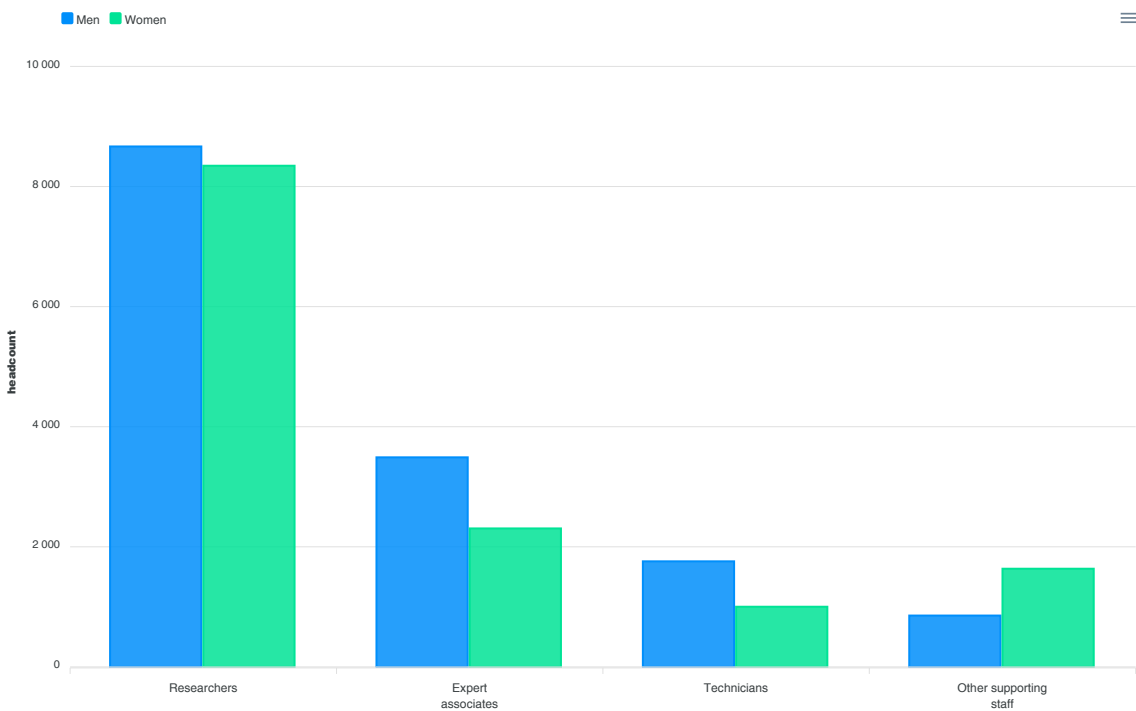
The R&D work may be the employees' main activity or their additional activity in part-time employment. In order to present the actual engagement of R&D employees, a full-time equivalent (FTE) is used in line with the standards of international statistics. The FTE is considered as the main indicator of R&D personnel for the purpose of international comparison.

Expressed as a full-time equivalent, there were a total of 16 663.6 person-years employed in R&D in 2023 (i.e. persons in full-time employment in R&D), out of which 45.8% were women. There were 9 523.7 researchers expressed as FTE.

## 5 R&amp;D PERSONNEL, BY TYPE OF EMPLOYMENT, SECTORS, OCCUPATION IN R&amp;D AND SEX, 2023

	Total		Researchers		Expert associates		Technicians		Other supporting staff	
	All	Women	All	Women	All	Women	All	Women	All	Women
<b>Headcount</b>										
Total R&D personnel	28 059	13 289	17 013	8 346	5 796	2 306	2 760	1 002	2 490	1 635
Business enterprise sector	9 655	3 008	3 080	974	3 936	1 201	1 781	472	858	361
Government and private non-profit sector	5 109	2 996	3 324	1 883	881	558	398	205	506	350
Higher education	13 295	7 285	10 609	5 489	979	547	581	325	1 126	924
Persons working on employment contract basis	26 733	12 704	16 191	7 992	5 557	2 200	2 559	917	2 426	1 595
Business enterprise sector	9 458	2 955	3 012	959	3 913	1 199	1 680	439	853	358
Government and private non-profit sector	4 592	2 768	3 017	1 763	759	499	366	190	450	316
Higher education	12 683	6 981	10 162	5 270	885	502	513	288	1 123	921
Persons hired under contractual agreement or author's contract	1 326	585	822	354	239	106	201	85	64	40
Business enterprise sector	197	53	68	15	23	2	101	33	5	3
Government and private non-profit sector	517	228	307	120	122	59	32	15	56	34
Higher education	612	304	447	219	94	45	68	37	3	3
<b>Full-time equivalent (FTE)</b>										
Total R&D personnel	16 663,6	7 640,2	9 523,7	4 610,8	4 190,5	1 605,9	1 641,1	594,8	1 308,3	828,7
Business enterprise sector	7 200,9	2 371,8	2 464,0	811,8	3 073,8	996,1	1 148,4	335,0	514,7	228,9
Government and private non-profit sector	3 529,5	2 072,9	2 223,5	1 284,3	609,7	369,6	288,5	138,2	407,8	280,8
Higher education	5 933,2	3 195,5	4 836,2	2 514,7	507,0	240,2	204,2	121,6	385,8	319,0
Persons working on employment contract basis	16 186,0	7 436,4	9 226,8	4 487,5	4 103,4	1 575,1	1 586,1	569,7	1 269,7	804,1
Business enterprise sector	7 137,8	2 358,2	2 436,6	807,4	3 064,5	995,0	1 125,7	329,0	511,0	226,8
Government and private non-profit sector	3 317,3	1 981,5	2 111,9	1 242,4	557,6	349,9	274,3	130,3	373,5	258,9
Higher education	5 730,9	3 096,7	4 678,3	2 437,7	481,3	230,2	186,1	110,4	385,2	318,4
Persons hired under contractual agreement or author's contract	477,6	203,8	296,9	123,3	87,1	30,8	55,0	25,1	38,6	24,6
Business enterprise sector	63,1	13,6	27,4	4,4	9,3	1,1	22,7	6,0	3,7	2,1
Government and private non-profit sector	212,2	91,4	111,6	41,9	52,1	19,7	14,2	7,9	34,3	21,9
Higher education	202,3	98,8	157,9	77,0	25,7	10,0	18,1	11,2	0,6	0,6

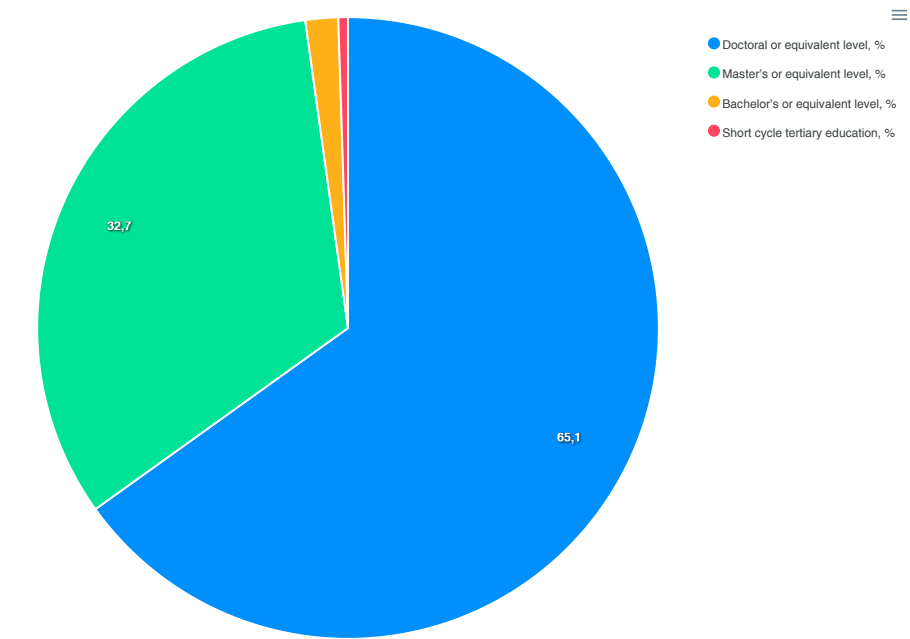
G-3 R&D PERSONNEL, BY OCCUPATION IN R&D AND SEX, HEADCOUNT, 2023



## 6 RESEARCHERS, BY TYPE OF EMPLOYMENT, SECTORS, EDUCATIONAL ATTAINMENT AND SEX, 2023

	Total		Researchers by educational attainment							
			Doctoral or equivalent level		Master's or equivalent level		Bachelor's or equivalent level		Short cycle tertiary education	
	All	Women	All	Women	All	Women	All	Women	All	Women
<b>Headcount</b>										
Researchers – total	17 013	8 346	11 076	5 741	5 567	2 527	280	63	90	15
Business enterprise sector	3 080	974	350	139	2 379	767	261	53	90	15
Government and private non-profit sector	3 324	1 883	2 658	1 472	664	411	2	-	-	-
Higher education	10 609	5 489	8 068	4 130	2 524	1 349	17	10	-	-
Persons working on employment contract basis	16 191	7 992	10 483	5 473	5 341	2 442	278	62	89	15
Business enterprise sector	3 012	959	306	133	2 358	759	259	52	89	15
Government and private non-profit sector	3 017	1 763	2 440	1 373	575	390	2	-	-	-
Higher education	10 162	5 270	7 737	3 967	2 408	1 293	17	10	-	-
Persons hired under contractual agreement or author's contract	822	354	593	268	226	85	2	1	1	-
Business enterprise sector	68	15	44	6	21	8	2	1	1	-
Government and private non-profit sector	307	120	218	99	89	21	-	-	-	-
Higher education	447	219	331	163	116	56	-	-	-	-
<b>Full-time equivalent (FTE)</b>										
Researchers – total	9 523,7	4 610,8	5 563,4	2 942,3	3 669,4	1 615,3	219,0	41,8	71,9	11,4
Business enterprise sector	2 464,0	811,8	273,9	119,8	1 905,5	641,8	212,7	38,8	71,9	11,4
Government and private non-profit sector	2 223,5	1 284,3	1 782,0	1 005,1	440,3	279,2	1,2	-	-	-
Higher education	4 836,2	2 514,7	3 507,5	1 817,4	1 323,6	694,3	5,1	3,0	-	-
Persons working on employment contract basis	9 226,8	4 487,5	5 352,5	2 846,6	3 584,4	1 587,8	218,8	41,7	71,1	11,4
Business enterprise sector	2 436,6	807,4	260,5	118,3	1 892,5	639,0	212,5	38,7	71,1	11,4
Government and private non-profit sector	2 111,9	1 242,4	1 695,7	966,4	415,0	276,0	1,2	-	-	-
Higher education	4 678,3	2 437,7	3 396,3	1 761,9	1 276,9	672,8	5,1	3,0	-	-
Persons hired under contractual agreement or author's contract	296,9	123,3	210,9	95,7	85,0	27,5	0,2	0,1	0,8	-
Business enterprise sector	27,4	4,4	13,4	1,5	13,0	2,8	0,2	0,1	0,8	-
Government and private non-profit sector	111,6	41,9	86,3	38,7	25,3	3,2	-	-	-	-
Higher education	157,9	77,0	111,2	55,5	46,7	21,5	-	-	-	-

G-4 RESEARCHERS, BY EDUCATIONAL ATTAINMENT, HEADCOUNT, 2023

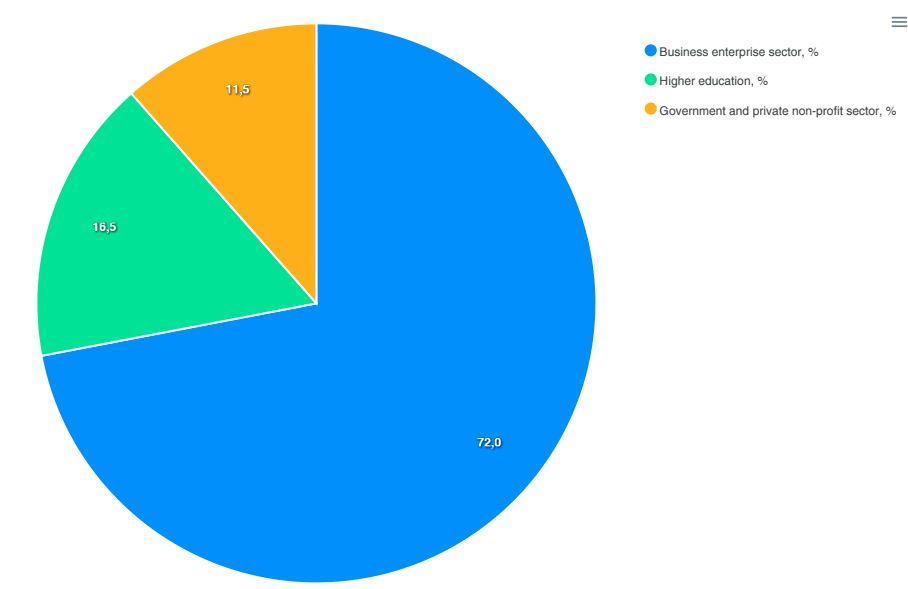


Regarding the sectoral distribution, 469 out of 651 observation units belonged to the business enterprise sector, 75 to the government and private non-profit sector and 107 to the higher education.

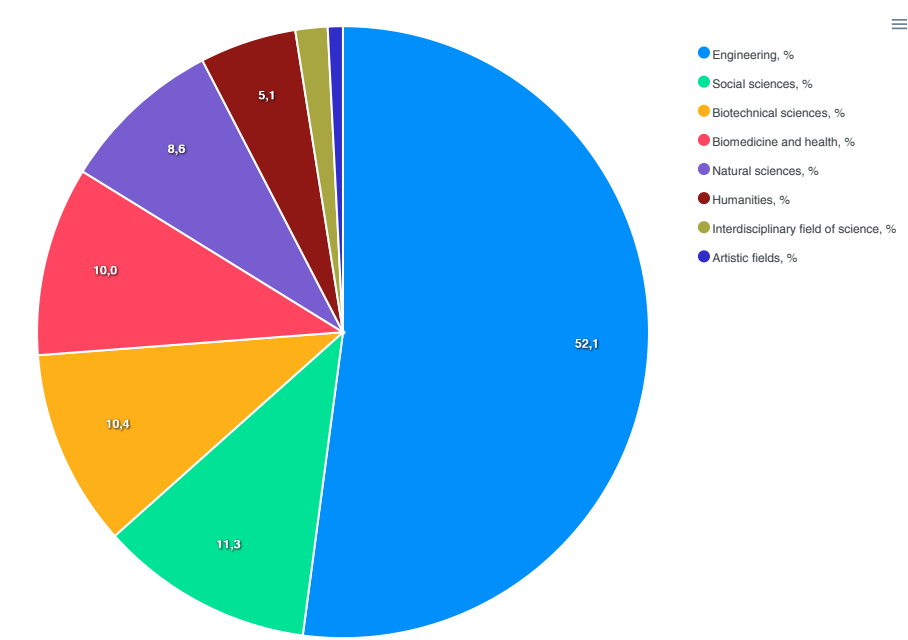
7 R&D PERFORMING UNITS, BY SECTORS AND FIELDS OF SCIENCE, 2023

	Total	Business enterprise sector	Government and private non-profit sector	Higher education
Total	651	469	75	107
Natural sciences	56	32	13	11
Engineering	339	308	4	27
Biomedicine and health	65	28	24	13
Biotechnical sciences	68	54	6	8
Social sciences	74	36	11	27
Humanities	33	6	17	10
Interdisciplinary field of science	11	5	-	6
Artistic fields	5	-	-	5

G-5 R&D PERFORMING UNITS (ENTERPRISES AND INSTITUTIONS), BY SECTORS, 2023



G-6 R&D PERFORMING UNITS (ENTERPRISES AND INSTITUTIONS), BY FIELDS OF SCIENCE, 2023



NOTES ON METHODOLOGY

Purpose of the survey

The purpose of the Research and Development survey is to monitor the R&D activity in the Republic of Croatia. The survey is conducted every year with the aim of collecting and publishing data on R&D personnel, expenditure and sources of funds for R&D, as well as the results of the R&D activity. The survey results enable the measurement of research and development activities in the Republic of Croatia and represent a part of the basis for adopting national policy on research and development activity and monitoring its implementation. They also represent official data on the research and development activity in the Republic of Croatia that are published in national and international publications and databases. In addition to continuous monitoring of research and development activities, the survey is important for the calculation of GDP.

The survey is conducted on the basis of the Official Statistics Act (NN, Nos 25/20 and 155/23). The legal basis of the European Union for the implementation of the survey is the Commission Implementing Regulation (EU) 2020/1197 of 30 July 2020 laying down technical specifications and arrangements pursuant to Regulation (EU) 2019/2152 of the European Parliament and of the Council on European business statistics repealing 10 legal acts in the field of business statistics and the European Business Statistics Methodological Manual for R&D statistics (2023 edition).

Sources and methods of data collection

Data are the result of statistical processing of annual reports collected from legal units dealing with R&D in the Republic of Croatia in the 2023 calendar year. The units from the business enterprise sector filled out the Annual Report on R&D for Enterprises (IR-1 form), the government and private non-profit sector the Annual



Report on R&D for Government and Private Non-Profit Sector (IR-2 form) and the institutions of higher education the Annual Report on R&D for Higher Education (IR-3 form). The forms were sent to the reporting units via electronic mail, along with general instructions and attachments required to fill out the forms. The reporting units returned the completed forms in the same way.

The reference period to which data on R&D personnel and expenditure refer is the entire 2023.

Pursuant to the Official Statistics Act (NN, Nos 25/20 and 155/23), the confidentiality of all data provided by the reporting units in the form is guaranteed. The data collected are used solely for statistical purposes and are published in aggregated form.

### Observation units

Starting this year the main observation unit/statistical unit for R&D in the business sector is the enterprise - a business entity that makes an organizational unit engaged in producing goods and/or services and benefits from a certain degree of autonomy, in accordance with Council Regulation (EEC) no. 696/93 of 15 March 1993 on statistical units for the observation and analysis of the production system in the Community. Depending on the business and organizational situation, it may correspond to either one legal unit or a group of several legal units. In addition to legal units, enterprises also include free lances and crafts.

Each enterprise as a whole is assigned a code number of its principal activity according to the National Classification of Activities, 2007 version. The principal activity is determined and updated by the Statistical Business Register of the Croatian Bureau of Statistics.

For other sectors (government, private non-profit and higher education sector), the units of observation are still legal and natural persons.

### Data revision

Data released on 15 November 2024 in the First Release ZTI-2024-2-1 Research and Development, 2023 have been revised because, due to some data processing issues, they were aggregated and presented at the level of legal units – the level at which they were collected. In this First Release, the data are consolidated and presented on the basis of a statistical unit "enterprise", which is in line with the definition determined by the Council Regulation (EEC) No 696/93 of 15 March 1993 on statistical units for the observation and analysis of the production system in the Community. According to this Regulation, the "enterprise" is "the smallest combination of legal units that is an organizational unit producing goods or services, which benefits from a certain degree of autonomy in decision-making, especially for the allocation of its current resources."

### Coverage and comparability

The statistical survey entitled Research and Development in 2023 covers legal units on the territory of the Republic of Croatia that are known or assumed to be engaged in the R&D activity. Due to the importance of research and development (R&D), which is seen as an initiator of economic growth and innovations, various data sources have been analysed in order to improve the survey coverage and to identify hitherto unknown legal units engaged in R&D. The following sources have been used: the Register of Scientific Organisations of the Ministry of Science and Education, the Survey on Innovation Activities in Croatian Enterprises (enterprises that indicated that they are engaged in R&D activities), the Statistical Business Register of the Croatian Bureau of Statistics, the previous Research and Development surveys and the project database within the Horizon Europe programme for the Republic of Croatia for data on funds allocated by applicants (EU\_CORDIS base), the information on awarded grants to enterprises from the European Structural and Investment Funds, a list of scientific institutions of the Croatian Scientific Bibliography (CROSB), a list of funded HAMAG-BICRO projects as well as a list of legal entities that have reported investments in R&D in the Annual Report on Gross Investment in Fixed Assets (INV-P form) for 2022. The analysis of the mentioned sources resulted in the basic list of 1 868 reporting units, to which a form was sent.

The 2023 data published in this First Release are not comparable with data for the previous years because the survey for 2023 was the first to be conducted with the "enterprise" as the statistical unit. Until 2023, the survey was conducted on legal units. Data for 2016 are not fully comparable with data from previous years due to the improvement of a number of statistical production processes and the interruption in time series.

Until 1996, the statistics on scientific research were compiled by means of the Annual Report for Legal Entities Engaged in Science and Research and Legal Entities Engaged in Research and Development (NIRO form), which covered all legal entities engaged in science and research as well as research units within enterprises and institutions, and all institutions of higher education that were recorded with the Register of the Ministry of Science and Technology of the Republic of Croatia in the referent year.

Since 1997, the sector approach has been introduced, based on the international methodology – the Frascati Manual 2002 – and aimed at the expansion of the business enterprise sector as the principal domain of research and development in the world. Data for the period from 1997 to 2003 were collected from business enterprises employing a hundred or more persons, the 2004 data were collected from business enterprises employing ten or more persons and, since 2005, enterprises with less than ten employees as well as the private non-profit sector have been covered. Since 2013, the private non-profit sector has been presented together with the government sector due to the small number of units.

### Definitions and explanations

Definitions of the R&D field are based on the international methodology – the Frascati Manual 2015 (*Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development, The Measurement of Scientific, Technological and Innovation Activities*, publisher: Organisation for Economic Co-operation and Development – OECD, Paris, 2015).

**Research and development (R&D)** comprise systematic creative work aimed at increasing knowledge about man, culture and society and its application in practice. For an activity to be an R&D activity, it must satisfy five criteria. The activity must be novel, creative, uncertain, systematic and transferable and/or reproducible. There are three types of research and development: basic research, applied research and experimental development.

**Basic research** is theoretical or experimental work, which mainly aims at attaining new knowledge about the basics of phenomena and facts with no practical application.

**Applied research** is theoretical or experimental work, which mainly aims at attaining new knowledge and which is primarily focused on achieving practical objectives.

**Experimental development** is systematic work based on the results of scientific research and practical experience, aimed at creating new materials, products and systems as well as at introducing new or improving existing processes, systems and services.

**Business enterprise sector** comprises enterprises the main activity of which is the production of goods and services intended for market at commercial price. The business enterprise sector includes public enterprises, as well as non-profit institutions that are market producers of goods or services.

**Government sector** comprises all units of central and local government, including social security funds, except institutions of higher education, as well as all non-profit institutions that are controlled by government units and are not market-oriented, and that are not part of the higher education sector.

**Private non-profit sector** comprises non-market, non-profit institutions serving providing goods or services to households (that is, the general public), except those mainly controlled and financed by the government, their main characteristic being that they should not be the source of revenue or profit to the institutions controlling them.

**Higher education** includes all institutions providing formal tertiary education programmes, regardless of their source of finance or legal status, and all research institutes and centres that have their R&D activities under the direct control of, or administered by, tertiary education institutions.

**Gross domestic expenditure on R&D (GERD)** is the total intramural expenditure on R&D performed in the national territory during the reporting calendar year. GERD includes domestically performed R&D that is financed from abroad but excludes funding for R&D performed abroad. Intramural R&D expenditures are all current expenditures and gross fixed capital expenditures for R&D performed within a reporting unit, irrespective of the source of funds.

**Current expenditures** comprise labour costs and other current costs used in R&D.

**Labour costs** include compensations of employees (wages and salaries and social contributions paid by an employer), vocational training costs and other labour costs.

**Other current costs** comprise material costs, costs of persons hired under contractual agreement or author's contract, acquiring services to support intramural R&D and other costs (costs of indirect services).

**Capital expenditures** are the annual gross amounts paid for the acquisition of fixed assets that are used repeatedly or continuously in the performance of R&D for more than one year. They comprise investments in land and buildings, machinery and equipment, computer software and patents, licences, studies and projects.

**Total R&D personnel** include all persons engaged directly in R&D, whether employed by the reporting unit or external contributors (persons hired under contractual agreement or author's contract) fully integrated into the unit's R&D activities, as well as those providing direct services for the R&D activities (such as R&D managers, administrators, technicians). According to the recommendations of the Frascati Manual 2015, persons who work less than 10% of full-time hours are not included.

**Researchers** are professionals engaged in the conception or creation of new knowledge. They conduct research and improve or develop concepts, theories, models, techniques instrumentation, software or operational methods.

**Technicians and equivalent staff** are persons whose main tasks require technical knowledge and experience in one or more fields of engineering, the physical and life sciences, natural or social sciences, humanities and the arts. They participate in R&D by performing scientific and technical tasks involving the application of concepts and operational methods and the use of research equipment, normally under the supervision of researchers.

**Expert associates** are persons with higher education employed to perform expert jobs (librarians, IT professionals, information specialists, etc.), who participate in the scientific and research and R&D work, but are not the managers of R&D projects.

**Other supporting staff** are employees who perform all the activities that directly contribute to the R&D performance, and which are not performed by researchers or technicians and expert associates. These activities include secretarial and other administrative tasks, the management of materials or equipment required for the R&D project implementation, supporting activities related to R&D such as planning, information and financial support, legal services, assistance in the assembly, adjustment, maintenance and repair of scientific equipment and instruments. Managerial and administrative staff who mainly deal with financial and personnel issues and general administration are also included, if their activities are directly related to R&D projects.

**Full-time equivalent (FTE)** is expressed in person-years and presents time as a share of full working time in which persons in employment are engaged in the work related to R&D (for example, if a person was engaged in works related to R&D for six months in full working time, it is expressed as 0.5 full-time equivalent – 0.5 FTE).

## Abbreviations

EEC	European Economic Community
EU	European Union
Eurostat	Statistical Office of the European Union
GDP	gross domestic product
HAMAG-BICRO	Croatian Agency for SMEs, Innovations and Investments
NN	Narodne novine, official gazette of the Republic of Croatia
OECD	Organisation for Economic Co-operation and Development
R&D	research and development

## Symbols

-	no occurrence
0,0	value not zero but less than 0.05 of the unit of measure used

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