

Table K1. Industrial sector energy consumption by region and sector, Low Zero-carbon Technology Cost case

quadrillion British thermal units

Region and sector	2022	2025	2030	2035	2040	2045	2050	Average annual percentage change, 2022–2050
Americas								
United States								
Energy-intensive manufacturing	17.5	17.4	18.2	18.7	19.1	19.6	20.2	0.5%
Non-energy-intensive manufacturing	2.9	2.8	3.0	3.1	3.3	3.5	3.7	0.9%
Nonmanufacturing	6.3	6.3	6.4	6.5	6.7	6.9	7.0	0.4%
Unclassified	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	--
Total	26.6	26.4	27.5	28.2	29.0	29.8	30.8	0.5%
Canada								
Energy-intensive manufacturing	2.1	2.2	2.6	3.0	3.4	3.8	4.1	2.5%
Non-energy-intensive manufacturing	1.5	1.6	1.7	1.8	2.0	2.1	2.3	1.5%
Nonmanufacturing	2.4	2.4	2.4	2.5	2.6	2.7	2.8	0.5%
Total	6.0	6.2	6.8	7.3	8.0	8.6	9.1	1.5%
Mexico								
Energy-intensive manufacturing	1.2	1.2	1.3	1.4	1.5	1.7	1.9	1.7%
Non-energy-intensive manufacturing	1.2	1.3	1.4	1.6	1.7	1.8	1.8	1.3%
Nonmanufacturing	0.6	0.7	0.9	0.9	0.9	0.9	0.9	1.4%
Total	3.1	3.2	3.6	3.9	4.1	4.4	4.6	1.5%
Brazil								
Energy-intensive manufacturing	3.6	3.6	3.9	4.1	4.2	4.3	4.3	0.7%
Non-energy-intensive manufacturing	1.7	1.8	2.0	2.2	2.4	2.5	2.6	1.5%
Nonmanufacturing	0.8	0.8	0.9	0.9	0.9	0.9	0.9	0.6%
Total	6.1	6.2	6.8	7.3	7.6	7.8	7.9	0.9%
Other Americas								
Energy-intensive manufacturing	2.3	2.3	2.5	2.7	3.0	3.2	3.5	1.5%
Non-energy-intensive manufacturing	2.2	2.4	2.7	3.1	3.5	3.9	4.4	2.4%
Nonmanufacturing	1.2	1.2	1.3	1.4	1.5	1.6	1.6	1.1%
Total	5.7	5.9	6.6	7.2	7.9	8.7	9.5	1.8%
Europe and Eurasia								
Western Europe								
Energy-intensive manufacturing	16.2	16.1	16.2	16.7	17.4	18.2	19.0	0.6%
Non-energy-intensive manufacturing	7.1	7.0	6.9	6.9	6.9	7.0	7.1	0.0%
Nonmanufacturing	2.9	2.9	3.0	3.0	3.0	3.1	3.1	0.2%
Total	26.3	26.0	26.1	26.6	27.4	28.2	29.2	0.4%
Russia								
Energy-intensive manufacturing	9.5	9.9	10.0	10.4	10.9	11.4	11.9	0.8%
Non-energy-intensive manufacturing	3.7	4.0	4.3	4.5	4.9	5.4	6.0	1.7%
Nonmanufacturing	2.5	1.9	2.0	2.0	2.1	2.1	2.1	-0.5%
Total	15.6	15.9	16.3	17.0	17.9	18.9	20.0	0.9%
Eastern Europe and Eurasia								
Energy-intensive manufacturing	2.1	2.3	2.7	2.9	3.3	3.7	4.2	2.5%
Non-energy-intensive manufacturing	0.8	0.8	0.7	0.7	0.8	0.8	0.9	0.8%
Nonmanufacturing	0.8	0.8	1.0	1.1	1.3	1.4	1.5	2.4%
Total	3.6	3.9	4.4	4.8	5.3	5.9	6.6	2.2%
Asia Pacific								
Japan								
Energy-intensive manufacturing	4.6	4.6	4.4	4.1	4.0	3.8	3.7	-0.8%
Non-energy-intensive manufacturing	1.4	1.5	1.4	1.3	1.3	1.2	1.2	-0.7%
Nonmanufacturing	0.4	0.3	0.3	0.3	0.3	0.3	0.3	-0.5%
Total	6.4	6.4	6.1	5.8	5.6	5.3	5.1	-0.8%
South Korea								
Energy-intensive manufacturing	4.4	4.4	4.6	4.6	4.6	4.6	4.5	0.1%

Non-energy-intensive manufacturing	1.1	1.1	1.2	1.3	1.4	1.4	1.5	1.1%
Nonmanufacturing	0.2	0.2	0.2	0.2	0.2	0.2	0.2	-0.6%
Total	5.7	5.8	6.0	6.1	6.1	6.2	6.2	0.3%
Australia and New Zealand								
Energy-intensive manufacturing	1.1	1.2	1.3	1.3	1.3	1.4	1.4	0.8%
Non-energy-intensive manufacturing	0.5	0.5	0.6	0.6	0.7	0.7	0.7	1.1%
Nonmanufacturing	1.0	1.0	1.0	1.1	1.2	1.3	1.4	1.3%
Total	2.6	2.7	2.9	3.1	3.2	3.4	3.5	1.1%
China								
Energy-intensive manufacturing	56.5	58.0	56.3	54.0	51.2	48.8	46.1	-0.7%
Non-energy-intensive manufacturing	22.4	24.0	25.1	26.0	26.2	26.1	25.4	0.4%
Nonmanufacturing	5.8	5.8	5.9	5.9	5.9	5.9	5.9	0.1%
Total	84.8	87.8	87.4	86.0	83.2	80.8	77.4	-0.3%
India								
Energy-intensive manufacturing	8.6	9.3	11.9	14.8	17.8	21.1	24.7	3.8%
Non-energy-intensive manufacturing	8.2	9.0	11.8	14.8	17.7	20.4	23.1	3.8%
Nonmanufacturing	1.8	2.0	2.4	2.7	2.9	3.1	3.3	2.1%
Total	18.6	20.3	26.0	32.3	38.4	44.7	51.1	3.7%
Other Asia Pacific								
Energy-intensive manufacturing	7.2	7.9	9.4	10.2	11.1	12.0	12.9	2.1%
Non-energy-intensive manufacturing	8.6	9.5	11.3	13.0	14.5	15.8	16.9	2.4%
Nonmanufacturing	1.8	1.8	1.9	2.0	2.1	2.2	2.3	0.9%
Total	17.6	19.2	22.6	25.2	27.7	30.1	32.2	2.2%
Africa and Middle East								
Africa								
Energy-intensive manufacturing	3.2	3.4	3.8	4.3	4.8	5.5	6.3	2.4%
Non-energy-intensive manufacturing	5.7	6.2	7.4	8.7	10.2	11.7	13.1	3.0%
Nonmanufacturing	1.4	1.3	1.3	1.4	1.5	1.5	1.5	0.3%
Total	10.3	11.0	12.6	14.4	16.5	18.7	20.9	2.6%
Middle East								
Energy-intensive manufacturing	7.4	7.6	7.9	8.3	8.7	9.1	9.3	0.8%
Non-energy-intensive manufacturing	7.9	7.9	8.1	8.7	9.3	9.7	10.0	0.8%
Nonmanufacturing	2.7	3.2	3.8	3.9	4.3	4.9	5.6	2.7%
Total	18.0	18.6	19.7	21.0	22.4	23.7	24.9	1.2%
World								
Energy-intensive manufacturing	147.5	151.5	156.9	161.6	166.4	172.1	177.9	0.7%
Non-energy-intensive manufacturing	76.9	81.4	89.8	98.6	106.7	114.1	120.5	1.6%
Nonmanufacturing	32.6	32.8	34.6	35.8	37.4	39.0	40.7	0.8%
Unclassified	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	--
Total	257.0	265.6	281.3	296.0	310.3	325.1	339.0	1.0%

Data source: U.S. Energy Information Administration, World Energy Projection System (2023), run lz_230821.151531 and Annual Energy Outlook 2023 (March 2023), www.eia.gov/aeo

Note: Totals may not equal sum of components due to independent rounding. Nonmanufacturing includes agriculture, construction, and mining; energy-intensive manufacturing includes food, pulp and paper, basic chemicals, refining, iron and steel, nonferrous metals, and nonmetallic minerals; non-energy-intensive manufacturing includes all other manufacturing industries.

Table K2. Industrial sector gross output by region and sector, Low Zero-carbon Technology Cost case

billion 2015 dollars

Region and sector	2022	2025	2030	2035	2040	2045	2050	Average annual percentage change, 2022–2050
Americas								
United States								
Energy-intensive manufacturing	\$2,388	\$2,426	\$2,624	\$2,775	\$2,989	\$3,255	\$3,544	1.4%
Non-energy-intensive manufacturing	\$3,493	\$3,786	\$4,282	\$4,756	\$5,371	\$6,079	\$6,872	2.4%
Nonmanufacturing	\$2,394	\$2,630	\$2,834	\$3,099	\$3,454	\$3,864	\$4,313	2.1%
Total	\$8,275	\$8,841	\$9,740	\$10,630	\$11,814	\$13,198	\$14,729	2.1%
Canada								
Energy-intensive manufacturing	\$256	\$266	\$307	\$341	\$377	\$415	\$452	2.1%
Non-energy-intensive manufacturing	\$332	\$359	\$413	\$458	\$504	\$549	\$596	2.1%
Nonmanufacturing	\$498	\$500	\$540	\$583	\$626	\$666	\$705	1.3%
Total	\$1,086	\$1,125	\$1,260	\$1,382	\$1,506	\$1,630	\$1,754	1.7%
Mexico								
Energy-intensive manufacturing	\$535	\$557	\$619	\$670	\$723	\$788	\$870	1.8%
Non-energy-intensive manufacturing	\$983	\$1,048	\$1,143	\$1,248	\$1,373	\$1,530	\$1,727	2.0%
Nonmanufacturing	\$466	\$490	\$537	\$577	\$609	\$640	\$670	1.3%
Total	\$1,983	\$2,095	\$2,299	\$2,494	\$2,706	\$2,959	\$3,268	1.8%
Brazil								
Energy-intensive manufacturing	\$868	\$910	\$997	\$1,054	\$1,079	\$1,097	\$1,104	0.9%
Non-energy-intensive manufacturing	\$612	\$660	\$752	\$827	\$878	\$923	\$960	1.6%
Nonmanufacturing	\$710	\$748	\$817	\$873	\$915	\$956	\$994	1.2%
Total	\$2,191	\$2,318	\$2,566	\$2,754	\$2,872	\$2,976	\$3,058	1.2%
Other Americas								
Energy-intensive manufacturing	\$899	\$956	\$1,084	\$1,210	\$1,344	\$1,488	\$1,640	2.2%
Non-energy-intensive manufacturing	\$937	\$935	\$1,068	\$1,201	\$1,338	\$1,478	\$1,626	2.0%
Nonmanufacturing	\$1,197	\$1,254	\$1,384	\$1,523	\$1,666	\$1,812	\$1,966	1.8%
Total	\$3,032	\$3,145	\$3,536	\$3,934	\$4,348	\$4,777	\$5,231	2.0%
Europe and Eurasia								
Western Europe								
Energy-intensive manufacturing	\$4,982	\$5,027	\$5,106	\$5,290	\$5,520	\$5,757	\$6,030	0.7%
Non-energy-intensive manufacturing	\$8,440	\$8,935	\$9,511	\$10,208	\$10,961	\$11,729	\$12,545	1.4%
Nonmanufacturing	\$4,377	\$4,532	\$4,829	\$5,077	\$5,328	\$5,547	\$5,771	1.0%
Total	\$17,799	\$18,494	\$19,446	\$20,575	\$21,808	\$23,032	\$24,346	1.1%
Russia								
Energy-intensive manufacturing	\$895	\$988	\$1,054	\$1,135	\$1,220	\$1,312	\$1,393	1.6%
Non-energy-intensive manufacturing	\$544	\$607	\$637	\$684	\$745	\$814	\$884	1.7%
Nonmanufacturing	\$1,282	\$1,252	\$1,312	\$1,333	\$1,346	\$1,363	\$1,376	0.3%
Total	\$2,721	\$2,847	\$3,003	\$3,152	\$3,311	\$3,489	\$3,653	1.1%
Eastern Europe and Eurasia								
Energy-intensive manufacturing	\$230	\$266	\$314	\$376	\$450	\$538	\$635	3.7%
Non-energy-intensive manufacturing	\$96	\$119	\$143	\$165	\$192	\$225	\$261	3.6%
Nonmanufacturing	\$750	\$825	\$1,028	\$1,187	\$1,363	\$1,527	\$1,689	2.9%
Total	\$1,076	\$1,210	\$1,486	\$1,728	\$2,005	\$2,290	\$2,586	3.2%
Asia Pacific								
Japan								
Energy-intensive manufacturing	\$941	\$965	\$939	\$906	\$885	\$864	\$847	-0.4%
Non-energy-intensive manufacturing	\$2,737	\$3,005	\$3,155	\$3,214	\$3,244	\$3,263	\$3,289	0.7%
Nonmanufacturing	\$670	\$682	\$700	\$697	\$693	\$687	\$684	0.1%
Total	\$4,349	\$4,652	\$4,793	\$4,816	\$4,821	\$4,814	\$4,820	0.4%
South Korea								
Energy-intensive manufacturing	\$1,067	\$1,123	\$1,152	\$1,160	\$1,143	\$1,119	\$1,089	0.1%
Non-energy-intensive manufacturing	\$1,692	\$1,796	\$2,032	\$2,169	\$2,259	\$2,346	\$2,427	1.3%

Nonmanufacturing	\$362	\$376	\$384	\$395	\$400	\$405	\$407	0.4%
Total	\$3,122	\$3,295	\$3,568	\$3,724	\$3,802	\$3,869	\$3,923	0.8%
Australia and New Zealand								
Energy-intensive manufacturing	\$173	\$187	\$204	\$218	\$233	\$247	\$260	1.5%
Non-energy-intensive manufacturing	\$130	\$137	\$148	\$158	\$168	\$176	\$183	1.2%
Nonmanufacturing	\$590	\$626	\$728	\$805	\$875	\$941	\$1,003	1.9%
Total	\$894	\$950	\$1,080	\$1,181	\$1,275	\$1,364	\$1,446	1.7%
China								
Energy-intensive manufacturing	\$10,799	\$12,196	\$13,640	\$14,680	\$15,315	\$15,839	\$16,048	1.4%
Non-energy-intensive manufacturing	\$25,771	\$29,890	\$35,517	\$40,345	\$43,724	\$46,431	\$47,679	2.2%
Nonmanufacturing	\$12,744	\$13,871	\$15,867	\$17,313	\$18,356	\$19,410	\$20,058	1.6%
Total	\$49,313	\$55,956	\$65,024	\$72,337	\$77,396	\$81,680	\$83,786	1.9%
India								
Energy-intensive manufacturing	\$3,724	\$4,307	\$6,027	\$8,080	\$10,238	\$12,613	\$15,084	5.1%
Non-energy-intensive manufacturing	\$3,007	\$3,411	\$4,772	\$6,342	\$8,039	\$9,891	\$11,862	5.0%
Nonmanufacturing	\$4,474	\$5,019	\$6,313	\$7,613	\$8,814	\$10,032	\$11,189	3.3%
Total	\$11,205	\$12,736	\$17,111	\$22,035	\$27,092	\$32,536	\$38,135	4.5%
Other Asia Pacific								
Energy-intensive manufacturing	\$4,475	\$5,072	\$6,198	\$7,492	\$8,958	\$10,552	\$12,213	3.7%
Non-energy-intensive manufacturing	\$8,764	\$9,681	\$11,754	\$13,758	\$15,813	\$17,814	\$19,719	2.9%
Nonmanufacturing	\$5,207	\$5,674	\$6,802	\$7,874	\$9,028	\$10,174	\$11,285	2.8%
Total	\$18,447	\$20,427	\$24,754	\$29,124	\$33,799	\$38,540	\$43,218	3.1%
Africa and Middle East								
Africa								
Energy-intensive manufacturing	\$1,364	\$1,503	\$1,761	\$2,052	\$2,362	\$2,697	\$3,054	2.9%
Non-energy-intensive manufacturing	\$885	\$975	\$1,136	\$1,314	\$1,502	\$1,701	\$1,902	2.8%
Nonmanufacturing	\$3,002	\$3,248	\$3,607	\$3,980	\$4,353	\$4,721	\$5,079	1.9%
Total	\$5,251	\$5,726	\$6,505	\$7,346	\$8,217	\$9,118	\$10,034	2.3%
Middle East								
Energy-intensive manufacturing	\$1,557	\$1,626	\$1,750	\$1,908	\$2,035	\$2,139	\$2,227	1.3%
Non-energy-intensive manufacturing	\$836	\$892	\$988	\$1,115	\$1,241	\$1,349	\$1,454	2.0%
Nonmanufacturing	\$2,580	\$2,768	\$2,954	\$3,122	\$3,289	\$3,447	\$3,581	1.2%
Total	\$4,973	\$5,285	\$5,691	\$6,145	\$6,565	\$6,935	\$7,262	1.4%
World								
Energy-intensive manufacturing	\$35,153	\$38,375	\$43,775	\$49,347	\$54,872	\$60,721	\$66,491	2.3%
Non-energy-intensive manufacturing	\$59,259	\$66,236	\$77,453	\$87,961	\$97,351	\$106,296	\$113,986	2.4%
Nonmanufacturing	\$41,304	\$44,494	\$50,635	\$56,050	\$61,115	\$66,192	\$70,773	1.9%
Total	\$135,716	\$149,104	\$171,863	\$193,357	\$213,338	\$233,209	\$251,249	2.2%

Data source: U.S. Energy Information Administration, World Energy Projection System (2023), run lz_230821.151531 and Annual Energy Outlook 2023 (March 2023), www.eia.gov/aeo; Oxford Economics, Global Industry Model (March 2023), www.oxfordeconomics.com (subscription site)

Note: Totals may not equal sum of components due to independent rounding. Gross output is sales or revenue, including final and intermediate goods and services, measured in purchasing power parity. Nonmanufacturing includes agriculture, construction, and mining; energy-intensive manufacturing includes food, pulp and paper, basic chemicals, refining, iron and steel, nonferrous metals, and nonmetallic minerals; non-energy-intensive manufacturing includes all other manufacturing industries.

Nonmanufacturing	0.5	0.5	0.5	0.4	0.4	0.4	0.4	-1.0%
Total	1.8	1.8	1.7	1.6	1.6	1.6	1.6	-0.5%
Australia and New Zealand								
Energy-intensive manufacturing	6.6	6.4	6.3	6.0	5.8	5.6	5.5	-0.6%
Non-energy-intensive manufacturing	3.9	4.0	4.0	4.0	3.9	3.9	3.8	-0.1%
Nonmanufacturing	1.7	1.5	1.4	1.4	1.4	1.4	1.4	-0.6%
Total	2.9	2.9	2.7	2.6	2.5	2.5	2.4	-0.7%
China								
Energy-intensive manufacturing	5.2	4.8	4.1	3.7	3.3	3.1	2.9	-2.1%
Non-energy-intensive manufacturing	0.9	0.8	0.7	0.6	0.6	0.6	0.5	-1.7%
Nonmanufacturing	0.5	0.4	0.4	0.3	0.3	0.3	0.3	-1.5%
Total	1.7	1.6	1.3	1.2	1.1	1.0	0.9	-2.2%
India								
Energy-intensive manufacturing	2.3	2.2	2.0	1.8	1.7	1.7	1.6	-1.2%
Non-energy-intensive manufacturing	2.7	2.6	2.5	2.3	2.2	2.1	1.9	-1.2%
Nonmanufacturing	0.4	0.4	0.4	0.3	0.3	0.3	0.3	-1.1%
Total	1.7	1.6	1.5	1.5	1.4	1.4	1.3	-0.8%
Other Asia Pacific								
Energy-intensive manufacturing	1.6	1.6	1.5	1.4	1.2	1.1	1.1	-1.5%
Non-energy-intensive manufacturing	1.0	1.0	1.0	0.9	0.9	0.9	0.9	-0.5%
Nonmanufacturing	0.3	0.3	0.3	0.3	0.2	0.2	0.2	-1.8%
Total	1.0	0.9	0.9	0.9	0.8	0.8	0.7	-0.9%
Africa and Middle East								
Africa								
Energy-intensive manufacturing	2.3	2.3	2.2	2.1	2.1	2.0	2.1	-0.5%
Non-energy-intensive manufacturing	6.4	6.4	6.5	6.6	6.8	6.9	6.9	0.3%
Nonmanufacturing	0.5	0.4	0.4	0.3	0.3	0.3	0.3	-1.6%
Total	2.0	1.9	1.9	2.0	2.0	2.0	2.1	0.2%
Middle East								
Energy-intensive manufacturing	4.8	4.7	4.5	4.4	4.3	4.3	4.2	-0.5%
Non-energy-intensive manufacturing	9.5	8.8	8.2	7.8	7.5	7.2	6.9	-1.1%
Nonmanufacturing	1.0	1.2	1.3	1.3	1.3	1.4	1.6	1.5%
Total	3.6	3.5	3.5	3.4	3.4	3.4	3.4	-0.2%
World								
Energy-intensive manufacturing	4.2	3.9	3.6	3.3	3.0	2.8	2.7	-1.6%
Non-energy-intensive manufacturing	1.3	1.2	1.2	1.1	1.1	1.1	1.1	-0.7%
Nonmanufacturing	0.8	0.7	0.7	0.6	0.6	0.6	0.6	-1.1%
Total	1.9	1.8	1.6	1.5	1.5	1.4	1.3	-1.2%

Data source: U.S. Energy Information Administration, World Energy Projection System (2023), run lz_230821.151531 and Annual Energy Outlook 2023 (March 2023), www.eia.gov/aeo

Note: Totals may not equal sum of components due to independent rounding. Nonmanufacturing includes agriculture, construction, and mining; energy-intensive manufacturing includes food, pulp and paper, basic chemicals, refining, iron and steel, nonferrous metals, and nonmetallic minerals; non-energy-intensive manufacturing includes all other manufacturing industries.