



Main Science & Technology Indicators of Korea

2023-March



Ministry of Science and ICT



Korea Institute of S&T
Evaluation and Planning

Notes

- This booklet is published biannually. Please note that figures may vary according to the exact time of the survey.
- The figures included in this booklet are based on survey and analysis of statistics as of March 2023.
 - OECD regularly publishes R&D statistics comparing various countries, and international comparisons in this booklet are mostly based on the latest version of their biannual publication, Main Science & Technology Indicators 2023–March.
- The source of each indicator is stated in detail (in some cases with URL). The sum of individual figures and the total may not be identical due to issues such as significant figures.
 - For example, figures were rounded to the nearest integer when recomputing statistics or adjusting units (ten thousand KRW → 100 million KRW). Differences between the sum of individual figures and the total may arise from these processes.
- Some figures were recalculated from original data by the publishers to suit the purpose of the indicator. Thus some figures of the final year may not have been calculated.
 - For example, if the available data for labor force is from 2019 and researchers is from 2018, total researchers per 1,000 labor force (FTE) was calculated only up to 2018.
- Rankings were based on data of the most recent year obtained (or recomputed).

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Main **Science & Technology**
Indicators of Korea
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Main Science and Technology Indicators

1. R&D Expenditure and Personnel

		Korea	USA	Japan	Germany	France	UK	China
R&D Expenditure	Gross Domestic Expenditure on R&D(100 million USD)	89,282 (5th)	806,013 (1st)	164,973 (3rd)	133,472 (4th)	65,426 (7th)	79,194 (6th)	297,431 (2nd)
	Ratio	1.00	9.03	1.85	1.49	0.73	0.89	3.33
	As a percentage of GDP(%)	4.93	3.46	3.30	3.13	2.21	2.93	2.14
	Government·Public: Private·Foreign Ratio(%)	23:77	27:73	21:79	30:70	35:65 ('19)	32:68	20:78
	Government Expenditure on R&D(100 million USD)	23,057	169,938	71,454	45,371	20,887	17,934 ('20)	–
	As a percentage of GDP(%)	1.37	0.67	1.69	1.11	0.71	0.66	–
R&D Personnel	Total Researchers (1,000 FTE)	471	1,493 ('20)	705	460	340	296	1,866 ('18)
	Total Researchers per 1,000 labor force(FTE)	16.7	9.2 ('20)	14.3	10.7	11.3	8.9	2.4

▶ Rankings were based on the data of the most recent year('21) obtained from OECD Main Science & Technology Indicators 2023-3, and the year given in parentheses means the base year of data shown

▶ The sum of Government·Public : Private·Foreign Ratio in China is less than 100.0%

▶ Total R&D expenditure in Korea : 102,1352 trillion KRW('21), Government Budget on R&D : 29.7770 trillion KRW('22) (before the supplementary budget)

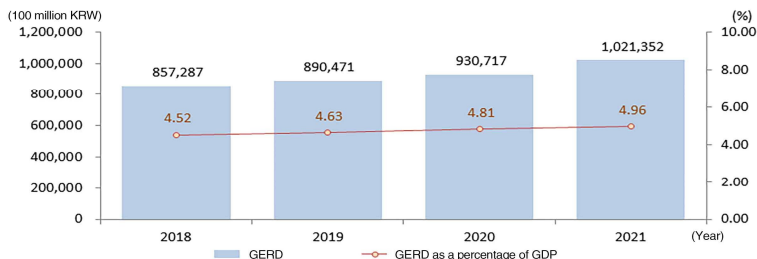
2. R&D Performance

		Korea	USA	Japan	Germany	France	UK	China
Publications ('21)	SCI Papers	83,680 (12th)	521,072 (2nd)	102,491 (7th)	149,965 (4th)	94,189 (10th)	174,396 (3rd)	641,543 (1st)
Patents	Number of triadic patent families('20)	3,379 (5th)	13,294 (2nd)	17,053 (1st)	4,454 (4th)	1,875 (6th)	1,732 (7th)	6,039 (3rd)
	Number of patent applications to the PCT('21)	20,718 (4th)	59,426 (2nd)	50,275 (3rd)	17,275 (5th)	7,339 (6th)	5,843 (7th)	69,581 (1st)
R&D-intensive industries('21) *Korea('20)	Receipts (A, 100 million USD)	1,717	3,867	1,209	2,971	1,186	960	9,943
	Payments (B, 100 million USD)	1,118	6,771	1,687	2,631	1,189	1,124	8,040
	Balance of payments ratio(A/B)	1.54	0.57	0.72	1.13	1.00	0.85	1.24
	Balance of payments ('100 million USD)	599	-2,905	-479	340	-3	-165	1,903
IMD evaluation ('22)	Competitiveness ranking	27	10	34	15	28	23	17
	Science	3	1	8	2	15	14	9
	Technology	19	11	42	33	15	18	12

R&D Expenditure

1. Gross Domestic Expenditure on R&D (GERD)

① GERD in Korea



▶ Since the GDP for year Y is finalized on March of Y+2yrs, there is a possibility of change in GERD as a percentage of GDP that was initially extracted from November of Y+1yr

▶ Source : MSIT·KISTEP, Survey of Research and Development in Korea

② GERD in major countries

		2018	2019	2020	2021
Korea	GERD(million USD)	77,924	76,412	78,856	89,283
	As a percentage of GDP(%)	4.52	4.63	4.80	4.93
USA	GERD(million USD)	618,066	677,881	730,329	806,013
	As a percentage of GDP(%)	3.01	3.17	3.47	3.46
Japan	GERD(million USD)	162,276	164,709	165,043	164,973
	As a percentage of GDP(%)	3.22	3.22	3.27	3.30
Germany	GERD(million USD)	123,609	123,171	121,739	133,472
	As a percentage of GDP(%)	3.11	3.17	3.13	3.13
France	GERD(million USD)	61,308	59,811	60,799	65,426
	As a percentage of GDP(%)	2.20	2.19	2.30	2.21
UK	GERD(million USD)	77,854	76,155	79,194	-
	As a percentage of GDP(%)	2.70	2.67	2.93	-
China	GERD(million USD)	297,431	-	-	-
	As a percentage of GDP(%)	2.14	-	-	-

▶ GERD is calculated by applying GERD in MSTI 2023–March and KRW/USD currency exchange rate

▶ Source : OECD, MSTI 2023–March (stats.oecd.org).

MSIT·KISTEP, Survey of Research and Development in Korea

3 GERD per capita and per researcher in Korea

	2018	2019	2020	2021
GERD per capita (1,000 KRW)	1,661	1,722	1,797	1,966
GERD per researcher (million KRW)	166.7	165.5	166.8	174.1

▶ The data is based on headcount

▶ Source : MSIT·KISTEP, Survey of Research and Development in Korea

4 GERD per capita and per researcher (FTE) in major countries

		2018	2019	2020	2021
GERD per capita population (USD)	Korea	1,511	1,476	1,521	1,725
	USA	1,880	2,051	2,201	2,426
	Japan	1,283	1,305	1,313	1,315
	Germany	1,491	1,482	1,464	1,604
	France	909	883	894	959
	UK	1,172	1,140	1,181	–
	China	212	–	–	–
GERD per researcher (FTE) (USD)	Korea	190,816	177,417	176,514	189,670
	USA	438,083	472,083	489,144	–
	Japan	239,298	241,572	239,232	234,170
	Germany	285,021	273,289	270,053	290,466
	France	200,721	190,862	189,081	192,426
	UK	–	–	–	–
	China	159,386	–	–	–

▶ Each country's GERD is calculated by applying the R&D expenditure and exchange rate to USD listed in MSTI 2023–March

▶ FTE (Full-time equivalent) takes into account the amount of researchers' actual participation in labor

▶ Source : OECD, MSTI 2023–March (stats.oecd.org)

MSIT·KISTEP, Survey of Research and Development in Korea

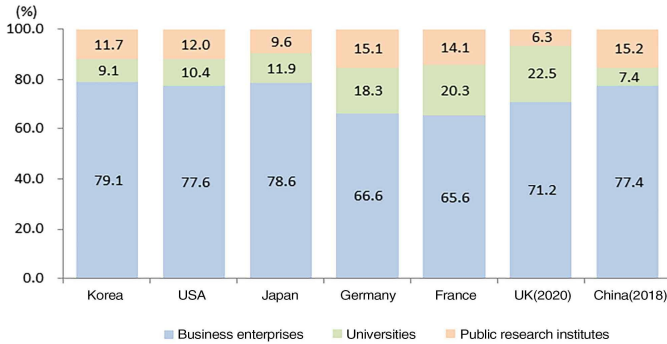
5 GERD by performance sector in Korea

	2018		2019		2020		2021	
	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)
Business enterprise	688,344	80.3	715,067	80.3	735,998	79.1	808,076	79.1
University	70,504	8.2	73,716	8.3	83,534	9.0	93,306	9.1
Public research institute	98,439	11.5	101,688	11.4	111,186	11.9	119,970	11.7
Total	857,287	100.0	890,471	100.0	930,717	100.0	1,021,352	100.0

▶ Non-profit organizations are included in public research institutes

▶ Source : MSIT·KISTEP, Survey of Research and Development in Korea

6 Percentage of GERD by performance sector in major countries (2021)



► Non-profit organizations are included in public research institutes

► Source : OECD, MSTI Indicators 2023-March (stats.oecd.org)

MSIT-KISTEP, Survey of Research and Development in Korea

7 GERD by source of funds in Korea

	2018		2019		2020		2021	
	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)
Government	183,630	21.4	190,955	21.4	215,812	23.2	240,950	23.6
Private	657,028	76.6	685,216	76.9	712,693	76.6	777,421	76.1
Abroad	16,629	1.9	14,300	1.6	2,212	0.2	2,982	0.3
Total	857,287	100.0	890,471	100.0	930,717	100.0	1,021,352	100.0

► Source : MSIT-KISTEP, Survey of Research and Development in Korea

8 Percentage of GERD by source of funds in major countries (%) (2021)

	Korea	USA	Japan	Germany ('20)	France ('20)	UK ('20)	China ('18)
Government	23.6	25.4	21.3	30.1	35.5	30.6	20.2
Private	76.1	67.9	78.1	62.6	56.8	57.5	76.6
Abroad	0.3	6.7	0.6	7.3	7.7	11.9	0.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	97.2

► The sum of Government, Private and Abroad of China is less than 100.0%

► Source : OECD, MSTI 2023-March(stats.oecd.org)

MSIT-KISTEP, Survey of Research and Development in Korea

9 GERD by type of R&D in Korea

	2018		2019		2020		2021	
	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)
Basic research	121,805	14.2	130,623	14.7	134,481	14.4	151,002	14.8
Applied research	188,247	22.0	200,401	22.5	200,786	21.6	214,704	21.0
Development research	547,235	63.8	559,446	62.8	595,450	64.0	655,647	64.2
Total	857,287	100.0	890,471	100.0	930,717	100.0	1,021,352	100.0

► Source : MSIT·KISTEP, Survey of Research and Development in Korea

10 GERD by type of R&D in major countries (%) (2020)

	Korea (‘21)	USA	Japan	France (‘19)	UK (‘19)	China
Basic research	14.4	15.0	12.3	22.7	18.3	6.0
Applied research	21.6	19.4	18.6	41.3	43.2	11.3
Development research	64.0	63.9	64.9	36.0	38.5	82.7

► For USA and Japan, other sources are excluded such that the total does not add up to 100.0%

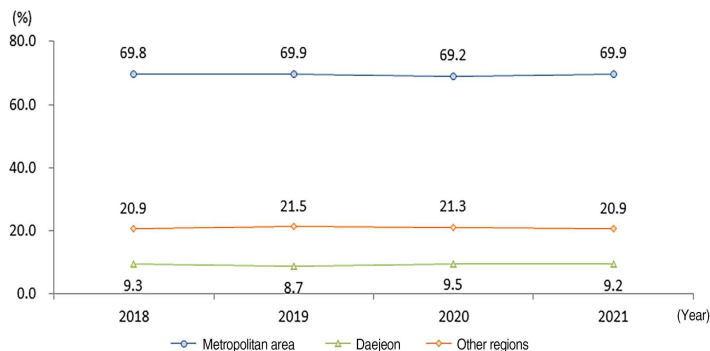
► Source : OECD, Research and Development Statistics (stats.oecd.org)

11 GERD on future and emerging technologies (6T) in Korea

	2018		2019		2020		2021	
	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)
Information Technology (IT)	307,329	35.8	330,158	37.1	348,158	37.4	391,210	38.3
Biotechnology (BT)	66,401	7.7	76,262	8.6	89,162	9.6	103,754	10.2
Nanotechnology (NT)	87,377	10.2	88,185	9.9	94,129	10.1	101,368	9.9
Space Technology (ST)	14,789	1.7	15,436	1.7	16,671	1.8	15,260	1.5
Environment Technology (ET)	79,636	9.3	77,641	8.7	88,952	9.6	101,260	9.9
Culture Technology (CT)	8,075	0.9	8,098	0.9	8,277	0.9	10,602	1.0
Others	293,680	34.3	294,691	33.1	285,368	30.7	297,899	29.2
Total	857,287	100.0	890,471	100.0	930,717	100.0	1,021,352	100.0

► Source : MSIT·KISTEP, Survey of Research and Development in Korea

12 GERD by region in Korea



	2018		2019		2020		2021	
	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)
Seoul	134,754	15.7	134,449	15.1	144,320	15.5	162,043	15.9
Busan	15,449	1.8	15,817	1.8	16,968	1.8	17,627	1.7
Daegu	13,258	1.5	13,360	1.5	13,641	1.5	14,876	1.5
Incheon	27,613	3.2	28,459	3.2	29,366	3.2	32,270	3.2
Gwangju	9,010	1.1	8,269	0.9	9,539	1.0	11,089	1.1
Daejeon	79,922	9.3	77,059	8.7	88,737	9.5	94,428	9.2
Ulsan	11,103	1.3	11,100	1.2	10,672	1.1	11,900	1.2
Sejong	5,171	0.6	5,941	0.7	6,115	0.7	6,534	0.6
Gyeonggi	436,153	50.9	459,348	51.6	470,451	50.5	519,571	50.9
Gangwon	4,818	0.6	5,172	0.6	5,551	0.6	6,859	0.7
Chungbuk	16,287	1.9	16,595	1.9	19,217	2.1	21,307	2.1
Chungnam	25,878	3.0	34,752	3.9	36,651	3.9	36,330	3.6
Jeonbuk	10,846	1.3	11,217	1.3	12,361	1.3	14,112	1.4
Jeonnam	6,608	0.8	7,238	0.8	7,041	0.8	8,143	0.8
Gyeongbuk	30,204	3.5	28,054	3.2	26,871	2.9	27,751	2.7
Gyeongnam	28,625	3.3	31,895	3.6	30,898	3.3	34,080	3.3
Jeju	1,590	0.2	1,744	0.2	2,316	0.2	2,433	0.2
Total	857,287	100.0	890,471	100.0	930,717	100.0	1,021,352	100.0

▶ Source : MSIT-KISTEP, Survey of Research and Development in Korea

2. Business Enterprise Expenditure on R&D(BERD)

13) Percentage of BERD financed by government in Korea (%)

	2018	2019	2020	2021
All business enterprise	4.4	4.5	5.3	5.8
SMEs and start-ups	13.9	13.4	14.9	16.2

▶ SME(Small-medium-sized business) here does not include start-ups (SMEs are broadly accepted as the combination of SMEs and start-ups)

▶ Source : MSIT·KISTEP, Survey of Research and Development in Korea

14) Percentage of BERD financed by government in major countries (%)

	2018	2019	2020	2021
Korea	4.4	4.4	5.3	5.8
USA	5.5	4.5	5.4	5.1
Japan	0.8	0.8	0.9	1.0
Germany	3.1	3.2	3.2	–
France	7.5	7.7	8.5	–
UK	6.3	6.0	7.1	7.1
China	3.2	3.8	–	–

▶ Source : OECD, MSTI 2023-March (stats.oecd.org)

MSIT·KISTEP, Survey of Research and Development in Korea

15) BERD by business type in Korea

	2018		2019		2020		2021	
	BERD (100 million KRW)	Percentage (%)	BERD (100 million KRW)	Percentage (%)	BERD (100 million KRW)	Percentage (%)	BERD (100 million KRW)	Percentage (%)
Large Corp.	438,236	63.7	446,658	62.5	451,694	61.4	491,394	60.8
Medium	95,954	13.9	101,864	14.2	103,691	14.1	114,751	14.2
Small	74,883	10.9	80,048	11.2	79,341	10.8	85,251	10.5
Start-up	79,272	11.5	86,497	12.1	101,272	13.8	116,681	14.4
Total	688,344	100.0	715,067	100.0	735,998	100.0	808,076	100.0

▶ SME(Small-medium-sized business) here does not include start-ups (SMEs are broadly accepted as the combination of SMEs and start-ups)

▶ Source : MSIT·KISTEP, Survey of Research and Development in Korea

16 BERD by industry in Korea

		2018	2019	2020	2021
BERD (100 million KRW)	Manufacturing	611,572	625,550	638,163	695,560
	Compounds and chemicals (excluding pharmaceuticals)	35,574	37,800	36,924	36,722
	Electrical machinery and apparatus, radio, TV and communications equipment	345,206	351,654	351,135	384,377
	Motor vehicles and trailers	84,389	84,084	85,170	87,723
	Services	62,349	75,823	84,130	99,188
Percentage (%)	Manufacturing	88.8	87.5	86.7	86.1
	Compounds and chemicals (excluding pharmaceuticals)	5.2	5.3	5.0	4.5
	Electrical machinery and apparatus, radio, TV and communications equipment	50.2	49.2	47.7	47.6
	Motor vehicles and trailers	12.3	11.8	11.6	10.9
	Services	9.1	10.6	11.4	12.3

► * shows the top 3 industries in the manufacturing industry for R&D expenditure

► Source : MSIT·KISTEP, Survey of Research and Development in Korea

17 BERD by industry in major countries (%)

	Korea (²¹)	USA (¹⁸)	Japan (²⁰)	Germany (¹⁹)	France (¹⁷)	UK (¹⁹)
Manufacturing	86.1	59.9	89.9	84.9	48.7	36.9
Services	12.3	35.2	8.5	14.4	48.2	60.5

► Source : OECD, Research and Development Statistics (stats.oecd.org)

MSIT·KISTEP, Survey of Research and Development in Korea

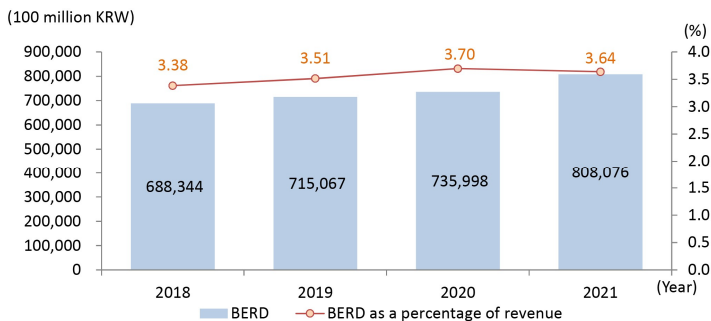
18 BERD performed in R&D-intensive industries of major countries

	Korea (²¹)	USA (²⁰)	Japan (²¹)	Germany (²⁰)	France (¹⁷)	UK (¹³)
BERD (million USD)	37,299	216,276	35,378	17,353	8,154	4,498
Percentage (%)	52.8	39.4	27.3	21.4	21.9	15.6

► R&D-intensive industries are defined as pharmaceutical, computer, electronic and optical, and aerospace industry (OECD)

► Source : OECD, MSTI 2023-March (stats.oecd.org)

19 BERD as a percentage of revenue in Korea



▶ Source : MSIT·KISTEP, Survey of Research and Development in Korea

20 BERD as a percentage of industry value added in major countries (2021)

	Korea	USA	Japan	Germany	France	UK	China
BERD as a percentage of value added in industry (%)	5.78	4.18	3.64	3.33	2.54	3.42	2.10

▶ Source : OECD, Main Science & Technology Indicators 2023-March (stats.oecd.org)

21 BERD intensity in Korea (%)

	2018	2019	2020	2021
Top 5 companies	47.6	46.9	45.2	44.6
Top 10 companies	53.9	52.9	51.6	50.3
Top 20 companies	58.3	57.1	55.8	54.9

▶ BERD intensity is the sum of BERD of top firms (in terms of BERD size) as a percentage of the total BERD

▶ Source : MSIT·KISTEP, Survey of Research and Development in Korea

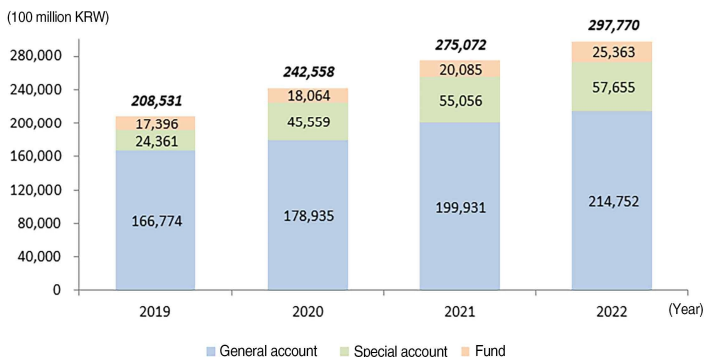
22 World's top 50 companies by BERD (2021)

Rank	Name	Country	Rank	Name	Country
1	ALPHABET	USA	26	ROBERT BOSCH	Germany
2	META	USA	27	ELI LILLY	USA
3	MICROSOFT	USA	28	ABBVIE	USA
4	HUAWEI INVESTMENT & HOLDING	China	29	STELLANTIS	Netherlands
5	APPLE	USA	30	CISCO SYSTEMS	USA
6	SAMSUNG ELECTRONICS	Korea	31	NTT	Japan
7	VOLKSWAGEN	Germany	32	SANOFI	France
8	INTEL	USA	33	BAYER	Germany
9	ROCHE	Switzerland	34	CHINA STATE CONSTRUCTION ENGINEERING	China
10	JOHNSON & JOHNSON	USA	35	GSK	UK
11	PFIZER	USA	36	IBM	USA
12	BRISTOL-MYERS SQUIBB	USA	37	SAP	Germany
13	MERCK US	USA	38	SIEMENS	Germany
14	MERCEDES-BENZ	Germany	39	SONY	Japan
15	TOYOTA MOTOR	Japan	40	GILEAD SCIENCES	USA
16	NOVARTIS	Switzerland	41	NVIDIA	USA
17	ALIBABA GROUP HOLDING	China	42	BROADCOM	USA
18	TENCENT	China	43	AMGEN	USA
19	ASTRAZENECA	UK	44	NOKIA	Finland
20	GENERAL MOTORS	USA	45	BOEHRINGER SOHN	Germany
21	BMW	Germany	46	TAKEDA PHARMACEUTICAL	Japan
22	FORD MOTOR	USA	47	ERICSSON	Sweden
23	ORACLE	USA	48	TAIWAN SEMICONDUCTOR	Taiwan
24	HONDA MOTOR	Japan	49	SALESFORCE	USA
25	QUALCOMM	USA	50	DENSO	Japan

► Source : EC, The 2022 EU Industrial R&D Investment Scoreboard (iri.jrc.ec.europa.eu/scoreboard.html)

3. Government Intramural Expenditure on R&D (GOVERD)

23. Total Government Budget Appropriations or Outlays for R&D (GBAORD) in Korea



	2019	2020	2021	2022
General account (100 million KRW)	166,774	178,935	199,931	214,752
Special account (100 million KRW)	24,361	45,559	55,056	57,655
Funds (100 million KRW)	17,396	18,064	20,085	25,363
Total GBAORD (100 million KRW)	208,532	242,558	275,072	297,770

► Based on the supplementary budget and revised fund management plan and 2022 budget is the standard of National Assembly finalized budget before the supplementary budget

► Source : MSIT·KISTEP, Governmental R&D Survey and Analysis

24. Total GBAORD in major countries (2022)

	Korea	USA	Japan	Germany	France ('21)	UK ('20)
Total GBAORD (million USD)	23,057	169,938	71,454	45,371	20,887	17,934
As a percentage of GDP (%)	1.37	0.67	1.69	1.11	0.71	0.66

► Source : OECD, MSTI 2023-March (stats.oecd.org)

25 GOVERD in Korea

	2018	2019	2020	2021
GOVERD (100 million KRW)	197,759	206,254	238,803	265,791
Number of projects	63,697	70,327	73,501	74,745

▶ Source : MSIT·KISTEP, Governmental R&D Survey and Analysis

26 GOVERD by performance sectors in Korea

	2018		2019		2020		2021	
	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)
Research institutes	90,747	45.9	93,124	45.2	101,611	42.6	108,371	40.7
Universities	45,365	22.9	50,278	24.4	57,508	24.1	63,317	23.8
Business enterprises	46,694	23.6	48,811	23.7	61,784	25.9	70,214	26.4
Ministries	2,993	1.5	1,829	0.9	1,914	0.8	2,634	1.0
Others	11,960	6.0	12,212	5.9	15,986	6.7	21,254	8.0
Total	197,759	100.0	206,254	100.0	238,803	100.0	265,791	100.0

▶ Source : MSIT·KISTEP, Governmental R&D Survey and Analysis

27 GOVERD by type of R&D in Korea

	2018		2019		2020		2021	
	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)
Basic research	44,651	32.7	46,415	32.7	50,714	30.1	53,068	27.5
Applied research	27,665	20.2	30,458	21.5	38,907	23.1	46,619	23.6
Development research	64,387	47.1	64,883	45.8	78,754	46.8	94,565	48.9
Total	136,703	100.0	141,757	100.0	168,375	100.0	193,252	100.0

▶ Percentage is calculated excluding 「Others」

▶ Source : MSIT·KISTEP, Governmental R&D Survey and Analysis

28 GOVERD by ministry in Korea

	2020		2021	
	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)
Ministry of Science and ICT	77,137	32.3	83,472	31.4
Ministry of Trade, Industry and Energy	40,113	16.8	46,451	17.5
Defense Acquisition Program Administration	37,715	15.8	38,497	14.5
Ministry of Education	21,646	9.1	23,058	8.7
Ministry of SMEs and Startups	14,046	5.9	16,650	6.3
Multi-ministerial	4,493	1.9	8,645	3.3
Rural Development Administration	6,869	2.9	7,705	2.9
Ministry of Oceans and Fisheries	6,803	2.8	7,524	2.8
Ministry of Land, Infrastructure and Transport	5,030	2.1	5,979	2.2
Ministry of Health and Welfare	6,433	2.7	5,768	2.2
Office for Government Policy Coordination	5,165	2.2	5,424	2.0
Ministry of Environment	3,670	1.5	4,011	1.5
Ministry of Agriculture, Food and Rural Affairs	2,076	0.9	2,281	0.9
Korea Forest Service	1,147	0.5	1,348	0.5
Korea Disease Control and Prevention Agency	-	-	1,167	0.4
Korea Meteorological Administration	990	0.4	1,161	0.4
Nuclear Safety and Security Commission	729	0.3	1,143	0.4
Ministry of Culture, Sports and Tourism	937	0.4	1,102	0.4
Ministry of Food and Drug Safety	921	0.4	1,056	0.4
Ministry of the Interior and Safety	728	0.3	967	0.4
Others	2,155	0.9	2,379	0.9
Total	238,803	100.0	265,791	100.0

▶ Source : MSIT·KISTEP, Governmental R&D Survey and Analysis

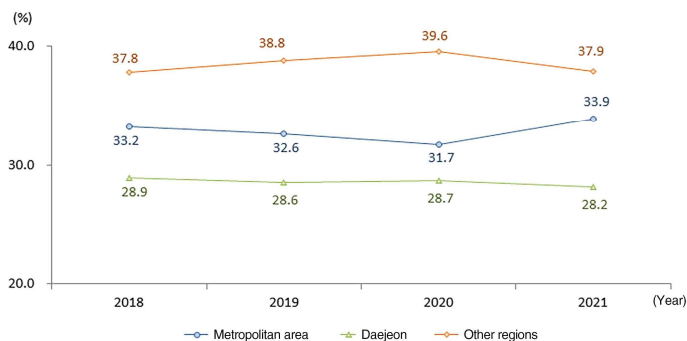
29 GOVERD on future and emerging technologies (6T) in Korea

	2018		2019		2020		2021	
	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)
Information Technology (IT)	33,451	18.1	34,633	18.0	43,168	19.2	49,004	19.5
Biotechnology (BT)	35,494	19.2	36,717	19.1	41,253	18.4	47,766	19.0
Nanotechnology (NT)	8,133	4.4	8,364	4.3	10,884	4.8	12,498	5.0
Space Technology (ST)	14,875	8.1	17,622	9.1	21,461	9.6	20,498	8.2
Environment Technology (ET)	22,294	12.1	22,747	11.8	27,738	12.3	33,993	13.5
Culture Technology (CT)	2,423	1.3	2,195	1.1	2,485	1.1	3,260	1.3
Others	67,919	36.8	70,320	36.5	77,694	34.6	84,255	33.5
Total	184,589	100.0	192,597	100.0	224,682	100.0	251,274	100.0

▶ Analyzed on science and national defense R&D programs

▶ Source : MSIT·KISTEP, Governmental R&D Survey and Analysis

30 GOVERD by region in Korea



	2018		2019		2020		2021	
	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)
Seoul	36,175	18.5	38,571	18.9	41,715	18.4	48,767	20.1
Busan	8,765	4.5	9,120	4.5	9,626	4.2	10,002	4.1
Daegu	6,233	3.2	6,301	3.1	6,842	3.0	7,168	3.0
Incheon	4,087	2.1	4,016	2.0	4,787	2.1	5,243	2.2
Gwangju	4,474	2.3	4,827	2.4	5,607	2.5	5,708	2.4
Daejeon	56,655	28.9	58,439	28.6	65,132	28.7	68,208	28.2
Ulsan	3,031	1.5	3,112	1.5	3,234	1.4	3,651	1.5
Sejong	4,696	2.4	4,837	2.4	5,159	2.3	5,877	2.4
Gyeonggi	24,763	12.7	24,139	11.8	25,611	11.3	28,082	11.6
Gangwon	2,804	1.4	2,996	1.5	3,156	1.4	3,601	1.5
Chungbuk	5,863	3.0	6,101	3.0	7,239	3.2	7,656	3.2
Chungnam	5,301	2.7	5,289	2.6	5,903	2.6	6,455	2.7
Jeonbuk	7,238	3.7	7,526	3.7	8,808	3.9	9,296	3.8
Jeonnam	2,724	1.4	3,199	1.6	3,671	1.6	3,654	1.5
Gyeongbuk	6,299	3.2	6,272	3.1	6,882	3.0	7,271	3.0
Gyeongnam	15,351	7.8	18,365	9.0	22,156	9.7	19,628	8.1
Jeju	1,286	0.7	1,487	0.7	1,714	0.8	1,858	0.8
Total	195,744	100.0	204,597	100.0	227,242	100.0	242,125	100.0

▶ Analyzed on government R&D programs classified by region (excluding overseas and others)

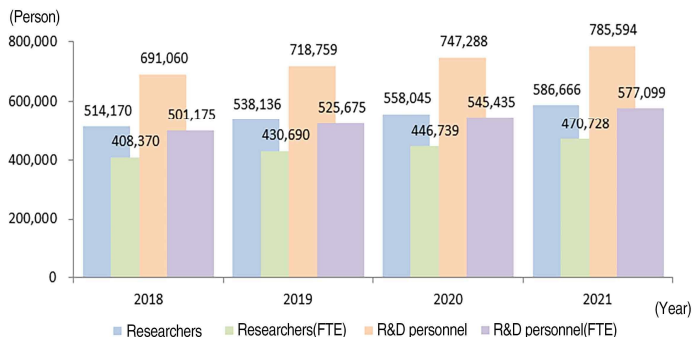
▶ Source : MSIT·KISTEP, Governmental R&D Survey and Analysis



R&D Personnel

4. R&D Personnel

31 Total researchers and total R&D personnel in Korea



Source : MSIT·KISTEP, Survey of Research and Development in Korea

32 Total researchers and total R&D personnel in major countries (FTE)

		2018	2019	2020	2021
Total researchers (FTE)	Korea	408,370	430,690	446,739	470,728
	USA	1,410,842	1,435,937	1,493,075	-
	Japan	678,134	681,821	689,889	704,502
	Germany	433,685	450,697	450,796	459,510
	France	305,439	313,374	321,550	340,004
	UK	-	-	-	-
	China	1,866,109	-	-	-
Total R&D personnel (FTE)	Korea	501,175	525,675	545,435	577,099
	Japan	896,901	903,367	911,620	942,024
	Germany	707,704	735,584	733,831	749,851
	France	453,387	461,891	470,586	501,053
	UK	-	-	-	-
	China	4,381,444	-	-	-

Source : OECD, MSTI 2023-March (stats.oecd.org)
MSIT·KISTEP, Survey of Research and Development in Korea

- 33 Total researchers per 10,000 population, per 1,000 total employment, and per 1,000 labor force (FTE) in Korea

	2018	2019	2020	2021
Total researchers (FTE)	408,370	430,690	446,739	470,728
Total researchers per 10,000 population (FTE)	79.1	83.3	86.3	90.6
Total researchers per 1,000 total employee (FTE)	15.2	15.9	16.6	17.3
Total researchers per 1,000 labor force (FTE)	14.7	15.4	16.0	16.7

► Source : OECD, Main Science & Technology Indicators 2023–March (stats.oecd.org)
MSIT-KISTEP, Survey of Research and Development in Korea

- 34 Total researchers per 10,000 population, per 1,000 total employment, and per 1,000 labor force (FTE) in major countries (2021)

	Korea	USA ('20)	Japan	Germany	France	UK ('17)	China ('18)
Researchers per 10,000 population (FTE)	90.6	45.0	56.1	55.2	49.8	44.8	13.3
Researchers per 1,000 total employment (FTE)	17.3	10.0	10.3	10.2	11.7	9.2	2.5
Researchers per 1,000 labor force (FTE)	16.7	9.2	10.2	10.7	11.3	8.9	2.4

► Source : OECD, MSTI 2023–March (stats.oecd.org)
MSIT-KISTEP, Survey of Research and Development in Korea

- 35 Researchers by sector of employment in Korea

	2018		2019		2020		2021	
	Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)
Business enterprises	368,237	72	387,448	72	401,116	72	429,465	73
Universities	108,529	21	110,619	21	115,924	21	114,635	20
Public research institutes	37,404	7	40,069	7	41,005	7	42,566	7
Total	514,170	100.0	538,136	100.0	558,045	100.0	586,666	100.0

► Source : MSIT-KISTEP, Survey of Research and Development in Korea

- 36 Percentage of researchers (FTE) by sector of employment in major countries (%) (2021)

	Korea	Japan	Germany	France	UK ('17)	China ('18)
Business enterprises	82.9	75.1	60.1	61.8	38.5	61.3
Universities	9.3	19.5	26.2	27.2	57.8	18.9
Public research institutes	7.8	5.4	13.6	11.1	3.7	19.8

► Source : OECD, Main Science & Technology Indicators 2023–March (stats.oecd.org)
MSIT-KISTEP, Survey of Research and Development in Korea

37 Women researchers in Korea

	2018	2019	2020	2021
Total researchers	514,170	538,136	558,045	586,666
Women researchers	104,728	113,187	119,551	130,055
Women researchers as a percentage of total researchers (%)	20.4	21.0	21.4	22.2

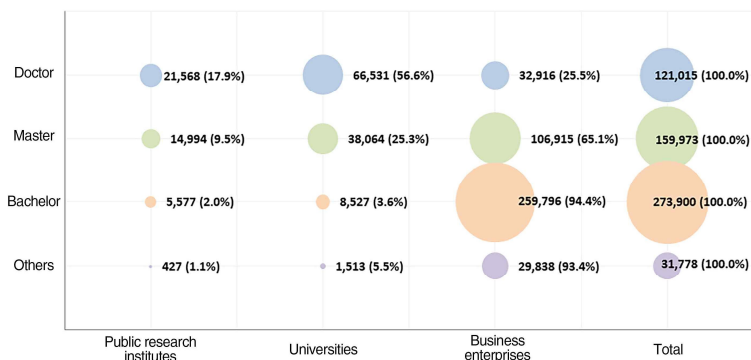
► Source : MSIT-KISTEP, Survey of Research and Development in Korea

38 Women researchers in major countries

	Korea ('21)	Japan ('21)	Germany ('19)	France ('17)	UK ('17)
Women researchers	130,055	175,419	187,231	117,754	201,858
As a percentage of total researchers (%)	22.2	17.8	28.1	28.3	38.7

► Source : OECD, Main Science & Technology Indicators 2023–March (stats.oecd.org)
MSIT-KISTEP, Survey of Research and Development in Korea

39 Distribution of researchers by sector of employment and qualification in Korea (2021)



► Source : MSIT-KISTEP, Survey of Research and Development in Korea

40 Researchers by degree in Korea

	2018		2019		2020		2021	
	Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)
Doctor	105,930	20.6	111,955	20.8	116,784	20.9	121,015	20.6
Master	144,399	28.1	149,529	27.8	153,878	27.6	159,973	27.3
Bachelor	233,922	45.5	247,267	45.9	256,264	45.9	273,900	46.7
Others	29,919	5.8	29,385	5.5	31,119	5.6	31,778	5.4
Total	514,170	100.0	538,136	100.0	558,045	100.0	586,666	100.0

▶ Source : MSIT·KISTEP, Survey of Research and Development in Korea

41 Researchers by field of study in Korea

	2018		2019		2020		2021	
	Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)
Natural science	72,884	14.2	86,248	16.0	81,152	14.5	88,727	15.1
Engineering	344,916	67.1	350,000	65.0	371,068	66.5	386,778	65.9
Medicine & health	29,774	5.8	31,848	5.9	33,262	6.0	35,396	6.0
Agricultural science	10,991	2.1	11,051	2.1	10,853	1.9	11,361	1.9
Humanities	27,931	5.4	28,854	5.4	30,213	5.4	32,267	5.5
Social science	27,674	5.4	30,135	5.6	31,497	5.6	32,137	5.5
Total	514,170	100.0	538,136	100.0	558,045	100.0	586,666	100.0

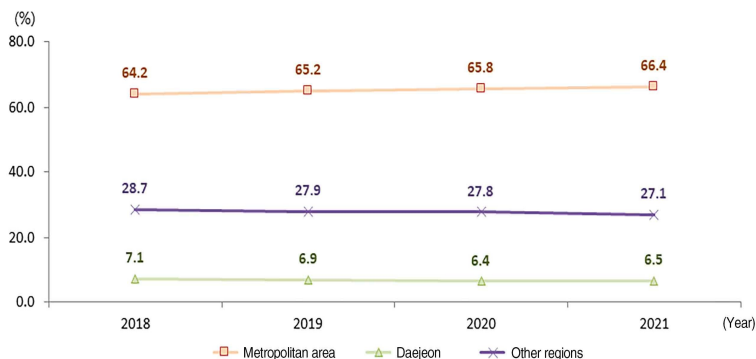
▶ Source : MSIT·KISTEP, Survey of Research and Development in Korea

42 Researchers by age in Korea

	2018		2019		2020		2021	
	Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)
Under 29	76,906	15.0	78,788	14.6	81,386	14.6	87,866	15.0
30~39	208,607	40.6	214,521	39.9	214,991	38.5	221,149	37.7
40~49	151,436	29.5	160,550	29.8	168,434	30.2	175,901	30.0
50~59	61,146	11.9	65,984	12.3	72,534	13.0	79,072	13.5
Over 60	16,075	3.1	18,293	3.4	20,700	3.7	22,678	3.9
Total	514,170	100.0	538,136	100.0	558,045	100.0	586,666	100.0

▶ Source : MSIT·KISTEP, Survey of Research and Development in Korea

43 Researchers by region in Korea



	2018		2019		2020		2021	
	Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)
Seoul	127,350	24.8	132,997	24.7	139,511	25.0	151,361	25.8
Busan	16,356	3.2	16,507	3.1	17,305	3.1	17,386	3.0
Daegu	13,429	2.6	14,047	2.6	14,498	2.6	14,856	2.5
Incheon	20,197	3.9	21,685	4.0	21,917	3.9	23,150	3.9
Gwangju	9,472	1.8	9,471	1.8	9,967	1.8	9,392	1.6
Daejeon	36,361	7.1	37,357	6.9	35,691	6.4	38,009	6.5
Ulsan	8,422	1.6	8,025	1.5	7,900	1.4	7,948	1.4
Sejong	4,064	0.8	4,199	0.8	4,741	0.8	4,979	0.8
Gyeonggi	182,654	35.5	195,972	36.4	205,899	36.9	215,116	36.7
Gangwon	6,730	1.3	7,084	1.3	7,268	1.3	7,938	1.4
Chungbuk	13,405	2.6	13,318	2.5	14,137	2.5	15,274	2.6
Chungnam	17,823	3.5	18,384	3.4	18,584	3.3	19,418	3.3
Jeonbuk	9,653	1.9	9,207	1.7	10,032	1.8	10,682	1.8
Jeonnam	5,106	1.0	5,532	1.0	5,769	1.0	6,055	1.0
Gyeongbuk	19,412	3.8	19,535	3.6	19,189	3.4	19,891	3.4
Gyeongnam	21,908	4.3	22,807	4.2	23,396	4.2	22,888	3.9
Jeju	1,828	0.4	2,009	0.4	2,241	0.4	2,323	0.4
Total	514,170	100.0	538,136	100.0	558,045	100.0	586,666	100.0

► Source : MSIT·KISTEP, Survey of Research and Development in Korea

44 Researchers by business size in Korea

	2018		2019		2020		2021	
	Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)
Large corp.	118,022	32.1	123,528	31.9	123,787	30.9	135,092	31.5
Medium	55,683	15.1	58,867	15.2	60,459	15.1	64,468	15.0
Small	99,748	27.1	104,879	27.1	104,141	26.0	109,581	25.5
Start-up	94,784	25.7	100,174	25.9	112,729	28.1	120,324	28.0
Total	343,367	100.0	368,237	100.0	401,116	100.0	429,465	100.0

▶ Small-medium sized business (SME) here does not include start-ups (SMEs are broadly accepted as the combination of SMEs and start-ups)

▶ Source : MSIT-KISTEP, Survey of Research and Development in Korea

45 Researchers by industry in Korea

		2018	2019	2020	2021
Number of researchers	Manufacturing	277,250	287,648	293,784	309,848
	Compounds and chemicals (excluding pharmaceuticals)*	39,679	41,351	21,835	22,944
	Electrical machinery and apparatus, radio, TV and communications equipment*	97,686	103,149	106,749	112,952
	Motor vehicles and trailers*	38,061	36,827	37,132	37,917
	Services	79,777	88,443	96,329	108,262
Percentage (%)	Manufacturing	75.3	74.2	73.2	72.1
	Compounds and chemicals (excluding pharmaceuticals)	10.8	10.7	5.4	5.3
	Electrical machinery and apparatus, radio, TV and communications equipment	26.5	26.6	26.6	26.3
	Motor vehicles and trailers	10.3	9.5	9.3	8.8
	Services	21.7	22.8	24.0	25.2

▶ * shows the top 3 industries in the manufacturing industry for R&D expenditure

▶ Source : MSIT-KISTEP, Survey of Research and Development in Korea

46 Researcher and doctoral researcher intensity of the top companies in Korea (%)

		2018	2019	2020	2021
Researcher	Top 5 companies	20.3	20.4	20.0	19.9
	Top 10 companies	24.2	24.3	23.4	23.5
	Top 20 companies	27.3	27.2	26.4	26.7
Doctoral researcher	Top 5 companies	33.8	33.3	32.2	31.2
	Top 10 companies	40.2	39.4	39.1	37.6
	Top 20 companies	45.6	44.7	43.9	42.8

▶ Researcher and doctoral researcher intensities were calculated by the order of the highest from each category

▶ Source : MSIT-KISTEP, Survey of Research and Development in Korea

47 Principal investigators of government R&D programs by sector, gender, and degree in Korea

		2018		2019		2020		2021	
		Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)
Sector	Research institutes	5,970	13.7	6,307	14.0	6,551	13.8	6,606	13.3
	Universities	21,639	49.5	24,067	53.4	24,659	51.9	25,588	51.4
	Business enterprises	14,512	33.2	13,007	28.9	14,371	30.3	15,247	30.6
	Others	1,519	3.5	1,638	3.6	1,870	3.9	2,297	4.6
	Ministries	60	0.1	56	0.1	56	0.1	59	0.1
	Total	43,700	100.0	45,075	100.0	47,507	100.0	49,797	100.0
Gender	Male	36,002	83.2	36,777	82.5	38,783	82.6	40,337	82.3
	Female	7,252	16.8	7,801	17.5	8,154	17.4	8,688	17.7
	Total	43,254	100.0	44,578	100.0	46,937	100.0	49,025	100.0
Degree	Doctor	30,122	69.6	32,879	73.8	34,030	72.5	35,828	73.1
	Master	5,122	11.8	4,933	11.1	5,463	11.6	5,708	11.6
	Bachelor and under	8,010	18.5	6,766	15.2	7,444	15.9	7,489	15.3
	Total	43,254	100.0	44,578	100.0	46,937	100.0	49,025	100.0

► Analysis includes principal investigators in science and technology R&D programs (excludes R&D programs for humanities and social sciences; classified national security R&D programs)

► For programs by sector, individuals with multiple affiliations were counted multiple times

► Source : MSIT·KISTEP, Governmental R&D Survey and Analysis

48 Current and shortfall of S&T industry personnel in Korea

	2018	2019	2020	2021
Current personnel	1,661,446	1,672,937	1,657,673	1,681,423
Shortfall of personnel	37,484	37,924	36,450	37,667
Percentage of shortfall (%)	2.2	2.2	2.2	2.2

► Source : MOTIE, Survey Reports on S&T Industry Personnel

5. Nurturing Human Capital

49 Number of students enrolled in bachelor's, master's and doctoral programs in Korea

		2019	2020	2021	2022
Bachelor's program	Total	1,893,882	1,875,553	1,815,238	1,760,027
	Science & engineering	694,897	691,173	667,710	654,032
	Percentage of science & engineering (%)	36.7	36.9	36.8	37.2
Master's program	Total	211,544	208,409	215,574	218,186
	Science & engineering	44,749	45,101	48,588	50,619
	Percentage of science & engineering (%)	21.2	21.6	22.5	23.2
Doctoral program	Total	65,828	68,089	72,036	74,706
	Science & engineering	28,851	29,647	31,527	32,699
	Percentage of science & engineering (%)	43.8	43.5	43.8	43.8

▶ Science & engineering is the sum of students in natural sciences and engineering majors. Bachelor's program is the sum of 2/3-year curricula and 4-year curricula. Number of enrolled students excludes students on leave

▶ Source : MOE, Statistical Yearbook of Education (kess.vedi.re.kr)

50 Number of science and engineering graduates with master's and doctoral degrees in Korea

		2019	2020	2021	2022
Master's degree	Total	82,137	83,046	80,030	83,869
	Science & engineering	20,076	19,949	19,494	20,435
	Percentage of science & engineering (%)	24.4	24.0	24.4	24.4
Doctoral degree	Total	15,308	16,139	16,420	17,760
	Science & engineering	6,713	7,263	7,314	7,578
	Percentage of science & engineering (%)	43.9	45.0	44.5	42.7

▶ Science & engineering is the sum of students in natural sciences and engineering majors

▶ Source : MOE, Statistical Yearbook of Education (kess.vedi.re.kr)

51 New doctorates in natural sciences and engineering as a percentage of all graduates in major countries (%) (2020)

	Korea	USA	Japan	Germany	France	UK
New doctorates in natural sciences and engineering as a percentage of all doctorate graduates	39.4	38.8	34.5	41.8	48.4	41.3

▶ Science & engineering is the sum of students in natural sciences and engineering majors, and natural sciences here means field 4 (science, comprising the life sciences, physical sciences, mathematics and statistics and computing) in ISCED 2011

▶ Source : OECD, Education at a Glance 2022 (www.oecd-ilibrary.org)

52 Tertiary education graduates in natural sciences and engineering as a percentage of all graduates in major countries (%)

	Korea	USA	Japan	Germany	France	UK
2019	25.0	14.8	21.8	32.3	22.2	22.3
2020	25.5	15.3	—	31.1	22.3	18.4

▶ Science & engineering is the sum of students in natural sciences and engineering majors. Tertiary education graduate school indicates all forms of institutes with the purpose of official tertiary education, regardless of legal status

▶ Source : OECD, Education at a Glance 2022 (www.oecd-ilibrary.org)

6. Publications

53 Number of papers published in SCI journals in Korea

	2018	2019	2020	2021
Number of papers published	64,501	70,710	76,822	83,680
World share (%)	3.41	3.35	3.41	3.51
World ranking	12	12	12	12

▶ World share(%) is the relative share to the total number of papers published worldwide. It is different from the relative share to the sum of the number of papers published yearly by each nation, which is greater than the total number of papers published worldwide due to papers co-authored by multiple countries

▶ Source : KISTEP·KAIST, SCI Analysis Research (2012–2021)

54 Number of papers published in SCI journals in major countries

		2018	2019	2020	2021
Korea	Number of papers	64,501	70,710	76,822	83,680
	World share (%)	3.41	3.35	3.41	3.51
	World ranking	12	12	12	12
USA	Number of papers	476,865	510,389	522,096	521,072
	World share (%)	25.20	24.20	23.19	21.84
	World ranking	1	1	2	2
Japan	Number of papers	87,504	92,457	98,557	102,491
	World share (%)	4.62	4.38	4.38	4.30
	World ranking	5	5	7	7
Germany	Number of papers	126,549	136,028	141,470	149,965
	World share (%)	6.69	6.45	6.28	6.29
	World ranking	4	4	4	4
France	Number of papers	83,949	87,982	92,424	94,189
	World share (%)	4.44	4.17	4.10	3.95
	World ranking	6	10	10	10
UK	Number of papers	151,444	165,626	171,141	174,396
	World share (%)	8.00	7.85	7.60	7.31
	World ranking	3	3	3	3
China	Number of papers	402,878	495,136	555,152	641,543
	World share (%)	21.29	23.48	24.65	26.89
	World ranking	2	2	1	1

▶ World share(%) is the relative share to the total number of papers published worldwide. It is different from the relative share to the sum of the number of papers published yearly by each nation, which is greater than the total number of papers published worldwide due to papers co-authored by multiple countries

▶ Source : KISTEP·KAIST, SCI Analysis Research (2012–2021)

- 55 Number of papers published in SCI journals per 10,000 population or per 100 researchers (FTE) in Korea

	2018	2019	2020	2021
Number of papers (SCI) per 10,000 population	12.50	13.67	14.84	16.11
Number of papers (SCI) per 100 researchers (FTE)	15.79	16.42	17.20	17.78

► Source : OECD, Main Science and Technology Indicators 2023–March (stats.oecd.org)
KISTEP·KAIST, SCI Analysis Research (2012–2021)

- 56 Number of papers published in SCI journals per 10,000 population or per 100 researchers (FTE) in major countries (2021)

	Korea	USA	Japan	Germany	France	UK	China
Number of papers (SCI) per 10,000 population	16.11	15.76	8.17	18.03	13.81	25.82	4.54
Number of papers (SCI) per 100 researchers (FTE)	17.78	32.17 ('19)	14.29	31.38	28.74	52.36 ('19)	24.34

► Source : OECD, Main Science and Technology Indicators 2023–March (stats.oecd.org)
KISTEP·KAIST, SCI Analysis Research (2012–2021)

- 57 Average citations per paper over five-year periods in Korea

	2014–2018	2015–2019	2016–2020	2017–2021
Average citations per paper over five-year periods	6.51	7.02	7.62	8.53
World average of citations	6.11	6.44	6.93	7.73

► Average citations per paper over five-year periods are the average number of cumulative citations over the five-year periods from the year of publication

► Source : KISTEP·KAIST, SCI Analysis Research (2012–2021)

- 58 Average citations per paper over five-year periods in major countries (2017–2021)

Korea	USA	Japan	Germany	France	UK	China
8.53	10.20	7.93	10.45	10.51	10.84	9.20

► Average citations per paper over five-year period are the average number of cumulative citations over the five-year period from the year of publication

► Source : KISTEP·KAIST, SCI Analysis Research (2012–2021)

59 Number of papers published in top 3 journals in Korea

	2018	2019	2020	2021
NATURE	28	33	50	44
SCIENCE	35	22	31	24
CELL	12	10	13	7
Total	75	65	94	75

► Only full-length papers (Articles and Reviews) were counted

► Source : KISTEP·KAIST, SCI Analysis Research (2012–2021)

60 Number of papers published by region in Korea (2021)

	Co-authorship		First authorship	
	Number of papers	Percentage (%)	Number of Papers	Percentage (%)
Seoul	40,742	33.6	25,074	39.5
Gyeonggi	17,673	14.6	8,398	13.2
Daejeon	11,183	9.2	5,674	8.9
Busan	6,024	5.0	3,048	4.8
Gyeongbuk	5,674	4.7	2,638	4.2
Daegu	5,180	4.3	2,612	4.1
Incheon	4,962	4.1	2,153	3.4
Gangwon	4,452	3.7	1,960	3.1
Gwangju	4,363	3.6	2,022	3.2
Gyeongnam	4,202	3.5	2,250	3.5
Jeonbuk	4,020	3.3	1,892	3.0
Chungnam	3,400	2.8	1,510	2.4
Chungbuk	3,255	2.7	1,403	2.2
Ulsan	2,621	2.2	1,313	2.1
Jeonnam	1,504	1.2	585	0.9
Jeju	1,115	0.9	497	0.8
Sejong	944	0.8	402	0.6
Others	103	0.1	39	0.1
Total	121,417	100.0	63,470	100.0

► Source : KISTEP·KAIST, SCI Analysis Research (2012–2021)

7. Patents

61 Domestic patent applications and patent grants in Korea

	2018	2019	2020	2021
Patent applications	209,992	218,975	226,759	237,998
Patent grants	119,012	125,661	134,766	145,882

► Source : KIPO, Intellectual Property Statistics (kipo.go.kr)

62 Domestic patent applications and patent grants by region in Korea

	Patent applications				Patent grants			
	2018	2019	2020	2021	2018	2019	2020	2021
Seoul	47,123	52,270	53,124	54,042	25,224	26,483	29,293	31,576
Busan	6,172	6,058	6,676	6,504	3,412	3,300	3,410	3,570
Daegu	4,619	4,801	4,782	5,037	2,519	2,781	2,881	2,837
Incheon	6,236	6,439	6,728	7,095	3,499	3,585	3,916	3,921
Gwangju	3,431	3,458	3,522	3,549	1,765	1,806	1,846	1,817
Daejeon	10,767	10,632	10,867	11,374	5,877	6,504	6,712	6,688
Ulsan	2,347	2,277	2,499	2,209	1,308	1,268	1,560	1,557
Sejong	811	813	874	57,830	394	405	482	34,663
Gyeonggi	47,175	49,685	54,696	2,898	25,440	27,708	31,565	1,706
Gangwon	2,666	2,604	2,800	4,353	1,479	1,462	1,572	2,413
Chungbuk	3,509	3,700	4,053	7,274	1,921	2,167	2,359	4,987
Chungnam	6,482	6,917	7,217	4,354	3,808	3,966	4,396	2,357
Jeonbuk	3,995	4,343	4,529	4,050	1,995	2,137	2,277	2,101
Jeonnam	3,223	3,424	3,592	6,733	1,605	1,836	1,906	4,390
Gyeongbuk	6,634	6,615	6,698	6,964	4,176	4,477	4,557	4,099
Gyeongnam	6,521	6,657	6,810	1,046	3,751	3,956	4,059	470
Jeju	837	891	1,003	922	412	430	485	564
Others	13	19	7	11	642	581	605	635
Total	162,561	171,603	180,477	186,245	89,227	94,852	103,881	110,351

► The table above refers to the first applicant's/patent holder's address

► 'Others' include those who are Korean citizens but do not have an address in Korea (overseas residents, soldiers, etc.)

► Based on the address of the first right holder among domestic rights holders

► Source : KIPO, Intellectual Property Statistics (kipo.go.kr)

63 Number of triadic patent families in Korea

	2017	2018	2019	2020
Triadic patent families	2,907	3,165	3,366	3,379
Triadic patent families per million population	56.6	61.4	65.0	65.2
Triadic patent families per 10,000 researchers (FTE)	75.9	77.5	78.1	75.6

► Triadic patent families : Patents applied to EPO(European Patent Office) and JPO(Japan Patent Office), and granted by USPTO(United States Patent and Trademark Office)

► Source : OECD, Main Science and Technology Indicators 2023–March (stats.oecd.org)

64 Number of triadic patent families in major countries (2020)

	Korea	USA	Japan	Germany	France	UK	China
Triadic patent families	3,379	13,294	17,053	4,454	1,875	1,732	6,039
Triadic patent families per million population	65.2	40.1	135.7	53.6	27.6	25.8	4.3
Triadic patent families per 10,000 researchers (FTE)	75.6	89.0	247.2	98.8	58.3	–	–

► Source : OECD, Main Science and Technology Indicators 2023–March (stats.oecd.org)

65 Number of patent applications to and grants from the USPTO in Korea

	2018	2019	2020	2021
Patent applications	33,961	36,424	37,490	36,909
Patent grants	19,780	21,684	21,974	20,703

► Patent applications here is number of Utility Patents by their filing year

► Source : WIPO, WIPO Statistics Database, 2021.12 (ipstats.wipo.int)

66 Number of patent applications to and grants from the USPTO in major countries (2021)

	Korea	USA	Japan	Germany	France	UK	China
Patent applications	36,909	262,244	75,364	27,964	11,088	12,745	45,842
Patent grants	20,703	149,538	46,339	16,221	6,402	7,178	23,705

► Patent applications here is number of Utility Patents by their filing year

► Country is based upon nationality of the first patentee. Hong Kong and Macao are not included in China.

► Source : WIPO, WIPO Statistics Database, 2022.11 (ipstats.wipo.int)

67 Top 10 companies granted U.S. Patents

Rank	2020		2021	
	Number of patents	Company	Number of patents	Company
1	9,130	International Business Machines Corp	8,682	International Business Machines Corp
2	6,415	Samsung Electronics Co Ltd	6,366	Samsung Electronics Co Ltd
3	3,225	Canon Inc	3,021	Canon Inc
4	2,905	Microsoft Technology Licensing LLC	2,798	Taiwan Semiconductor Manufacturing Co TSMC Ltd
5	2,867	Intel Corp	2,770	Huawei Technologies Co Ltd
6	2,833	Taiwan Semiconductor Manufacturing Co TSMC Ltd	2,615	Intel Corp
7	2,831	LG Electronics Inc	2,541	Apple Inc
8	2,791	Apple Inc	2,487	LG Electronics Inc
9	2,761	Huawei Technologies Co Ltd	2,418	Microsoft Technology Licensing LLC
10	2,276	Qualcomm Inc	2,149	Qualcomm Inc

► Source : IFIClaims (ificlaims.com)

68 Number of patent applications to and grants from the EPO in Korea

	2018	2019	2020	2021
Patent applications	7,280	8,332	9,085	9,386
Patent grants	6,258	7,251	7,050	5,806

► Source : WIPO, WIPO Statistics Database, 2022. 11 (wipo.int)

69 Number of patent applications to and grants from the EPO in major countries (2021)

	Korea	USA	Japan	Germany	France	UK	China
Patent applications	9,386	46,691	21,591	25,935	10,650	5,623	16,550
Patent grants	5,806	27,424	15,395	16,507	6,794	3,206	6,864

► Source : WIPO, WIPO Statistics Database, 2022. 11 (wipo.int)

70 Number of patent applications filed under the PCT in Korea

	2018	2019	2020	2021
PCT applications	16,920	19,074	20,048	20,718

► PCT (Patent Cooperation Treaty) : International patent law treaty that provides a unified procedure for filing patent applications to protect inventions in each of its contracting states

► Source : WIPO, WIPO Statistics Database, 2022.11 (ipstats.wipo.int)

71 Number of patent applications filed under the PCT in major countries (2021)

	Korea	USA	Japan	Germany	France	UK	China
PCT applications	20,718	59,426	50,275	17,275	7,339	5,843	69,581
Rank	4	2	3	5	6	7	1

► Source : WIPO, WIPO Statistics Database, 2022.11 (ipstats.wipo.int)

72 Number of patent applications filed under the PCT in the ICT and biotechnology sector in major countries (2020)

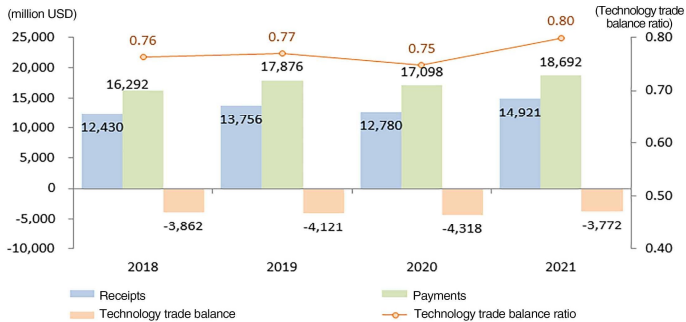
	Korea	USA	Japan	Germany	France	UK	China
ICT	6,840	18,286	11,872	2,877	1,149	1,322	30,417
Biotechnology	1,422	7,458	1,538	773	532	669	2,884

► The number of patent applications is based on priority year, extracted from OECD data for the comparison of the same standards

► Source : OECD, Main Science and Technology Indicators 2023-March (stats.oecd.org)

8. Technology Trade

73. Technology balance of payments in Korea



	2018	2019	2020	2021
Receipts (million USD)	12,430	13,756	12,780	14,921
Payments (million USD)	16,292	17,876	17,098	18,692
Technology trade balance (million USD)	-3,862	-4,121	-4,318	-3,772
Technology trade balance ratio(Receipts/Payments)	0.76	0.77	0.75	0.80

▶ Source : Statistics Report on the Technology Trade of Korea, published by MSIT-Korea Industrial Technology Association (www.koita.or.kr)

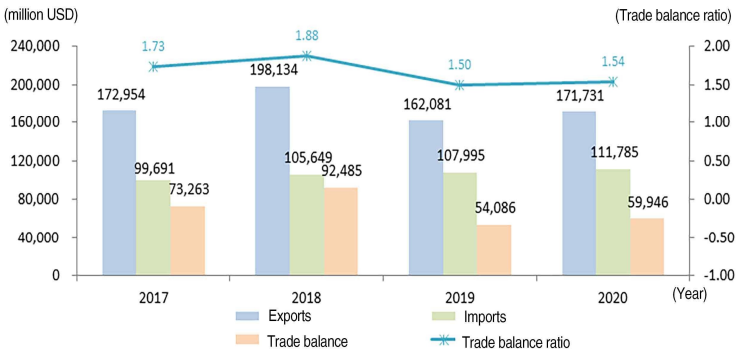
74. Technology balance of payments by industry in Korea

	Receipts (million USD)		Payments (million USD)		Balance of payments (million USD)		Balance of payments ratio (Receipts/Payments)	
	2020	2021	2020	2021	2020	2021	2020	2021
ICT	6,064	6,235	6,606	5,306	-542	929	0.92	1.18
Electrical-electronics	3,345	4,005	5,798	8,121	-2,453	-4,116	0.58	0.49
Machine	1,490	2,015	1,618	1,838	-129	177	0.92	1.10
Chemistry	440	1,367	1,116	1,004	-676	363	0.39	1.36
Construction	145	155	64	67	80	88	2.25	2.31
Agriculture, forestry and fisheries	68	110	255	235	-188	-125	0.27	0.47
Textiles	16	15	179	163	-163	-148	0.09	0.09
Materials	27	14	109	161	-82	-147	0.25	0.09
Others	1,186	1,005	1,353	1,798	-167	-793	0.88	0.56
Total Amount	12,780	14,921	17,098	18,693	-4,318	-3,772	0.75	0.80

▶ Source : Statistics Report on the Technology Trade of Korea, published by MSIT-Korea Industrial Technology Association (www.koita.or.kr)

9. International Trade in High-Tech Industries

75. International trade in R&D-intensive industries of Korea



	2017	2018	2019	2020
Exports (million USD)	172,954	198,134	162,081	171,731
Imports (million USD)	99,691	105,649	107,995	111,785
Trade balance (million USD)	73,263	92,485	54,086	59,946
Trade balance ratio(Exports/Imports)	1.73	1.88	1.50	1.54

► R&D-intensive industries include pharmaceutical, computer, electronic and optical, and aerospace industries, as defined by OECD

► Source : OECD, Main Science and Technology Indicators 2023-March (stats.oecd.org)

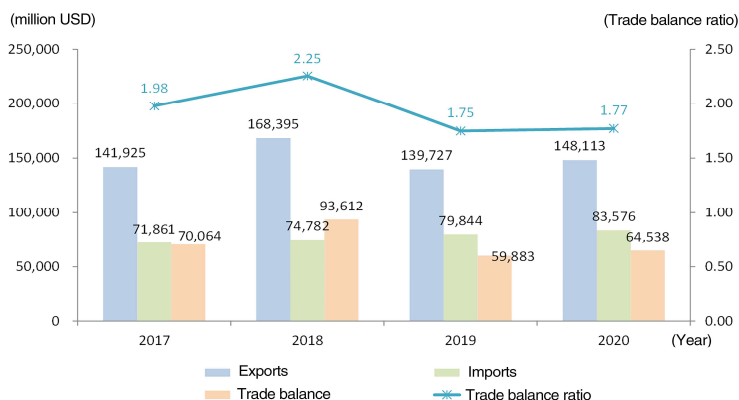
76. International trade in R&D-intensive industries of major countries (2021)

	Korea ('20)	USA	Japan	Germany	France	UK	China
Exports (million USD)	171,731	386,658	120,865	297,107	118,589	95,961	994,290
Imports (million USD)	111,785	677,146	168,715	263,098	118,927	112,419	804,014
Trade balance (million USD)	59,946	-290,488	-47,850	34,009	-338	-16,457	190,277
Trade balance ratio (Exports/Imports)	1.54	0.57	0.72	1.13	1.00	0.85	1.24

► R&D-intensive industries include pharmaceutical, computer, electronic and optical, and aerospace industries, as defined by OECD

► Source : Main Science and Technology Indicators 2023-March (stats.oecd.org)

77 ICT industry trade in Korea



	2017	2018	2019	2020
Exports (million USD)	141,925	168,395	139,727	148,113
Imports (million USD)	71,861	74,782	79,844	83,576
Trade balance (million USD)	70,064	93,612	59,883	64,538
Trade balance ratio (Exports/Imports)	1.98	2.25	1.75	1.77

► Source : OECD, STAN Bilateral Trade Database ISIC4 ed. 2022 (stats.oecd.org)

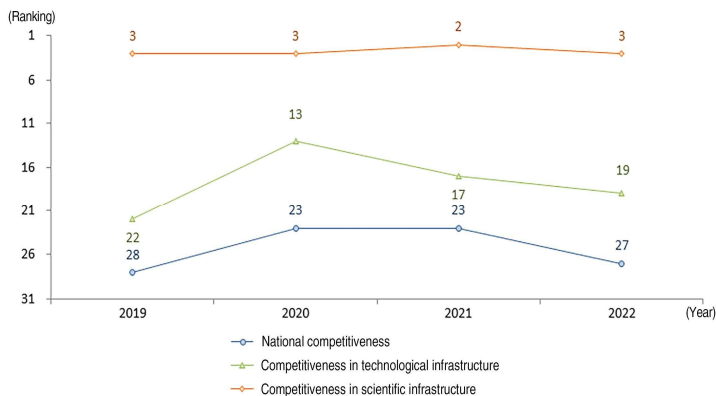
78 ICT industry trade in major countries (2021)

	Korea	USA	Japan	Germany	France	UK	China
Exports (million USD)	148,113	158,926	65,202	82,118	21,271	17,316	857,505
Imports (million USD)	83,576	410,624	100,980	119,623	46,076	52,006	636,480
Trade balance (million USD)	64,538	-251,698	-35,778	-37,505	-24,805	-34,690	221,025
Trade balance ratio (Exports/Imports)	1.77	0.39	0.65	0.69	0.46	0.33	1.35

► Source : OECD, STAN Bilateral Trade Database ISIC4 ed. 2022 (stats.oecd.org)

10. National Competitiveness

79 Competitiveness ranking of Korea (IMD)



	2019	2020	2021	2022
Overall competitiveness	28	23	23	27
Economic performance	27	27	18	22
Government efficiency	31	28	34	36
Business efficiency	34	28	27	33
Infrastructure	20	16	17	16
– Scientific infrastructure	3	3	2	3
– Technological infrastructure	22	13	17	19

► Source : IMD, The World Competitiveness Yearbook (www.imd.org)

80 Competitiveness ranking of major countries (2022, IMD)

	Korea	USA	Japan	Germany	France	UK	China
Competitiveness	27	10	34	15	28	23	17
– Science infrastructure	3	1	8	2	15	14	9
– Technology infrastructure	19	11	42	33	15	18	12

► Source : IMD, The World Competitiveness Yearbook 2022 (www.imd.org)

81 Competitiveness ranking of Korea in scientific infrastructure (IMD)

	2019	2020	2021	2022
Total expenditure on R&D	5	5	5	5
Total expenditure on R&D as a percentage of GDP	1	2	2	2
Total expenditure on R&D per capita	9	8	9	9
Business expenditure on R&D	5	5	5	5
Business expenditure on R&D as a percentage of GDP	2	2	2	2
Total R&D personnel nationwide	6	6	6	5
Total R&D personnel nationwide per 1,000 people	5	3	3	3
Total R&D personnel in business enterprise	6	5	5	5
Total R&D personnel in business per 1,000 people	3	3	3	3
Researcher in R&D per 1,000 people	2	2	1	1
Percentage of total first university degrees in science and engineering**	-	-	10	11
Scientific articles	9	10	9	8
Nobel prizes	29	29	29	28
Nobel prizes per 1,000,000 people	29	29	29	28
Number of patent applications	4	4	4	4
Number of patent applications filed per 100,000 inhabitants	3	3	2	2
Number of patents granted	4	4	4	4
Number of patents in force per 100,000 inhabitants	4	4	4	4
Medium- and high-tech value added	4	4	4	5
Laws relating to scientific research do encourage innovation*	34	31	30	31
Intellectual property rights are adequately enforced*	37	38	36	37
Knowledge transfer is highly developed between companies and universities*	35	30	25	30
Overall Ranking	3	3	2	3

▶ * represents indicators in the survey

▶ ** represented percentage of university degree in science and technology before 2021

▶ Source : IMD, The World Competitiveness Yearbook (www.imd.org)

82 Competitiveness ranking of Korea in technological infrastructure (IMD)

	2019	2020	2021	2022
Investment in telecommunications as a percentage of GDP	46	42	44	15
Mobile broadband subscribers (based upon 4G and 5G)**	10	10	9	11
Monthly telephone costs per capita	57	55	57	54
Communications technology*	12	10	12	12
Number of secure internet servers	–	–	–	43
Number of internet users per 1,000 people	16	16	7	8
Number of broadband subscribers per 1,000 inhabitants	21	27	26	25
Internet bandwidth speed	27	2	12	12
Digital technology skills are readily available*	26	18	33	46
Qualified engineers are available in labor market*	31	25	37	42
Public and private sector ventures are supporting technological development*	41	29	38	46
Development and application of technology are supported by the legal environment†	50	44	45	48
Funding for technological development is readily available*	42	38	34	30
High-tech exports	8	4	6	5
High-tech exports as a percentage of manufactured exports	19	6	7	6
ICT as a percentage of total service exports	28	41	41	35
Cyber security is being adequately addressed by corporations*	23	21	23	28
Overall Ranking	22	13	17	19

▶ * represents indicators in the survey

▶ ** represented based upon 3G and 4G services before 2021

▶ Source : IMD, The World Competitiveness Yearbook (www.imd.org)

83 Global competitiveness of Korea (WEF)

	2017	2018	2019
Global competitiveness	17	15	13
Institutions	28	27	26
Infrastructure	7	6	6
ICT adoption	1	1	1
Macroeconomic stability	1	1	1
Health	20	19	8
Skills	31	27	27
Product market	65	67	59
Labor market	47	48	51
Financial system	22	19	18
Market size	13	14	14
Business dynamism	22	22	25
Innovation capability	10	8	6

► Source : WEF, The Global Competitiveness Report (www.weforum.org)

84 Global competitiveness ranking of major countries (2019, WEF)

Korea	USA	Japan	Germany	France	UK	China
13	2	6	7	15	9	28

► Source : WEF, The Global Competitiveness Report, 2019 (www.weforum.org)

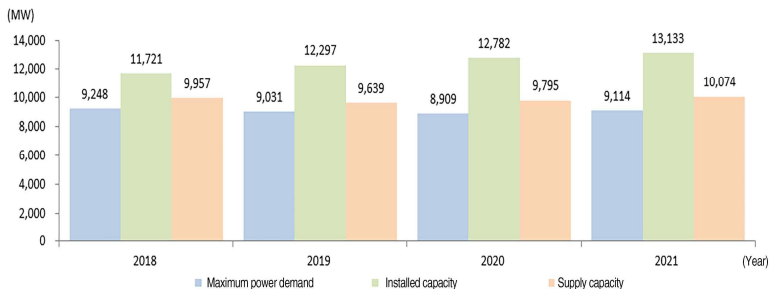
85 Composite Science and Technology Innovation Index (COSTII) of Korea

	2018		2019		2020		2021	
	Indicator (Score)	Ranking	Indicator (Score)	Ranking	Indicator (Score)	Ranking	Indicator (Score)	Ranking
COSTII	11.424	7	12.246	8	12.658	5	12.245	5
Resource	1.907	6	1.957	5	1.993	5	2.039	5
Activities	3.438	3	3.725	3	3.254	3	3.457	3
Network	1.491	19	1.761	15	1.878	11	1.894	14
Environment	2.536	22	2.708	22	2.813	22	2.767	23
Performance	1.97	10	2.019	9	1.922	9	2.087	10

► Source : MSIT·KISTEP, COSTII 2022

11. Energy and Resources

86 Electricity supply and demand in Korea



▶ Installed capacity and supply capacity is based on each year's time of occurrence for maximum power demand

▶ Source : KEPCO, Electric Power statistics 2022 (home.kepco.co.kr)

87 Petroleum and LNG supply in Korea

		2018	2019	2020	2021
Petroleum	Crude oil imports (million barrels)	1,116	1,072	980	960
	Amount of crude oil imports (million USD)	79,790	70,223	44,427	67,691
LNG	Imports (1,000 tons)	44,015	40,750	39,982	45,932

▶ Source : Statistics Korea (Korea National Oil Corporation, Korea Gas Corporation, and Korea Customs) (www.index.go.kr)

88 Total primary energy supply per 1,000 USD of GDP in major countries (2021)

	Korea	USA	Japan	Germany	France	UK	China ('20)
Energy supply (toe)/ 1,000 USD (PPP)	0.13	0.10	0.08	0.07	0.08	0.06	0.15

▶ Source : OECD, Primary energy supply (indicator)

89 Nuclear electricity as a percentage of total electricity generation in major countries (% , 2020)

Korea	USA	Japan	Germany	France	UK
27.4	19.4	3.6	11.2	65.9	15.3

▶ Source : OECD, Electricity generation (indicator)

90 Overseas natural resource development in Korea

		2018	2019	2020	2021
Number of overseas resource development programs (cumulative)	Petroleum/Gas	380	383	386	388
	In progress	122	119	118	110
	Production	73	70	69	62
	Development	11	11	10	10
	Exploration	38	38	39	38
	Completed programs	258	264	268	278
	General minerals	544	547	549	551
	In progress	316	308	301	291
	Completed programs	228	239	248	260
Self-sufficient development ratio (%)	Petroleum/Gas	13.0	13.0	12.0	11.0
	Bituminous coal	30.0	32.0	34.0	41.0
	Iron	32.0	32.0	34.0	34.0
	Bronze	8.0	10.0	12.0	8.0
	Zinc	19.9	20.7	21.5	21.6
	Nickel	55.2	55.0	47.2	44.8

► Self-sufficient development ratio indicates the percentage of resource developed and produced by domestic companies compared to total imports

► Source : Statistics Korea (Ministry of Trade, Industry & Energy) (www.index.go.kr)

12. Green Growth and Technology

91 Renewable energy supply in Korea (1,000 toe, %)

	2018	2019	2020	2021
Renewable energy supply	10,097	10,584	12,378	14,000
Supply percentage (%)	3.3	3.5	4.2	4.6
Solar heat	27.4	26.9	26.0	25.6
Sunlight	2,194.0	3,055.2	4,165.2	5,317.2
Bio	4,442.4	4,162.4	3,899.2	4,263.6
Waste	1,126.9	1,119.8	1,166.0	1,198.2
Water power	718.8	594.5	826.3	651.2
Wind power	525.2	570.8	671.1	677.5
Geothermal heat	205.5	224.7	240.9	255.6
Hydrogen/Fuel cell	376.3	487.2	755.9	1,023.1
Marine	103.4	101.0	97.4	96.9
hydrothermal	14.7	21.2	23.6	24.8
IGCC	362.5	219.7	506.4	466.6

► Source : Statistics Korea (New Renewable Energy Center) (www.index.go.kr)

92 Contribution of renewable energy to energy supply in major countries (%, 2021)

Korea	USA	Japan	Germany	France	UK	China ('20)
2.13	8.00	7.07	15.64	11.64	12.59	10.01

► Source : OECD, Renewable energy (indicator)

93 CO₂ emissions in major countries (kg/PPP \$, 2021)

Korea	USA	Japan	Germany	France	UK	China('20)
0.26	0.22	0.19	0.15	0.10	0.11	0.43

► Source : IEA, Data Services, 2022

94 Health and Environment programs as a percentage of GBARD in major countries (% , 2021)

Korea	USA	Japan	Germany	France	UK ('20)
15.2	56.2	9.6	11.9	12.2	30.3

► Source : Main Science and Technology Indicators 2023–March

13. Space

95 Space programs as a percentage of GBARD in major countries (2021)

	Korea	USA	Japan	Germany	France	UK ('20)
GBARD for space programs (million USD)	377	11,566	2,987	2,017	2,319	168
Space programs as a percentage of GBARD (%)	1.87	13.53	4.06	4.40	12.43	1.02

► Government R&D budget does not include national defense budget

► Source : Main Science and Technology Indicators 2023–March (stats.oecd.org)

96 BERD performed in aerospace industry in major countries (2021)

	Korea	USA ('20)	Japan	Germany ('20)	France ('17)	UK ('13)
Aerospace industry R&D expenditure (million USD)	365	23,086	542	1,471	2,969	2,186
Percentage of aerospace industry R&D expenditure in BERD (%)	0.52	4.20	0.42	1.81	7.95	7.58

► Source : Main Science and Technology Indicators 2023–March (stats.oecd.org)

14. Biotechnology

97 BERD performed in biotechnology industry in major countries (2020)

	Korea	USA	Germany ('21)	France
Biotechnology industry R&D expenditures(million ppp \$)	2,448	88,423	3,873	4,012
Companies in biotechnology industry	998	2,910	877('20)	2,239

► OECD, Key Biotechnology Indicators (<https://oecd.org/kbi/>)

98 Trends and personnel in biotechnology industry in Korea

		2018	2019	2020	2021
Industry trends (trillion KRW)	Production	10.61	12.66	17.20	21.00
	Domestic demand	7.10	8.18	9.60	13.90
	Exports	5.24	6.54	10.02	11.90
	Imports	1.73	2.07	2.40	4.80
Personnel	R&D personnel	14,532	15,333	16,733	17,908
	Production personnel	16,169	16,802	17,829	17,867
	Total	30,701	32,135	35,365	35,775

► R&D personnel indicates personnel for R&D in biotechnology

► Production personnel indicates personnel for production, including facility management and quality assurance in biotechnology

► Source : MOTIE, Korea Biotechnology Industry Organization, Report on Survey of Domestic Bio-industry

15. Economic and Social Indicators

99 Population and GDP per capita in major countries (2021)

	Korea	USA	Japan	Germany	France	UK	China
Population (thousands)	51,745	332,213	125,502	83,196	68,217	67,351	1,412,600
GDP per capita (USD)	34,998	70,181	39,884	51,204	43,360	46,361	12,554

► Source : OECD, Main Science and Technology Indicators 2023-March (stats.oecd.org)

100 Labor force, total employment, and industry value added in major countries (2021)

	Korea	USA	Japan	Germany	France	UK	China
Labor force (thousands)	28,117	162,630	68,755	43,019	30,123	33,786	780,240
Total employment (thousands)	27,273	154,756	68,207	44,972	29,007	32,407	746,520
Value added of industry (100 million USD)	12,222	149,622	35,601	26,706	16,875	18,849	144,887

► Source : OECD, Main Science and Technology Indicators 2023-March (stats.oecd.org)

Glossary

Abbreviation	Full name
EPO	European Patent Organization
IMD	International Institute for Management Development
ISIC	International Standard Industrial Classification
JPO	Japan Patent Office
KAIST	Korea Advanced Institute of Science and Technology
KEPCO	Korea Electric Power Corporation
KIPO	Korea Intellectual Property Office
KSIC	Korean Standard Industrial Classification
MOE	Ministry of Education
MOTIE	Ministry of Trade, Industry & Energy
MSIT	Ministry of Science and ICT
MSTI	Main Science and Technology Indicators
OECD	Organization for Economic Cooperation and Development
PCT	Patent Cooperation Treaty
PPP	Purchasing Power Parity
SCI	Science Citation Index
USPTO	United States Patent and Trademark Office
WEF	World Economic Forum
WIPO	World Intellectual Property Organization

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- Bae, Jin Kyoung baejk@korea.kr

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- Center for Data Analysis Innovation, Office of National R&D Evaluation and Analysis
- Han, Woong-Yong hanwy@kistep.re.kr

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