National Center for Science and Engineering Statistics

InfoBrief

Critical and Emerging Technologies by U.S. Businesses: Use and R&D Funding and Performance

NSF 25-307 | November 2024

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Critical and emerging technologies (CETs) are "novel, advanced technologies with the potential to chart new pathways in American innovation and strengthen our national security."[1] In October 2020, the White House Office of Science and Technology Policy (OSTP) released the National Strategy for Critical and Emerging Technologies,[2] which contained an initial list of priority CETs. To build on this work, the Fast Track Action Subcommittee of the National Science and Technology Council was formed in 2022 and identified the potential of CETs to "inform a forthcoming strategy on U.S. technological competitiveness and national security."

The Annual Business Survey (ABS) 2022 (reference year 2021) included questions on 14 of the CETs from OSTP's initial priority list.[3] The ABS included questions on both the usage of CETs and research and development (R&D) performance or funding within the area of each CET. The ABS collects data related to innovation, intellectual property, technology, company information, and business owner demographics from businesses with one or more employees. The ABS also collects R&D data from microbusinesses (businesses with one to nine employees). This is the sixth year of the ABS, which was developed and is cosponsored by the National Center for Science and Engineering Statistics within the U.S. National Science Foundation and by the Census Bureau.

Use of Critical and Emerging Technologies

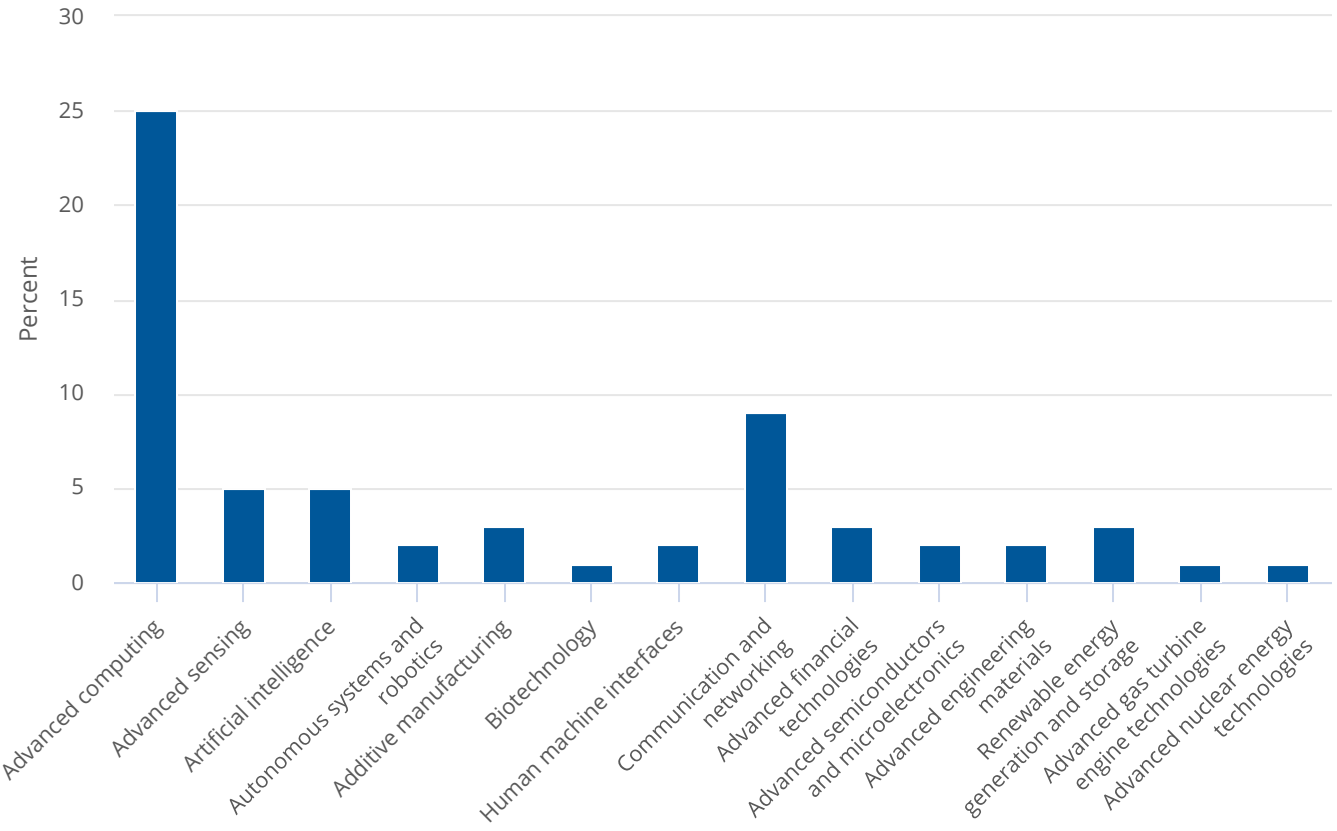
The CETs in the ABS 2022 include the following:

- Advanced computing
- Advanced sensing
- Artificial intelligence
- Autonomous systems and robotics
- Additive manufacturing
- Biotechnology
- Human-machine interfaces
- Communication and networking technologies
- Advanced financial technologies
- Advanced semiconductors and microelectronics
- Advanced engineering materials
- Renewable energy generation and storage
- Advanced gas turbine engine technologies
- Advanced nuclear energy technologies

For each CET, respondents were asked if they used each technology "a lot," "somewhat," "a little," or "not at all." Figure 1 presents the percentage of businesses that used each technology "a little" or more.

Figure 1

Companies using critical and emerging technologies: 2021



Note(s):
Use is defined as "a lot," "somewhat," and "a little."

Source(s):
National Center for Science and Engineering Statistics and Census Bureau, 2022 Annual Business Survey: Data Year 2021.

The 2022 ABS found that 25% of businesses used advanced computing (figure 1). Advanced computing was defined in the questionnaire as “supercomputing, edge computing, cloud computing, data storage, advanced computing architectures.” Advanced computing was followed by communication and networking technologies at 9%.[4] Each of the other 12 CETs included in the ABS was used by 5% or less of the businesses surveyed.

By Industry

Overall, businesses had low incidence rates of using most of the CETs included in the survey. However, when examined at the subsector and industry group level,[5] there are some important differences (table 1). Information and communications technology (ICT) CETs are widely used. Nearly all subsectors have at least 5% usage rates (based on point estimates) of ICT CETs, such as advanced computing (32 subsectors) and communication and networking (31 subsectors). A higher percentage of companies reported using advanced computing (25%) than using any other CET. The following industry groups all had use rates of advanced computing that were significantly greater than 50%: software publishers (North American Industry Classification System [NAICS] code 5112), data processing, hosting, and related services (NAICS 518), and computer systems design and related systems (NAICS 5415). With respect to communication and networking technologies, the following industry groups had high use rates: communications equipment (NAICS 3342) at 56% and

telecommunications (NAICS 517) at 42%. Advanced manufacturing[6] CETs—such as advanced sensing, autonomous systems and robotics, and additive manufacturing—are used throughout the 18 manufacturing subsectors. Point estimates indicate at least 5% usage rates of advanced sensing in 13 subsectors, autonomous systems and robotics in 13 subsectors, and additive manufacturing in 14 subsectors.

Table 1

Companies using critical and emerging technologies, by industry: 2021

(Percent)

Industry	NAICS code	Companies (number)	Advanced computing	Advanced sensing	Artificial intelligence	Autonomous systems and robotics	Additive manufacturing	Biotechnology	Human machine interfaces	Communication and networking	Advanced financial technologies	Advanced semiconductors and microelectronics	Advanced engineering materials	Renewable energy generation and storage	Advanced gas turbine engine technologies	Advanced nuclear energy technologies
All industries	11, 21–23, 31–33, 42–81	4,874,928	25.3	5.2	4.8	2.4	3.0	1.4	2.0	8.9	3.2	1.7	2.0	2.6	1.0	0.8
Manufacturing industries	31–33	209,282	24.7	8.5	4.8	8.2	12.0	1.3	2.1	9.4	3.0	4.2	5.1	3.5	1.4	0.7
Food	311	19,326	19.2	6.2	2.6	4.6	2.1	1.4	1.3	6.1	2.9	1.8	1.6	2.8	0.9	0.5
Beverage and tobacco products	312	9,354	22.9	5.3	1.9	3.5	2.2	1.8	1.4	9.8	2.3	0.9	1.6	8.6	0.8	0.4
Textile, apparel, and leather products	313–16	9,443	17.0	4.3	3.2	3.1	6.1	1.3	1.6	5.6	2.3	1.5	2.4	2.7	1.5	1.3
Wood products	321	9,546	21.9	7.1	2.7	5.1	5.3	0.7	1.1	7.5	3.5	1.7	2.8	2.9	1.0	0.3
Paper	322	1,500	34.6	10.9	9.9	10.0	11.9	2.9	1.4	17.9	3.9	4.1	3.7	6.8	0.5	0.5
Printing and related support activities	323	20,212	25.2	4.8	3.5	1.4	4.3	0.3	0.6	6.0	2.2	1.0	0.7	1.2	0.5	0.3
Petroleum and coal products	324	546	22.5	4.4	2.8	4.6	2.4	1.2	1.2	6.0	2.2	2.8	2.6	5.0	1.7	0.8
Chemicals	325	7,961	26.2	10.0	6.0	6.3	9.7	6.3	2.1	11.9	6.4	4.7	6.7	6.1	1.7	1.2
Pesticide, fertilizer, and other agricultural chemicals	3253	580	33.3	6.7	7.3	9.8	6.2	6.4	4.3	14.9	6.4	5.8	4.7	5.7	4.6	4.3
Pharmaceuticals and medicines	3254	1,536	31.5	12.0	7.7	8.6	11.3	20.4	4.1	12.4	6.8	3.8	4.9	5.6	2.2	2.1
Soap, cleaning compound, and toilet preparation	3256	1,652	19.8	8.9	8.1	5.8	9.2	2.5	2.0	4.8	2.8	1.6	5.1	5.3	1.8	1.2
Other chemicals	other 325	4,194	25.6	10.2	4.1	5.0	9.6	2.8	1.3	14.1	7.7	6.3	8.4	6.7	1.0	0.4
Plastics and rubber products	326	7,060	27.1	12.6	4.9	14.1	16.9	1.0	2.9	11.5	3.6	3.9	7.5	2.7	1.0	0.9
Nonmetallic mineral products	327	7,290	20.1	5.1	4.3	5.6	7.2	0.5	1.3	9.1	2.8	1.8	3.5	2.3	1.3	0.4
Primary metals	331	2,079	26.3	14.5	5.3	15.0	14.7	0.5	1.2	12.8	2.7	2.9	7.4	3.8	1.3	0.8
Fabricated metal products	332	46,128	24.1	8.7	5.0	10.4	13.4	0.6	1.7	8.0	2.9	4.2	6.1	2.4	1.9	0.8

Table 1

Companies using critical and emerging technologies, by industry: 2021

(Percent)

Industry	NAICS code	Companies (number)	Advanced computing	Advanced sensing	Artificial intelligence	Autonomous systems and robotics	Additive manufacturing	Biotechnology	Human machine interfaces	Communication and networking	Advanced financial technologies	Advanced semiconductors and microelectronics	Advanced engineering materials	Renewable energy generation and storage	Advanced gas turbine engine technologies	Advanced nuclear energy technologies
Machinery	333	16,440	31.5	14.5	7.6	18.9	20.9	1.5	5.0	12.7	3.5	8.4	10.4	5.0	1.9	1.4
Computer and electronic products	334	8,527	37.7	22.4	12.0	13.7	26.2	2.9	6.5	30.4	4.2	20.0	15.3	7.4	2.8	1.3
Communications equipment	3342	850	40.2	21.6	9.7	10.2	26.8	0.5	6.3	55.9	3.8	20.7	10.0	6.2	0.1	0.0
Semiconductor and other electronic components	3344	2,711	34.2	22.0	11.0	18.0	24.0	1.7	7.7	27.8	4.1	25.2	17.1	10.2	3.4	2.0
Navigational, measuring, electromedical, and control instruments	3345	3,737	39.3	24.5	13.1	12.7	30.2	4.7	6.2	26.9	3.8	18.8	17.8	6.7	3.4	1.2
Other computer and electronic products	other 334	1,230	39.6	17.0	13.0	10.0	18.2	1.9	5.4	29.1	6.4	11.2	7.8	4.1	1.1	0.9
Electrical equipment, appliances, and components	335	3,925	23.9	14.1	7.8	10.6	21.4	0.8	3.1	19.5	3.5	13.5	10.7	10.4	2.2	1.9
Transportation equipment	336	7,325	26.1	11.1	5.5	13.2	19.9	0.7	2.7	10.9	3.9	4.7	8.2	4.5	2.2	0.8
Automobiles, bodies, trailers, and parts	3361–63	4,494	25.4	11.6	5.3	14.7	19.5	0.9	2.9	10.4	4.1	5.2	7.1	4.9	1.7	0.7
Aerospace products and parts	3364	1,044	35.1	15.9	8.7	17.3	29.8	0.4	2.8	17.3	4.9	6.6	16.1	3.2	5.4	1.0
Other transportation	other 336	1,787	22.4	7.2	4.0	6.9	14.8	0.3	2.2	8.1	2.5	2.5	5.8	3.8	1.4	0.5
Furniture and related products	337	12,060	22.0	4.3	3.0	5.7	8.8	0.5	1.5	4.5	1.9	1.9	1.6	2.5	0.6	0.4
Miscellaneous	339	20,536	25.4	7.2	4.7	6.6	20.8	1.7	2.3	7.8	2.5	3.2	4.7	2.3	0.7	0.8
Medical equipment and supplies	3391	7,602	26.7	10.3	8.7	9.1	32.3	3.2	3.6	6.9	2.8	2.7	7.0	1.6	1.1	1.0
Other miscellaneous manufacturing	3399	12,933	24.6	5.4	2.2	5.3	13.9	0.5	1.4	8.2	2.4	3.5	3.3	2.8	0.5	0.5
Nonmanufacturing industries	11, 21–23, 42–81	4,665,645	25.3	5.0	4.8	2.1	2.7	1.4	2.0	9.0	3.2	1.4	1.8	2.6	1.0	0.9
Agriculture, forestry, fishing, and hunting	11	19,567	19.1	6.0	3.1	3.1	0.6	1.8	0.0	8.7	1.6	0.5	1.3	2.7	1.2	0.2
Mining, extraction, and support activities	21	14,004	24.0	5.9	3.3	2.8	1.7	0.9	0.8	12.0	3.7	1.9	3.1	3.4	1.7	1.0
Utilities	22	2,994	27.3	7.4	3.8	1.9	1.2	0.6	1.8	14.7	5.1	2.4	2.7	14.6	3.3	1.3
Construction	23	635,568	19.1	4.0	2.6	1.9	1.8	0.7	1.3	6.6	2.4	1.3	1.9	3.8	1.0	0.6
Wholesale trade	42	241,440	22.5	5.5	4.0	3.0	4.0	1.4	1.9	9.1	2.8	2.3	2.3	2.9	1.4	1.0
Retail trade	44–45	546,067	21.3	4.0	3.7	2.1	2.9	1.4	1.7	7.2	3.3	1.7	1.8	2.5	1.2	1.2

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(Percent)

Industry	NAICS code	Companies (number)	Advanced computing	Advanced sensing	Artificial intelligence	Autonomous systems and robotics	Additive manufacturing	Biotechnology	Human machine interfaces	Communication and networking	Advanced financial technologies	Advanced semiconductors and microelectronics	Advanced engineering materials	Renewable energy generation and storage	Advanced gas turbine engine technologies	Advanced nuclear energy technologies
Transportation and warehousing	48–49	165,454	22.2	5.1	4.0	2.5	2.0	1.1	1.4	11.2	4.0	1.9	1.7	2.7	1.9	1.0
Information	51	65,445	42.4	8.2	14.5	2.5	2.6	1.0	4.9	20.7	5.0	2.0	1.6	2.9	0.8	0.7
Publishing	511	17,755	45.2	8.2	17.7	1.7	2.5	0.7	5.1	14.2	5.3	1.4	1.2	1.4	0.3	0.3
Newspaper, periodical, book, and directory publishers	5111	9,162	28.4	2.9	3.3	0.3	1.7	0.0	0.8	9.2	2.4	1.3	0.6	0.9	0.0	0.1
Software publishers	5112	8,589	63.2	13.8	33.3	3.2	3.4	1.5	9.9	19.6	8.4	1.4	1.9	1.9	0.7	0.5
Telecommunications	517	7,319	40.8	13.2	7.5	3.4	3.9	2.2	2.7	42.0	6.3	3.6	3.5	6.3	2.5	2.1
Data processing, hosting, and related services	518	8,346	60.7	11.4	25.3	3.1	2.3	1.6	5.7	22.3	8.2	2.2	1.2	2.2	0.6	0.5
Other information	other 51	32,027	36.5	6.2	11.5	2.5	2.6	0.8	4.9	19.2	3.6	2.2	1.3	3.1	0.6	0.6
Finance and insurance	52	198,128	34.1	4.1	6.4	1.2	0.9	0.7	1.3	10.8	5.6	0.9	0.8	1.3	0.5	0.5
Real estate and rental and leasing	53	283,276	23.7	3.0	4.3	1.0	1.0	0.5	1.5	7.1	2.7	0.6	0.7	2.0	0.6	0.4
Lessors of nonfinancial intangible assets (except copyrighted works)	533	1,956	38.7	0.0	4.6	2.2	6.0	0.0	2.3	6.7	0.0	0.0	0.0	0.0	0.0	0.0
Other real estate and rental and leasing	other 53	281,321	23.6	3.0	4.3	1.0	1.0	0.5	1.5	7.1	2.7	0.6	0.7	2.0	0.6	0.4
Professional, scientific, and technical services	54	717,229	39.6	7.3	9.1	2.9	3.3	1.7	3.2	13.9	4.4	1.7	2.0	2.7	0.9	0.7
Legal services	5411	152,543	37.2	4.6	3.3	0.9	0.5	0.5	1.0	11.4	2.8	0.6	0.5	1.5	0.5	0.5
Accounting, tax preparation, bookkeeping, and payroll services	5412	109,075	47.8	4.3	7.0	1.2	0.8	0.8	1.1	11.9	6.6	0.9	0.7	1.5	0.7	0.7
Architectural, engineering, and related services	5413	87,994	36.2	13.6	5.6	7.1	9.2	1.2	5.1	14.3	2.9	3.8	5.9	6.4	1.3	0.8
Specialized design services	5414	29,258	35.4	4.8	6.3	1.1	5.4	0.4	4.0	8.7	1.7	0.8	1.0	1.5	0.3	0.3
Computer systems design and related services	5415	100,282	54.8	12.1	22.9	5.1	4.7	2.0	7.0	26.6	7.9	3.0	1.9	2.7	1.1	0.7

Table 1

Companies using critical and emerging technologies, by industry: 2021

(Percent)

Industry	NAICS code	Companies (number)	Advanced computing	Advanced sensing	Artificial intelligence	Autonomous systems and robotics	Additive manufacturing	Biotechnology	Human machine interfaces	Communication and networking	Advanced financial technologies	Advanced semiconductors and microelectronics	Advanced engineering materials	Renewable energy generation and storage	Advanced gas turbine engine technologies	Advanced nuclear energy technologies
Management, scientific, and technical consulting services	5416	144,421	32.3	6.1	9.3	2.2	2.3	1.8	3.1	12.0	4.2	1.3	1.9	3.3	0.9	0.7
Scientific research and development services	5417	11,149	39.9	16.9	18.9	10.7	15.9	32.3	5.9	16.5	3.9	8.2	14.2	5.3	1.8	1.6
Advertising, public relations, and related services	5418	28,236	34.4	4.5	9.6	1.3	2.8	0.7	3.2	11.4	4.3	1.1	1.1	2.0	0.7	0.7
Other professional, scientific, and technical services	5419	54,270	33.0	6.1	7.9	2.3	2.0	2.4	2.0	9.9	3.2	1.2	1.2	3.5	0.7	0.6
Management of companies and enterprises	55	3,153	27.9	6.9	4.2	2.3	2.3	0.0	6.3	15.9	9.3	1.9	0.0	2.4	0.2	0.2
Administrative and support and waste management and remediation services	56	293,539	21.5	2.9	3.3	1.3	1.1	0.6	1.0	6.7	2.3	0.8	0.9	2.1	0.7	0.5
Educational services	61	57,078	24.4	2.6	4.7	1.5	2.0	0.8	1.9	8.3	3.3	0.8	0.6	1.2	0.5	0.5
Health care and social assistance	62	536,276	30.4	7.8	5.3	2.4	5.6	3.2	2.3	9.8	3.4	1.7	2.7	2.3	1.0	0.9
Health care services	621–23	469,939	31.9	8.5	5.4	2.4	6.2	3.6	2.5	10.4	3.5	1.7	2.9	2.3	0.9	1.0
Social assistance	624	66,336	19.9	3.0	3.5	1.6	1.5	1.1	1.4	5.6	2.4	1.0	1.2	1.7	1.3	1.0
Arts, entertainment, and recreation	71	89,491	20.8	3.6	3.5	1.7	2.4	0.7	2.5	7.7	2.4	0.9	1.6	2.3	0.7	0.5
Accommodation and food services	72	455,071	16.1	3.6	3.2	2.1	2.0	1.7	1.9	6.3	3.4	1.7	1.8	2.5	1.7	1.5
Other services	81	341,869	17.9	4.2	3.1	2.3	2.1	1.2	1.6	6.3	2.8	1.6	1.8	2.4	1.2	0.9

NAICS = 2017 North American Industry Classification System.

Note(s):
Detail across rows may not add to total because of rounding or unavailable NAICS detail for select records beyond the 4-digit industry classification. Detail across columns have been adjusted to add to total. Industry classification is based on dominant establishment payroll. Statistics are representative of companies located in the United States. Use is defined as "a lot," "somewhat," and "a little."

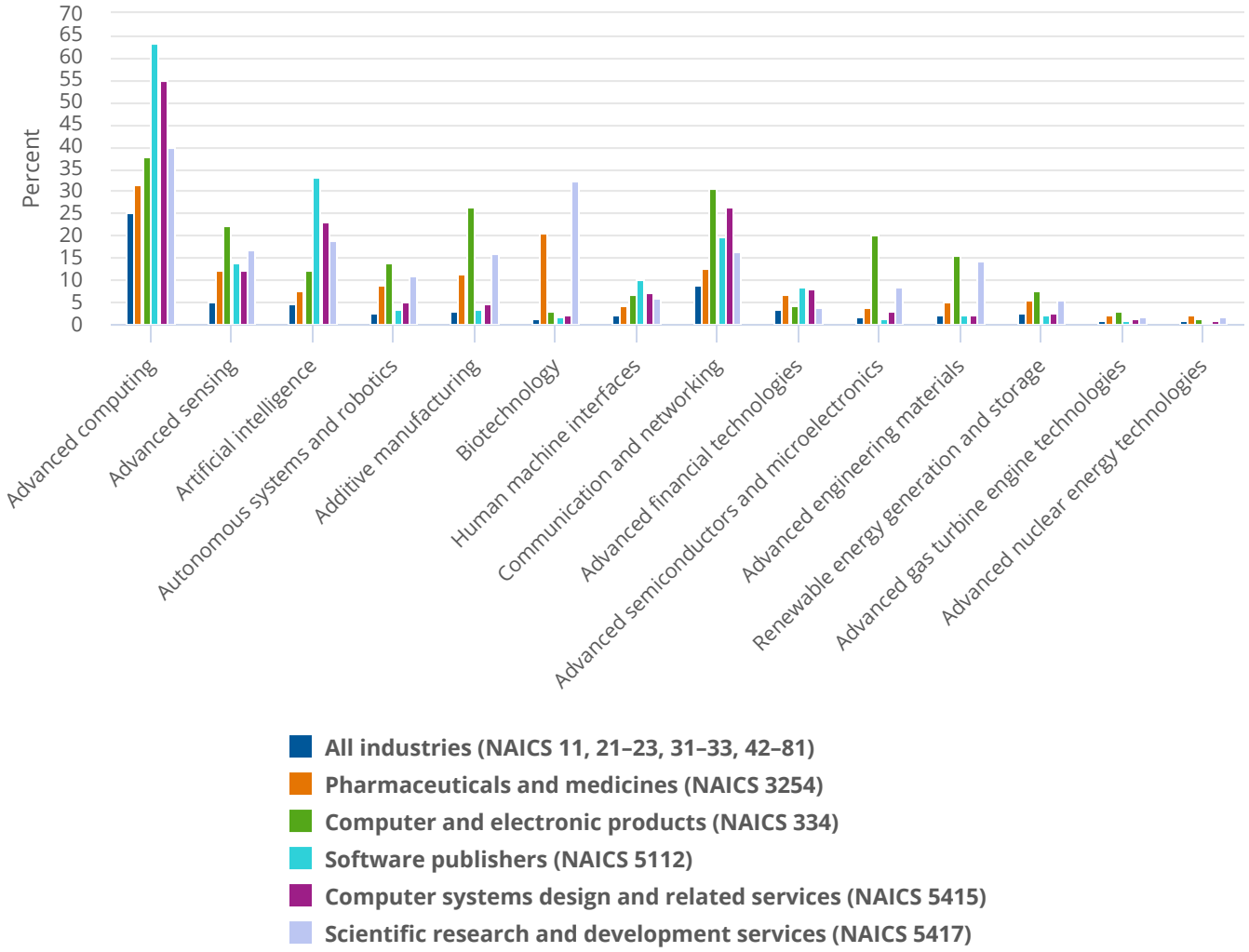
Source(s):
National Center for Science and Engineering Statistics and Census Bureau, 2022 Annual Business Survey: Data Year 2021.

For businesses with 10 or more employees, pharmaceutical and medicine (NAICS 3254), computer and electronic products (NAICS 334), software publishing (NAICS 5112), computer systems design and related services (NAICS 5415), and scientific research and development services (NAICS 5417) are among the highest in R&D intensities, measured as the ratio of R&D to sales within the industry.[7] Figure 2 presents ABS data[8] on the use of CETs by these industries. Over

half (55%) of the computer systems design and related services industry (NAICS 5415) used advanced computing at least "a little," and 27% of companies in this industry used the communication and networking CET. Forty percent of the scientific research and development services industry (NAICS 5417) used the advanced computing CET at least "a little," and 32% of companies in this industry used the biotechnology CET.

Figure 2

Companies using critical and emerging technologies, by industry: 2021



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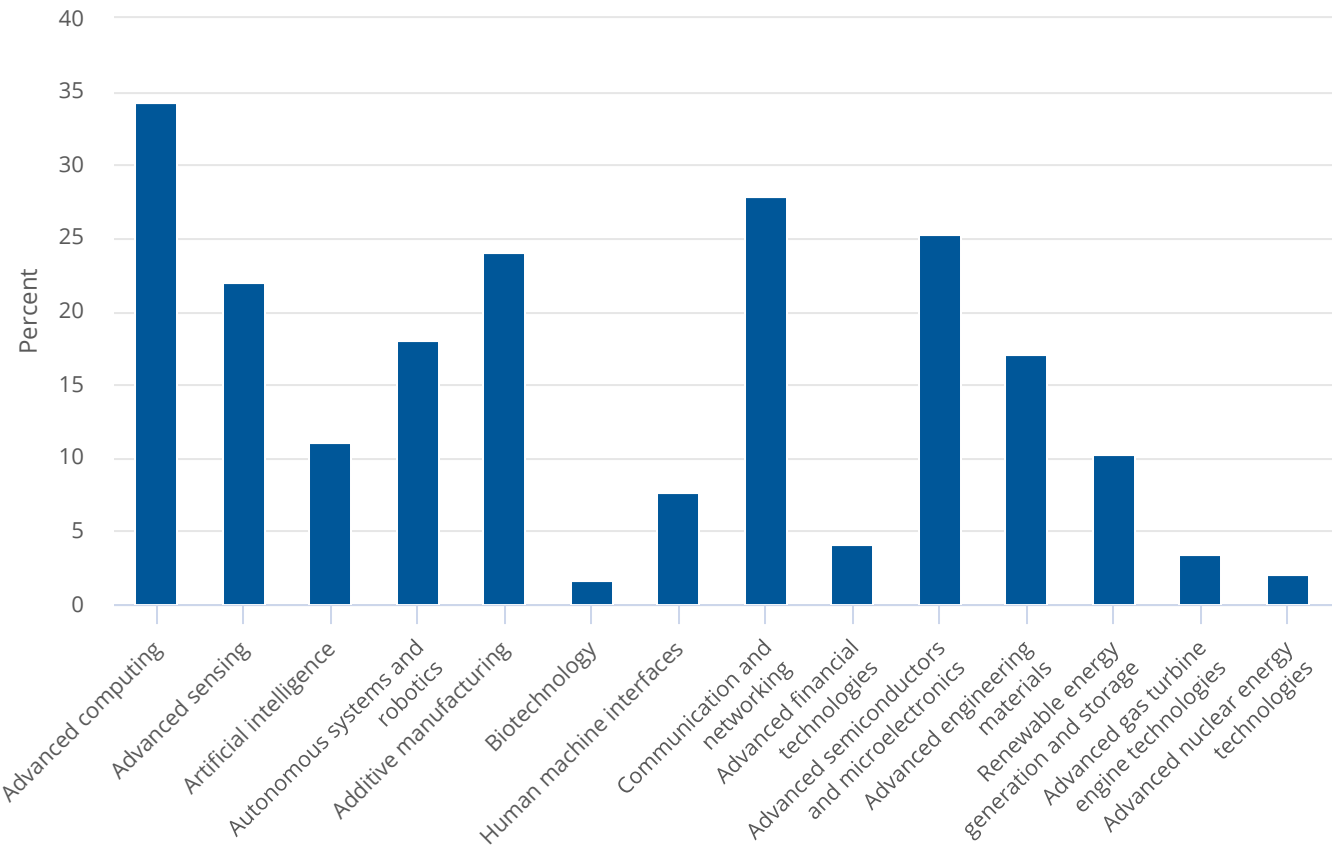
Source(s):
National Center for Science and Engineering Statistics and Census Bureau, 2022 Annual Business Survey: Data Year 2021.

The recent CHIPS and Science Act (H.R. 4346) focused attention on key manufacturing industries such as the computer and electronic products industry (NAICS 334). Within this industry, advanced computing, communication and networking, and additive manufacturing had usage rates of more than 20% (figure 2). Figure 3 shows the usage of CETs in the semiconductor and other electronic components industry (NAICS 3344), which shows that CETs such as advanced computing, communication and networking, and advanced semiconductors and microelectronics all had usage rates of more than 20%.

Figure 3

Use of critical and emerging technologies in the semiconductor and other electronic components industry (NAICS 3344): 2021



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Source(s):
National Center for Science and Engineering Statistics and Census Bureau, 2022 Annual Business Survey: Data Year 2021.

By Company Size

Across the CETs included in the 2022 ABS questionnaire, large companies (250 or more employees) had a higher percentage of CET usage, compared with the other sizes of companies. Thirty-three percent of companies with 25,000 or more employees and 4% of microbusinesses (companies with one to nine employees) used the autonomous systems and robotics CET (table 2). Nineteen percent of companies with 25,000 or more employees used the human machine interfaces CET, whereas only 4% of microbusinesses used these CETs.

Table 2

Companies using critical and emerging technologies, by company size: 2021

(Percent)

Employment size	Companies (number)	Advanced computing	Advanced sensing	Artificial intelligence	Autonomous systems and robotics	Additive manufacturing	Biotechnology	Human machine interface	Communication and networking technologies	Advanced financial technologies	Advanced semiconductors and microelectronics	Advanced engineering materials	Renewable energy generation and storage	Advanced gas turbine engine technologies	Advanced nuclear energy technologies
All companies	4,874,928	25.3	5.2	4.8	2.4	3.0	1.4	2.0	8.9	3.2	1.7	2.0	2.6	1.0	0.8
Micro companies															
1–4	2,734,191	22.2	4.4	4.3	1.9	2.4	1.4	1.8	7.4	2.8	1.4	1.5	2.4	1.0	0.9
5–9	950,548	25.7	5.2	4.8	2.4	3.5	1.6	2.0	8.6	3.6	1.7	2.1	2.7	1.2	0.9
Small companies															
10–19	577,397	29.4	5.7	5.2	2.7	4.0	1.8	2.0	10.7	3.9	1.9	2.4	2.7	1.0	0.9
20–49	399,566	31.7	6.6	5.1	3.2	4.0	1.2	1.8	12.4	4.2	2.0	2.5	3.0	1.2	0.6
Medium companies															
50–99	115,591	38.3	9.1	6.9	5.6	5.3	1.8	2.3	16.7	5.9	2.9	3.5	4.1	1.4	0.9
100–249	63,969	41.5	11.7	9.4	6.6	6.1	1.5	2.8	20.4	6.7	3.0	3.5	5.4	1.9	0.9
Large companies															
250–499	18,124	48.2	17.2	13.7	10.7	6.2	1.5	3.2	23.4	9.6	4.1	3.2	4.3	1.6	0.7
500–999	7,668	53.9	18.8	15.8	11.6	8.2	1.8	2.9	25.7	8.5	4.0	5.3	6.7	1.4	0.7
1,000–4,999	6,010	53.8	19.9	20.6	16.0	10.6	2.3	5.9	30.4	11.8	6.1	7.6	10.8	3.5	1.6
5,000–9,999	982	63.7	33.8	35.4	24.7	15.7	10.4	9.9	35.1	16.9	10.2	11.6	17.2	6.3	3.4
10,000–24,999	516	73.5	38.4	44.5	33.4	21.1	7.5	15.9	40.6	21.0	12.6	16.0	25.6	11.9	5.4
25,000 or more	372	55.4	39.8	44.2	32.9	18.9	8.7	18.9	48.5	25.9	16.7	17.4	25.6	8.3	4.1

Note(s):
Detail across rows may not add to total because of rounding. Detail across columns have been adjusted to add to total. Industry classification is based on dominant establishment payroll. Statistics are representative of companies located in the United States. Use is defined as "a lot," "somewhat," and "a little."

Source(s):
National Center for Science and Engineering Statistics and Census Bureau, 2022 Annual Business Survey: Data Year 2021.

Funding or Performing R&D in CETs by Industry

For each of the CETs, respondents were asked if their business performed or funded R&D in that area. Very few companies fund R&D or perform R&D in the 14 CETs included on the ABS. The percentages range from 0% for advanced nuclear energy technologies to 3% in advanced computing for all industries (table 3). However, there are some industries where the percentages are higher for certain CETs. Over one-quarter (28%) of software publishers (NAICS 5112) and 15% of companies classified as the computer systems design and related services industry (NAICS 5415) funded or performed R&D in the advanced computing CET. Fifteen percent of companies in the computer and electronic products industry (NAICS 334) funded or performed R&D in the communication and networking CET. The computer and electronic products industry is made up of the businesses in communications equipment (NAICS 3342), semiconductor and other electronic components (NAICS 3344), and navigational, measuring, electromedical, and control instruments (NAICS 3345). These industries had 44%, 12%, and 12%, respectively, of their businesses funding or performing R&D in the communication and networking CET.

Table 3

Companies funding or performing critical and emerging technologies, by industry: 2021

(Percent)

Industry	NAICS code	Companies (number)	Advanced computing	Advanced sensing	Artificial intelligence	Autonomous systems and robotics	Additive manufacturing	Biotechnology	Human machine interfaces	Communication and networking	Advanced financial technologies	Advanced semiconductors and microelectronics	Advanced engineering materials	Renewable energy generation and storage	Advanced gas turbine engine technologies	Advanced nuclear energy technologies
All industries	11, 21–23, 31–33, 42–81	4,874,928	2.5	0.8	1.0	0.5	0.8	0.3	0.4	1.1	0.5	0.2	0.4	0.6	0.2	0.1
Manufacturing industries	31–33	209,282	2.1	2.1	1.2	2.4	4.5	0.5	0.6	1.8	0.4	0.8	1.6	1.1	0.4	0.2
Food	311	19,326	1.1	0.7	0.4	1.1	0.4	0.6	0.2	0.7	0.6	0.0	0.1	0.3	0.0	0.0
Beverage and tobacco products	312	9,354	0.7	0.5	0.4	0.2	0.7	0.2	0.1	0.3	0.3	0.0	0.1	1.9	0.3	0.0
Textile, apparel, and leather products	313–16	9,443	1.5	0.8	0.5	0.4	2.7	0.1	0.2	0.7	0.1	0.2	0.7	0.4	0.1	0.1
Wood products	321	9,546	1.4	1.8	0.4	1.9	2.6	0.2	0.2	0.9	0.1	0.1	0.5	0.3	0.1	0.0
Paper	322	1,500	2.8	1.6	0.6	1.6	2.3	2.8	0.1	0.4	0.1	0.1	1.6	1.0	0.3	0.1
Printing and related support activities	323	20,212	2.3	0.5	0.4	0.2	1.6	0.0	0.0	1.1	0.2	0.1	0.1	0.2	0.2	0.1
Petroleum and coal products	324	546	1.4	1.8	1.2	1.4	1.4	0.2	0.4	0.8	0.4	0.2	0.8	1.2	0.2	0.0
Chemicals	325	7,961	2.3	2.3	1.3	2.4	4.0	4.0	0.4	1.0	1.2	0.6	3.4	1.4	0.4	0.3
Pesticide, fertilizer, and other agricultural chemicals	3253	580	0.0	0.5	1.6	1.2	1.7	2.1	0.5	2.1	0.5	0.5	1.0	0.7	0.5	0.5
Pharmaceuticals and medicines	3254	1,536	3.4	1.3	2.3	1.0	2.7	13.8	0.5	0.7	0.7	0.3	1.9	1.0	0.3	0.3
Soap, cleaning compound, and toilet preparation	3256	1,652	2.5	1.8	1.6	3.1	2.5	1.1	0.3	0.6	0.4	0.1	2.3	2.0	0.2	0.2
Other chemicals	other 325	4,194	2.1	3.1	0.7	2.8	5.5	1.8	0.3	1.1	1.8	0.9	4.6	1.4	0.6	0.3
Plastics and rubber products	326	7,060	2.1	3.0	1.2	4.9	8.3	0.3	0.4	1.5	0.6	0.7	2.4	1.0	0.3	0.3
Nonmetallic mineral products	327	7,290	1.3	1.2	0.3	1.2	2.2	0.3	0.3	0.9	0.3	0.4	1.3	0.4	0.7	0.2
Primary metals	331	2,079	1.9	1.9	1.5	6.8	6.6	0.1	0.5	0.8	0.3	0.2	4.6	0.7	0.8	0.5
Fabricated metal products	332	46,128	2.0	2.2	1.4	3.0	5.1	0.0	0.3	1.3	0.2	0.5	1.7	0.9	0.7	0.1
Machinery	333	16,440	1.9	3.8	2.2	6.3	7.1	0.2	2.0	2.1	0.5	2.9	3.3	1.7	0.5	0.1
Computer and electronic products	334	8,527	7.4	10.9	6.2	5.7	8.7	1.9	2.9	14.5	1.2	5.3	3.8	3.2	1.3	0.7
Communications equipment	3342	850	7.6	10.5	5.3	8.4	8.6	0.0	4.5	43.9	0.4	4.4	2.3	3.8	0.0	0.1

Table 3

Companies funding or performing critical and emerging technologies, by industry: 2021

(Percent)

Industry	NAICS code	Companies (number)	Advanced computing	Advanced sensing	Artificial intelligence	Autonomous systems and robotics	Additive manufacturing	Biotechnology	Human machine interfaces	Communication and networking	Advanced financial technologies	Advanced semiconductors and microelectronics	Advanced engineering materials	Renewable energy generation and storage	Advanced gas turbine engine technologies	Advanced nuclear energy technologies
Semiconductor and other electronic components	3344	2,711	5.8	8.8	4.7	6.6	8.0	0.5	2.9	11.6	2.1	9.4	4.5	5.3	1.2	1.0
Navigational, measuring, electromedical, and control instruments	3345	3,737	7.4	14.1	7.1	5.4	10.4	3.7	2.5	11.7	0.6	3.5	4.1	2.0	2.2	0.7
Other computer and electronic products	other 334	1,230	10.7	6.6	7.5	3.0	5.5	1.0	2.9	9.1	1.7	2.6	2.7	1.4	0.0	0.2
Electrical equipment, appliances, and components	335	3,925	4.3	5.3	2.3	3.6	8.0	0.6	2.0	6.8	0.5	5.4	3.8	5.4	1.3	1.0
Transportation equipment	336	7,325	3.4	3.0	1.3	4.8	7.4	0.4	1.3	2.3	0.7	1.3	3.6	3.0	1.1	0.4
Automobiles, bodies, trailers, and parts	3361–63	4,494	3.8	3.6	1.4	5.2	6.2	0.4	1.0	2.2	0.8	1.5	3.4	3.5	0.7	0.4
Aerospace products and parts	3364	1,044	2.7	4.1	2.0	6.0	13.6	0.1	1.7	2.7	0.4	1.0	4.6	1.2	3.9	0.6
Other transportation	other 336	1,787	2.7	0.6	0.7	3.2	6.6	0.3	1.8	2.3	0.4	1.2	3.5	2.9	0.5	0.3
Furniture and related products	337	12,060	1.6	0.1	0.8	0.6	3.4	0.0	0.1	0.4	0.1	0.1	0.5	0.4	0.3	0.1
Miscellaneous	339	20,536	2.2	1.6	0.7	1.4	7.9	0.8	1.1	0.8	0.6	0.4	1.5	0.7	0.1	0.1
Medical equipment and supplies	3391	7,602	2.3	2.6	0.7	1.6	13.4	1.6	1.8	0.6	0.9	0.3	1.7	0.1	0.0	0.0
Other miscellaneous manufacturing	3399	12,933	2.1	0.9	0.7	1.4	4.7	0.3	0.6	0.8	0.5	0.4	1.4	1.1	0.2	0.2
Nonmanufacturing industries	11, 21–23, 42–81	4,665,645	2.5	0.7	1.0	0.4	0.6	0.3	0.4	1.1	0.5	0.2	0.3	0.5	0.2	0.1
Agriculture, forestry, fishing, and hunting	11	19,567	0.8	0.7	0.7	0.5	0.0	0.6	0.0	0.5	0.0	0.0	0.0	0.3	0.1	0.0
Mining, extraction, and support activities	21	14,004	0.5	0.5	0.4	0.1	0.2	0.0	0.3	0.3	0.1	0.1	0.2	0.3	0.1	0.1
Utilities	22	2,994	3.4	0.7	1.0	0.3	0.1	0.1	0.3	1.3	0.2	0.1	0.1	4.0	1.4	0.6
Construction	23	635,568	1.2	0.3	0.4	0.2	0.3	0.1	0.2	0.7	0.2	0.1	0.2	0.9	0.2	0.1
Wholesale trade	42	241,440	2.4	0.9	0.9	0.7	1.2	0.3	0.4	1.6	0.4	0.4	0.6	0.5	0.2	0.1
Retail trade	44–45	546,067	1.9	0.6	0.7	0.4	0.7	0.3	0.2	0.7	0.4	0.2	0.3	0.6	0.2	0.2
Transportation and warehousing	48–49	165,454	1.9	0.6	0.6	0.3	0.3	0.2	0.2	1.0	0.5	0.1	0.2	0.4	0.2	0.1
Information	51	65,445	9.1	2.1	6.1	0.7	0.7	0.4	1.8	3.5	1.5	0.4	0.5	0.3	0.1	0.2
Publishing	511	17,755	14.8	3.4	10.7	0.8	0.7	0.6	2.2	3.4	2.0	0.3	0.5	0.2	0.1	0.2

Table 3

Companies funding or performing critical and emerging technologies, by industry: 2021

(Percent)

Industry	NAICS code	Companies (number)	Advanced computing	Advanced sensing	Artificial intelligence	Autonomous systems and robotics	Additive manufacturing	Biotechnology	Human machine interfaces	Communication and networking	Advanced financial technologies	Advanced semiconductors and microelectronics	Advanced engineering materials	Renewable energy generation and storage	Advanced gas turbine engine technologies	Advanced nuclear energy technologies
Newspaper, periodical, book, and directory publishers	5111	9,162	2.5	0.1	1.2	0.1	0.5	0.3	0.1	1.0	0.5	0.4	0.0	0.1	0.0	0.0
Software publishers	5112	8,589	28.0	7.0	20.9	1.5	0.9	0.9	4.5	6.0	3.7	0.2	1.0	0.4	0.1	0.5
Telecommunications	517	7,319	6.2	2.0	1.8	1.2	1.1	0.8	1.2	9.8	1.0	0.8	1.4	1.0	0.8	0.8
Data processing, hosting, and related services	518	8,346	17.5	4.3	12.9	1.8	1.4	0.9	2.8	5.2	3.0	0.9	0.2	0.9	0.2	0.2
Other information	other 51	32,027	4.4	0.7	2.8	0.2	0.4	0.0	1.4	1.7	0.9	0.2	0.3	0.1	0.0	0.0
Finance and insurance	52	198,128	3.3	0.6	1.2	0.3	0.2	0.2	0.2	1.2	1.1	0.1	0.1	0.3	0.1	0.1
Real estate and rental and leasing	53	283,276	1.7	0.2	0.6	0.2	0.3	0.1	0.3	0.6	0.4	0.1	0.1	0.3	0.1	0.1
Lessors of nonfinancial intangible assets (except copyrighted works)	533	1,956	4.6	2.4	2.4	0.0	0.0	0.0	2.4	2.4	0.0	0.0	0.0	0.0	0.0	0.0
Other real estate and rental and leasing	other 53	281,321	1.7	0.2	0.6	0.2	0.3	0.1	0.3	0.6	0.4	0.1	0.1	0.3	0.1	0.1
Professional, scientific, and technical services	54	717,229	5.1	1.5	2.5	1.0	0.9	0.7	0.9	2.0	0.8	0.3	0.5	0.8	0.2	0.1
Legal services	5411	152,543	2.6	0.2	0.5	0.2	0.2	0.1	0.3	0.7	0.3	0.1	0.1	0.1	0.1	0.1
Accounting, tax preparation, bookkeeping, and payroll services	5412	109,075	3.8	0.3	0.6	0.2	0.1	0.1	0.3	0.7	0.9	0.1	0.1	0.2	0.1	0.1
Architectural, engineering, and related services	5413	87,994	3.8	3.4	1.8	2.4	2.4	0.3	1.6	3.1	0.3	0.7	1.7	2.6	0.3	0.3
Specialized design services	5414	29,258	2.5	0.5	0.9	0.0	1.3	0.0	1.1	0.9	0.0	0.2	0.0	0.4	0.0	0.0
Computer systems design and related services	5415	100,282	15.3	3.6	8.9	2.1	1.3	0.7	2.5	6.0	2.4	0.4	0.3	0.7	0.3	0.2
Management, scientific, and technical consulting services	5416	144,421	3.9	1.3	2.5	1.0	0.7	0.5	0.7	1.6	1.1	0.3	0.5	1.0	0.2	0.2
Scientific research and development services	5417	11,149	9.0	9.0	9.4	4.7	5.4	25.7	2.6	4.2	0.7	3.6	7.7	3.1	1.0	0.8

Table 3

Companies funding or performing critical and emerging technologies, by industry: 2021

(Percent)

Industry	NAICS code	Companies (number)	Advanced computing	Advanced sensing	Artificial intelligence	Autonomous systems and robotics	Additive manufacturing	Biotechnology	Human machine interfaces	Communication and networking	Advanced financial technologies	Advanced semiconductors and microelectronics	Advanced engineering materials	Renewable energy generation and storage	Advanced gas turbine engine technologies	Advanced nuclear energy technologies
Advertising, public relations, and related services	5418	28,236	3.3	0.4	1.8	0.4	0.6	0.0	0.6	1.5	0.4	0.1	0.1	0.4	0.2	0.0
Other professional, scientific, and technical services	5419	54,270	3.3	1.0	1.5	0.2	0.3	0.5	0.3	1.1	0.4	0.2	0.1	0.3	0.0	0.0
Management of companies and enterprises	55	3,153	3.3	0.0	2.3	2.3	2.3	0.0	2.3	0.0	1.6	0.0	0.0	0.0	0.0	0.0
Administrative and support and waste management and remediation services	56	293,539	2.1	0.4	0.6	0.3	0.2	0.2	0.3	0.9	0.3	0.1	0.2	0.5	0.1	0.1
Educational services	61	57,078	1.7	0.4	1.1	0.3	0.4	0.0	0.6	1.5	0.6	0.0	0.0	0.2	0.0	0.0
Health care and social assistance	62	536,276	2.6	0.9	0.9	0.4	0.9	0.4	0.4	1.0	0.4	0.2	0.4	0.3	0.2	0.1
Health care services	621–23	469,939	2.7	0.9	0.8	0.4	1.0	0.5	0.4	0.9	0.4	0.2	0.4	0.3	0.1	0.1
Social assistance	624	66,336	2.2	0.8	1.0	0.4	0.4	0.2	0.4	1.1	0.6	0.2	0.3	0.4	0.3	0.2
Arts, entertainment, and recreation	71	89,491	1.5	0.1	0.3	0.1	0.3	0.0	0.2	0.6	0.1	0.0	0.1	0.3	0.0	0.0
Accommodation and food services	72	455,071	1.7	0.7	0.6	0.4	0.5	0.4	0.4	0.8	0.6	0.3	0.3	0.5	0.3	0.3
Other services	81	341,869	1.5	0.5	0.5	0.4	0.5	0.1	0.3	0.7	0.3	0.2	0.2	0.4	0.2	0.1

NAICS = 2017 North American Industry Classification System.

Note(s):
Detail across rows may not add to total because of rounding or unavailable NAICS detail for select records beyond the 4-digit industry classification. Detail across columns have been adjusted to add to total. Industry classification is based on dominant establishment payroll. Statistics are representative of companies located in the United States.

Source(s):
National Center for Science and Engineering Statistics and Census Bureau, 2022 Annual Business Survey: Data Year 2021.

Funding or Performing R&D in CETs by Company Size

A higher proportion of larger companies than smaller companies performed or funded R&D in most CETs, although the differences between size categories are not uniform. For example, 2% of microbusinesses fund or perform R&D in advanced sensing, but 20% of businesses with 25,000 or more employees fund or perform R&D in that technology area (table 4). Less than 1% of microbusinesses fund or perform R&D in advanced gas turbine engine technologies or biotechnology, but for companies with 25,000 or more employees, 3% fund or perform R&D in advanced gas turbine engine technologies and 5% fund or perform R&D in biotechnology.

Table 4

Companies funding or performing critical and emerging technologies, by company size: 2021

(Percent)

Employment size	Companies (number)	Advanced computing	Advanced sensing	Artificial intelligence	Autonomous systems and robotics	Additive manufacturing	Biotechnology	Human machine interface	Communication and networking technologies	Advanced financial technologies	Advanced semiconductors and microelectronics	Advanced engineering materials	Renewable energy generation and storage	Advanced gas turbine engine technologies	Advanced nuclear energy technologies
All companies	4,874,928	2.5	0.8	1.0	0.5	0.8	0.3	0.4	1.1	0.5	0.2	0.4	0.6	0.2	0.1
Micro companies															
1–4	2,734,191	2.2	0.7	0.9	0.4	0.5	0.3	0.4	1.0	0.5	0.2	0.3	0.5	0.2	0.2
5–9	950,548	2.8	0.9	1.0	0.4	0.8	0.3	0.4	1.1	0.5	0.2	0.4	0.5	0.2	0.2
Small companies															
10–19	577,397	2.4	0.7	1.0	0.5	0.9	0.4	0.4	1.2	0.5	0.2	0.4	0.6	0.2	0.1
20–49	399,566	2.8	1.0	1.2	0.8	1.2	0.4	0.4	1.4	0.5	0.4	0.6	0.7	0.2	0.1
Medium companies															
50–99	115,591	4.4	1.6	1.7	1.1	1.5	0.5	0.6	2.1	0.9	0.6	0.8	0.7	0.2	0.2
100–249	63,969	4.0	1.8	2.3	2.1	2.4	0.6	0.6	2.1	0.5	0.6	0.8	0.8	0.3	0.1
Large companies															
250–499	18,124	5.4	3.2	4.0	4.1	1.9	0.5	0.3	2.4	1.2	0.7	0.5	1.1	0.2	0.1
500–999	7,668	7.7	2.0	3.6	2.6	2.2	0.8	0.7	3.2	0.9	0.5	1.3	1.1	0.1	0.1
1,000–4,999	6,010	9.4	4.6	7.2	5.4	4.0	1.1	2.2	5.2	2.0	1.6	3.1	3.2	1.0	0.5
5,000–9,999	982	22.0	16.1	18.8	10.3	7.5	8.8	5.3	16.2	10.3	2.7	5.3	7.2	2.7	1.1
10,000–24,999	516	22.9	13.3	17.6	12.7	9.6	3.3	6.9	12.2	5.7	4.1	8.8	9.4	3.3	2.0
25,000 or more	372	26.8	20.1	26.8	18.1	10.4	4.7	16.1	18.1	7.4	7.7	7.7	11.4	3.3	1.0

Note(s):
Detail across rows may not add to total because of rounding. Detail across columns have been adjusted to add to total. Industry classification is based on dominant establishment payroll. Statistics are representative of companies located in the United States.

Source(s):
National Center for Science and Engineering Statistics and Census Bureau, 2022 Annual Business Survey: Data Year 2021.

Survey Information and Data Availability

The statistics from the ABS are based on a sample; as such, they are subject to both sampling and nonsampling errors (see “Technical Notes” in the data tables report at https://ncses.nsf.gov/surveys/annual-business-survey/2022#technical-notes).

For the full ABS 2022 (reference year 2021), 300,000 employer companies were sampled to represent the population of 4.9 million employer companies, and the unit response rate was 67.0%.

The full set of data tables on R&D, company demographics, innovation, technology, and patent and intellectual property protection from this survey are available in the report *Annual Business Survey: 2022 (Data Year 2021)*. Individual data tables and tables with relative standard errors and imputation rates from the ABS 2022 are available upon request from the Survey Manager.

NCSES has reviewed this product for unauthorized disclosure of confidential information and approved its release (NCSES-DRN24-049).

Notes

1 Available at https://www.whitehouse.gov/wp-content/uploads/2022/02/02-2022-Critical-and-Emerging-Technologies-List-Update.pdf.

2 Available at https://trumpwhitehouse.archives.gov/wp-content/uploads/2020/10/National-Strategy-for-CET.pdf.

3 Not all CETs were included in the ABS 2022 questionnaire to limit length of the questionnaire and burden on respondents.

4 Examples of communication and networking technologies include radiofrequency and mixed signal circuits, antennas and components, spectrum management technologies, communications and network security, and mesh networks/infrastructure independent communication technologies.

5 Due to data availability, this InfoBrief will discuss 2-digit nonmanufacturing and 3-digit manufacturing as subsectors. All 4-digit codes are industry groups. For more information on NAICS codes, see https://www.census.gov/programs-surveys/economic-census/year/2022/guidance/understanding-naics.html.

6 See https://www.whitehouse.gov/wp-content/uploads/2022/10/National-Strategy-for-Advanced-Manufacturing-10072022.pdf and https://trumpwhitehouse.archives.gov/wp-content/uploads/2018/10/Advanced-Manufacturing-Strategic-Plan-2018.pdf.

7 See *Business R&D Performance in the United States Tops $600 Billion in 2021:* table 3 at https://ncses.nsf.gov/pubs/nsf23350.

8 The questions on the ABS went to businesses with one or more employees.

Suggested Citation

Kindlon A, Anderson G, Rhodes A; National Center for Science and Engineering Statistics (NCSES). 2024. *Critical and Emerging Technologies by U.S. Businesses: Use and R&D Funding and Performance*. NSF 25-307. Alexandria, VA: U.S. National Science Foundation. Available at https://ncses.nsf.gov/pubs/nsf25307.

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