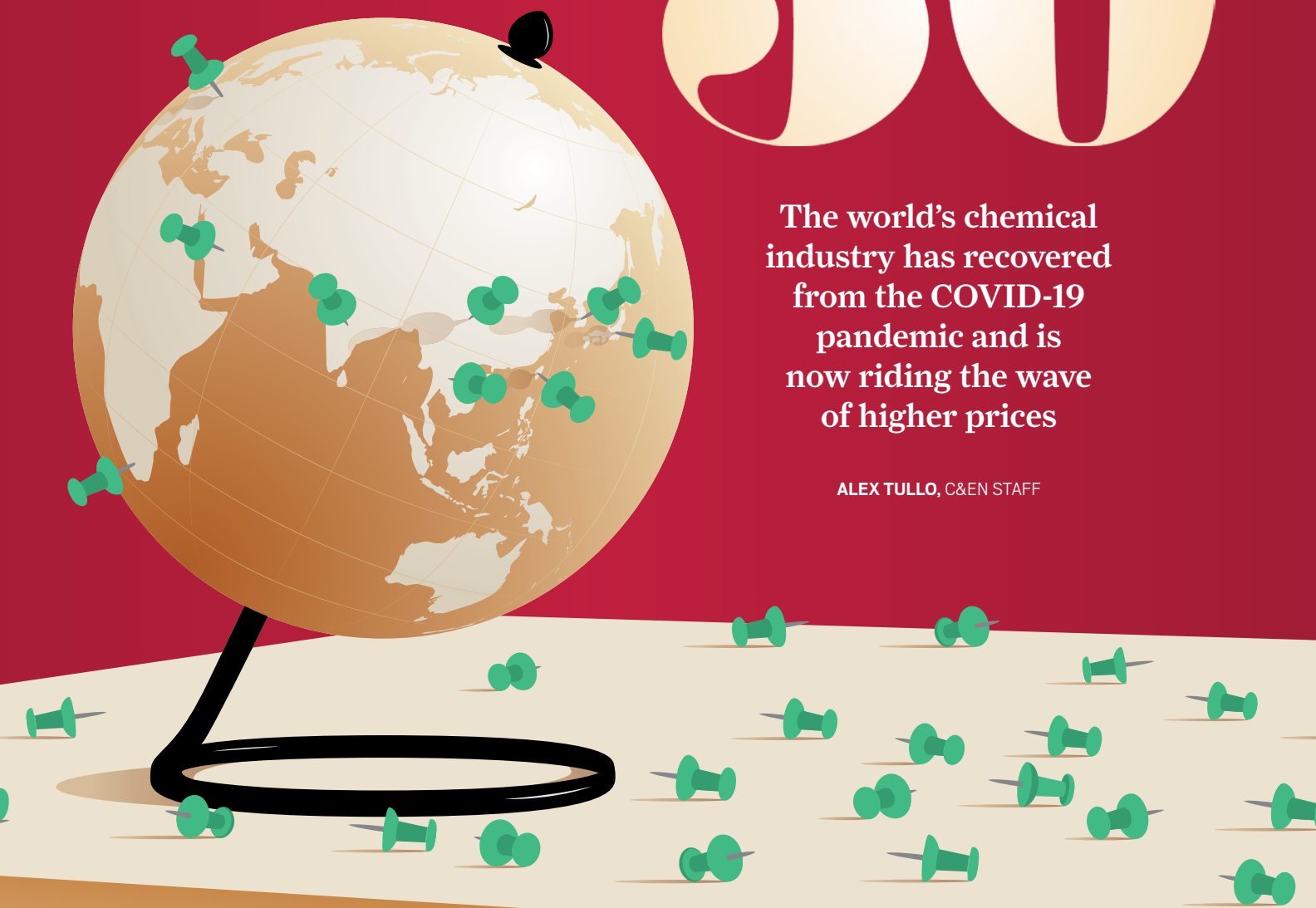


c&en's GLOBAL TOP

50

The world's chemical industry has recovered from the COVID-19 pandemic and is now riding the wave of higher prices

ALEX TULLO, C&EN STAFF



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he world's chemical industry didn't just grow in 2021, it positively swelled.

According to C&EN's latest Global Top 50 survey, the world's 50 largest chemical companies, in aggregate, posted sales of \$1.1 trillion in 2021, the fiscal year that forms the basis of the ranking. That's a 38% increase over the combined total for the same 50 firms in 2020.

Profits more than kept up. Chemical operating income for the 41 firms that break out such numbers jumped 148% in 2021, hitting \$127 billion.

There are two big reasons for the spike in chemical sales and earnings in 2021. First, the world's economy sagged in 2020 on account of the COVID-19 pandemic. This downturn hit the chemical industry, albeit not as severely as it did industries like aerospace and automotive. The 50 firms that appeared a year ago in C&EN's survey posted a 7% decline in sales. And they posted earnings declines for the second year in a row. With the world economy recovering in 2021, it stands to reason that chemical sales recovered as well.

Also related to the spike is inflation, the likes of which some countries around the world haven't seen in decades. According to the Energy Information Administration, the US benchmark oil price rose from \$47.07 per barrel in December 2020 to \$71.69 a year later.

The chemical industry, most of which relies on oil as a raw material, responded by raising prices in kind. According to LyondellBasell Industries, US and European ethylene prices increased by 35% and 60%, respectively, in 2021, while polyethylene prices rose about 45%. Prices for ammonia more than doubled.

Thus, the healthiest sales increases seen in the Global Top 50 came from petrochemical companies. Sabic, Formosa Plastics, PetroChina, LyondellBasell Industries, and ExxonMobil Chemical all clocked in with sales increases of 40% or more. Also riding the crest of the commodity price wave are fertilizer makers such as Yara, Nutrien, and Mosaic, which posted astounding increases in sales.

A few companies in the 2021 ranking fell off in 2022 because they didn't have enough sales to make the cut. These are the US petrochemical maker Westlake, the US agricultural chemical producer Corteva Agriscience, and the Japanese chemical makers Tosoh and DIC.

Joining the ranking for the first time is EuroChem Group, one of the fertilizer makers that got a lift from higher commodity prices. It debuts at number 44. Thailand's PTT Global Chemical returns at 46 after a 1-year hiatus.

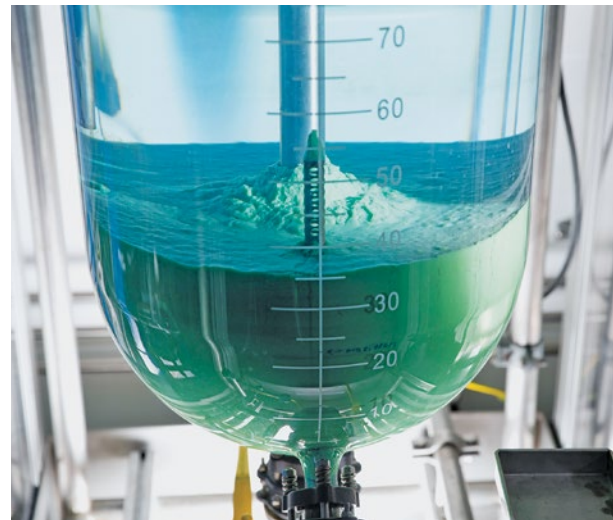
Two Chinese newcomers make the ranking: TongKun Group at 48 and Hengyi Petrochemical at 50. Both are polyester producers that make their own raw materials. Hengyi also has a large,

integrated nylon 6 business. Both companies join similar Chinese firms, like Hengli Petrochemical and Rongsheng Petrochemical. All these companies have been building massive complexes for aromatics and derivatives, in many cases swamping entire segments of the chemical industry—such as purified terephthalic acid—with new capacity that is well beyond the scale of players outside China.

1 BASF

2021 chemical sales: \$93.0 billion

For the third consecutive year, BASF heads the Global Top 50. Because it has a home base in Germany, the company was strongly impacted by Russia's invasion of Ukraine. BASF pledged in April to wind down operations in Russia and Belarus, which represent about 1% of its sales. The company says it will continue supplying agrochemicals to these countries to avoid disrupting the world's delicate food supply chain. BASF has also been affected by the severe increase in European natural gas prices that the war has exacerbated. In March, BASF chairman Martin Brudermüller told a Houston audience at the IHS Markit World Petrochemical Conference that "European industry really has to rethink" its strategy, given its dependence on natural gas from Russia. The war has also affected the company's Wintershall Dea energy joint



Mixed metal oxide cathode materials being prepared at BASF

CREDIT: WILL LUDWIG/C&EN/SHUTTERSTOCK

CREDIT: BASF

venture, which has extensive operations in Russia. During the first quarter, BASF took a \$1.2 billion write-off related to the cancellation of Nord Stream 2, a natural gas pipeline between Germany and Russia that Wintershall helped finance. BASF is also anticipating the coming energy transition. The company is carving out its emission catalyst business, which it acquired with its 2006 purchase of Engelhard. The move is a response to the dim outlook for internal combustion engine vehicles and could be a prelude to a sale. BASF has simultaneously been trying to grow as a producer of materials for electric vehicle batteries and aims to spend \$5 billion on production capacity outside Europe.

2 Sinopec

2021 chemical sales: \$65.8 billion

Once again, the blue-chip Chinese firm Sinopec is the second-largest chemical company in the world. Sinopec is working on an enormous lineup of capital expansions in China. Last year in Zhenhai, it started up an ethylene cracker project and began work on a propane dehydrogenation plant that it hopes to finish in 2024. The firm is building a cracker and derivatives project in Tianjin that it expects to complete next year and is bringing another one to completion in Hainan this year. Sinopec is also constructing a massive purified terephthalic acid complex in Yizheng. Like many energy and chemical firms, Sinopec has gotten into the act of carbon abatement. In Zibo earlier this year, it started up a carbon-capture-and-storage project that will handle 1 million metric tons of carbon dioxide annually.

3 Dow

2021 chemical sales: \$55.0 billion

In 2020, Dow revealed its aspiration to reach carbon emission neutrality by 2050, and at an investor event in October, it detailed its plans to get there. The company aims to spend \$1 billion per year, about a third of its capital budget, to decarbonize its petrochemical sites around the world one by one. Topping that list is Fort Saskatchewan, Alberta, where in an industry first, the company will build a carbon-neutral ethylene cracker. An autothermal reformer will process the cracker's off-gases to generate hydrogen that will be burned in the cracker's furnaces instead of natural gas. Dow will capture the resulting carbon dioxide and inject it into Alberta's CO₂ pipeline for sequestration. Dow's sustainability push extends beyond greenhouse gases and into plastic waste. At the October event, for example, the company said it would collaborate with Fuenix Ecology to build a waste plastics pyrolysis plant in the Netherlands.

4 Sabic

2021 chemical sales: \$43.2 billion

The Saudi giant Sabic has a large presence in Europe owing to its acquisition of petrochemical businesses from DSM and Huntsman more than a decade ago. And while the company gained a North American engineering polymer business in 2007 with the purchase of GE Plastics, a US toehold in petrochemicals has been more elusive. Sabic finally accomplished this long-term objective in January when its \$10 billion joint venture with ExxonMobil Chemical, Gulf Coast Growth Ventures,

started up near Corpus Christi, Texas. The venture produces ethylene and the derivatives polyethylene and ethylene glycol. The project is noteworthy because of how quickly it was erected: in just over 2 years. Some recent US petrochemical projects have experienced delays longer than that.

5 Formosa Plastics

2021 chemical sales: \$43.2 billion

Formosa Plastics' proposed \$9.4 billion petrochemical complex in St. James Parish, Louisiana, suffered a major setback last year when the US Army Corps of Engineers ordered a full environmental review. That process could take longer than 2 years, according to local activists. The massive project, which would include an ethylene cracker, polyethylene plants, and other facilities, was originally unveiled in 2015. While the complex would be an important diversification move for the Taiwan-based company, S&P Global Ratings noted in a report in October that Formosa's management could be reaching the end of its patience for delays and local opposition. "We see diminishing probability that the planned mega project in Louisiana will go ahead, given the changing political atmosphere in the U.S.," the credit rating agency wrote.

6 Ineos

2021 chemical sales: \$39.9 billion

Since its inception in the 1990s, Ineos has expanded by acquiring established divisions of large chemical companies. Most recently, in early 2021, it bought BP's aromatics business, a major producer of purified terephthalic acid, for \$5 billion. Since then, Ineos has been focusing on sustainability. In September, it announced a \$1.3 billion plan to reduce carbon dioxide emissions by 60% at its Grangemouth, Scotland, petrochemical complex by 2030. It will do so by capturing the greenhouse gas and sending it to the proposed Acorn CO₂ system, which aims to inject it under the North Sea. In October, Ineos said it plans to spend \$2.3 billion on green hydrogen projects. It will construct a 20 MW electrolyzer, powered by alternative energy, in Rafnes, Norway. And in Cologne, Germany, Ineos wants to build a 100 MW electrolyzer that will make hydrogen for green ammonia. Separately, Ineos is installing a unit in Cologne to extract acetonitrile made during acrylonitrile production. Acetonitrile is a solvent used in butadiene extraction and in high-performance liquid chromatography. Its use is acutely growing as a solvent in the production of oligonucleotides for RNA vaccines.



Ineos is expanding poly(α -olefin) capacity at this facility in La Porte, Texas.

CREDIT: INEOS

Global Top 50

Chemical sales and profits swelled for nearly every company in 2021.

RANK		COMPANY	CHEMICAL SALES (\$ MILLIONS)	CHANGE FROM 2020	CHEMICAL SALES AS % OF TOTAL SALES	SECTOR	CHEMICAL OPERATING PROFIT ^b (\$ MILLIONS)	CHANGE FROM 2020	CHEMICAL OPERATING MARGIN ^c	HEADQUARTERS	IDENTIFIABLE CHEMICAL ASSETS (\$ MILLIONS)	OPERATING RETURN ON CHEMICAL ASSETS ^d
2021	2020 ^a											
1	1	BASF	\$92,982	32.9%	100.0%	Diversified	\$9,179	80.5%	9.9%	Germany	\$103,375	8.9%
2	2	Sinopec	65,848	31.9	15.9	Petrochemicals	1,761	9.5	2.7	China	34,539	5.1
3	3	Dow	54,968	42.6	100.0	Diversified	7,887	208.6	14.3	US	62,990	12.5
4	5	Sabic	43,230	50.1	92.7	Petrochemicals	8,779	445.8	20.3	Saudi Arabia	79,919	11.0
5	4	Formosa Plastics ^e	43,173	47.8	72.2	Petrochemicals	n/a	n/a	n/a	Taiwan	n/a	n/a
6	16	Ineos	39,937	121.2	100.0	Diversified	5,370	344.2	13.4	UK	37,226	14.4
7	6	PetroChina	39,693	41.7	9.8	Petrochemicals	1,862	9.5	4.7	China	n/a	n/a
8	11	LyondellBasell Industries	38,995	66.6	84.5	Petrochemicals	8,009	172.6	20.5	US	n/a	n/a
9	7	LG Chem	37,257	41.8	100.0	Diversified	4,389	179.5	11.8	South Korea	44,664	9.8
10	12	ExxonMobil	36,858	59.6	13.3	Petrochemicals	9,960	272.3	27.0	US	39,722	25.1
11	8	Mitsubishi Chemical Group	30,719	24.8	84.8	Diversified	2,547	74.3	8.3	Japan	43,120	5.9
12	13	Hengli Petrochemical ^f	27,961	31.9	91.1	Petrochemicals	n/a	n/a	n/a	China	n/a	n/a
13	9	Linde	27,926	14.5	90.7	Industrial gases	6,703	25.0	24.0	UK	n/a	n/a
14	10	Air Liquide	27,148	13.4	98.3	Industrial gases	2,779	16.3	10.2	France	50,645	5.5
15	14	Syngenta Group	24,900	20.9	81.1	Agricultural chemicals	n/a	n/a	n/a	Switzerland	n/a	n/a
16	20	Reliance Industries ^g	22,583	65.6	21.1	Petrochemicals	n/a	n/a	n/a	India	n/a	n/a
17	27	Wanhua Chemical	22,561	98.2	100.0	Diversified	4,978	142.1	22.1	China	29,502	16.9
18	29	Braskem	19,575	80.4	100.0	Petrochemicals	5,038	278.0	25.7	Brazil	17,155	29.4
19	17	Sumitomo Chemical	19,176	24.7	76.2	Diversified	1,581	118.3	8.2	Japan	23,747	6.7
20	21	Shin-Etsu Chemical ^f	18,885	38.6	100.0	Diversified	6,157	72.4	32.6	Japan	36,901	16.7
21	22	Covestro	18,813	48.5	100.0	Diversified	2,655	206.6	14.1	Germany	18,421	14.4
22	18	Toray Industries	17,856	20.9	88.0	Diversified	1,227	40.3	6.9	Japan	n/a	n/a
23	19	Evonik Industries	17,692	22.6	100.0	Specialty chemicals	1,541	39.7	8.7	Germany	26,362	5.8
24	23	Shell	16,993	45.0	6.5	Petrochemicals	1,390	72.0	8.2	UK	n/a	n/a
25	15	DuPont	16,653	-18.4	100.0	Specialty chemicals	2,652	59.7	15.9	US	45,707	5.8
26	25	Yara	16,617	43.4	100.0	Fertilizers	1,068	-9.2	6.4	Norway	17,272	6.2
27	34	Rongsheng Petrochemical	16,001	59.6	58.3	Petrochemicals	n/a	n/a	n/a	China	n/a	n/a
28	31	Lotte Chemical	15,827	48.2	100.0	Diversified	1,341	330.3	8.5	South Korea	19,976	6.7
29	28	Mitsui Chemicals	14,681	33.1	100.0	Diversified	1,269	70.3	8.6	Japan	17,615	7.2
30	32	Indorama Ventures	14,626	41.2	100.0	Petrochemicals	1,315	339.6	9.0	Thailand	16,929	7.8
31	42	Chevron Phillips Chemical	14,104	67.1	100.0	Petrochemicals	n/a	n/a	n/a	US	17,777	n/a
32	33	Umicore	13,567	34.4	47.7	Specialty chemicals	542	104.3	4.0	Belgium	9,134	5.9
33	26	Solvay	13,527	17.7	100.0	Specialty chemicals	1,618	37.5	12.0	Belgium	23,718	6.8
34	24	Bayer	12,743	9.7	24.4	Agricultural chemicals	n/a	n/a	n/a	Germany	n/a	n/a
35	40	Mosaic	12,357	42.3	100.0	Fertilizers	2,770	299.5	22.4	US	22,036	12.6
36	46	Nutrien	11,590	62.0	41.8	Fertilizers	4,825	242.9	41.6	Canada	25,940	18.6
37	36	Arkema	11,261	20.7	100.0	Specialty chemicals	1,320	98.6	11.7	France	14,552	9.1
38	37	Asahi Kasei	10,908	20.9	48.7	Specialty chemicals	1,004	65.9	9.2	Japan	16,214	6.2
39	35	DSM	10,888	13.5	100.0	Specialty chemicals	1,247	38.7	11.5	Netherlands	18,944	6.6
39	38	Hanwha Solutions ^f	10,888	22.8	86.6	Specialty chemicals	541	12.3	5.0	South Korea	17,465	3.1
41	41	Eastman Chemical	10,476	23.6	100.0	Specialty chemicals	1,451	32.5	13.9	US	15,519	9.3
42	30	Johnson Matthey	10,412	-2.5	47.2	Specialty chemicals	387	-9.1	3.7	UK	3,204	12.1
43	39	Air Products	10,323	16.6	100.0	Industrial gases	2,215	3.6	21.5	US	26,859	8.2
44	—	EuroChem Group	10,202	65.8	100.0	Fertilizers	3,400	170.9	33.3	Switzerland	14,269	23.8
45	44	Borealis	10,164	26.0	100.0	Petrochemicals	1,668	435.9	16.4	Austria	15,361	10.9
46	—	PTT Global Chemical	9,084	52.1	62.0	Diversified	1,140	483.3	12.5	Thailand	16,521	6.9
47	43	Sasol	9,011	10.8	65.9	Diversified	1,337	n.m.	14.8	South Africa	n/a	n/a
48	—	TongKun Group ^f	8,996	28.4	100.0	Petrochemicals	n/a	n/a	n/a	China	n/a	n/a
49	45	Lanxess	8,940	23.8	100.0	Specialty chemicals	562	16.4	6.3	Germany	12,443	4.5
50	—	Hengyi Petrochemical	8,858	66.8	44.3	Diversified	n/a	n/a	n/a	China	n/a	n/a

Sources: Company documents, C&EN analysis. **Note:** Some figures converted at 2021 average exchange rates of US\$1.00= 5.3958 Brazilian reais, 6.4508 Chinese yuan, 0.8453 euros, 73.9351 Indian rupees, 109.8429 Japanese yen, 1144.8911 South Korean won, 3.75 Saudi riyals, 14.7751 South African rand, 27.9366 New Taiwan dollars, and 32.0052 Thai baht. *n/a* means not available, and *n.m.* means not meaningful. **a** Prior-year rankings have been revised from the July 26, 2021, issue of C&EN to reflect restated results and changes in exchange rates. **b** Chemical sales less administrative expenses and cost of sales. **c** Chemical operating profit as a percentage of chemical sales. **d** Chemical operating profit as a percentage of identifiable chemical assets. **e** C&EN estimates. **f** Chemical sales include a significant amount of nonchemical products.

7 PetroChina

2021 chemical sales: \$39.7 billion

PetroChina heaped on the growth in 2021, expanding by 42% from 2020 as China's economy recovered from the effects of the COVID-19 pandemic. New projects in China will only further the company's expansion. This year, it is due to complete the \$10 billion Guangdong Petrochemical project. The massive effort includes a refinery, an aromatics unit, and an ethylene cracker. PetroChina has also finished work on an ethylene project in Tarim that will use domestically produced ethane as its feedstock. In Jieyang, an enormous \$1 billion acrylonitrile-butadiene-styrene plant with 600,000 metric tons per year of capacity is in the works.

commodity chemical business. It bought 50% stakes in ethylene complexes in the US and China. And according to newly surfaced government documents, it is considering building a high-density polyethylene plant in Corpus Christi, Texas.

9 LG Chem

2021 chemical sales: \$37.3 billion

LG Chem has been laying down big money on sustainable polymer and battery material projects. Last August, the company announced plans to invest \$2.3 billion through 2028 on sustainable material facilities in Seosan, South Korea. One of these units will make the compostable polymer poly(butylene adipate-co-terephthalate). With the agricultural giant ADM, LG aims

capture 10 million metric tons (t) per year of carbon dioxide generated in the hydrogen production process, reducing the site's carbon footprint by 30%. The project would connect to a massive carbon-capture-and-storage hub in the region that ExxonMobil is spearheading. Also in Baytown, the company is building a facility that will use new chemical technology to recycle waste plastics. It hopes to process 500,000 t of plastics annually around the world by 2026 and is also considering projects in Canada, the Netherlands, and Singapore.

11 Mitsubishi Chemical Group

2021 chemical sales: \$30.7 billion

Within a year of taking over the helm of Japan's largest chemical maker, CEO Jean-Marc Gilson, a veteran of Dow Corning and Roquette, launched a major restructuring initiative. Mitsubishi Chemical Group plans to carve out its petrochemical and coal-based chemical businesses as a separate company and then exit them by the end of its 2023 fiscal year. The units, which make olefins, polyolefins, and other bulk petrochemicals, generate about 20% of the company's sales. Mitsubishi Chemical Group wants to focus on more specialized areas, such as electronic materials and the life sciences.

12 Hengli Petrochemical

2021 chemical sales: \$28.0 billion

The expansion program at this Chinese firm is a good illustration of just how massively and systematically the Chinese petrochemical industry has been growing in recent years. For example, Hengli Petrochemical plans to bring on line 5 million metric tons (t) per year of capacity for the polyester raw material purified terephthalic acid (PTA) later this year in Huizhou, China. The company is building a 450,000 t plant to make poly(butylene adipate-co-terephthalate) (PBAT), which will consume some of the PTA as a raw material. Hengli is building a 300,000 t adipic acid unit, also to help feed PBAT production. And it is working on a big polyester fiber expansion and recently opened a large ethylene cracker.

13 Linde

2021 chemical sales: \$27.9 billion

Like its industrial gas rivals Air Liquide and Air Products, Linde is focused on carbon reduction. In May, the German firm and BP announced



8 LyondellBasell Industries

2021 chemical sales: \$39.0 billion

Some chemical companies have been ditching commodities to focus on specialties. LyondellBasell Industries is exiting refining so it can better home in on commodities. In April, the company said it would shutter its 100-year-old Houston refinery by the end of 2023. The refinery, part of LyondellBasell Industries since it spun off from Atlantic Richfield in 1989, has long been an issue for the company. It was a joint venture with the Venezuelan state oil company PDVSA for more than a decade before Lyondell bought out its partner for \$2.1 billion in 2006. Company officials say they may repurpose the property for sustainability projects such as a plastics pyrolysis plant. Meanwhile, LyondellBasell has been steadily growing its

to establish lactic acid and polylactic acid capacity in the US. And with the South Korean oil company GS Caltex, LG is planning large-scale fermentation of the acrylic acid raw material 3-hydroxypropionic acid. In battery materials, LG broke ground in January on a \$420 million plant in Gumi, South Korea, that will make cathode materials for electric vehicle batteries. It is also spending \$375 million to form a battery separator joint venture in Hungary with Japan's Toray Industries.

10 ExxonMobil

2021 chemical sales: \$36.9 billion

Over the past year, ExxonMobil has been advancing sustainability initiatives. In March, it unveiled plans to build a blue hydrogen facility at its refining and petrochemical complex in Baytown, Texas. The project would

that they would collaborate on a large carbon-capture-and-storage project on the Texas Gulf Coast. The firms aim to make blue hydrogen, produced by reforming natural gas and storing the by-product carbon dioxide. Linde will distribute this hydrogen to customers via its regional pipeline network. The firms aim to store some 15 million metric tons of CO₂ annually in underground formations. In Austria, Linde is building a plant to make green hydrogen—derived from water electrolysis powered by renewable energy—for sale to the semiconductor maker Infineon

Technologies. To help shore up helium supply, Linde is adding an extraction unit at a natural gas liquefaction plant in Texas. The project will increase the world's supply of helium by more than 3%.

14 Air Liquide

2021 chemical sales: \$27.1 billion

Late last year, the French industrial gas giant Air Liquide got into a business that is as high tech as a chemical business can get. It signed an agreement with the Canadian nuclear power

operator Laurentis Energy Partners to buy helium-3, a light isotope of helium formed via the β decay of the heavy hydrogen isotope tritium. Air Liquide will market 5,000–10,000 L of the ³He annually. The isotope is needed for quantum computing, which must operate at temperatures as close to absolute zero as possible. Conventional liquid ⁴He cooling can get down to 1–4 K, and getting below that requires mixing in some ³He. Separately, Air Liquide is building what it calls the world's largest biomethane plant, at a Chicago-area landfill. The industrial gas maker estimates that the collected methane could generate 380 GW h of energy annually. It is also building a methane recovery plant in Wisconsin.

Spending

Chemical capital spending and R&D budgets increased for most companies in 2021.

	CHEMICAL CAPITAL SPENDING			CHEMICAL R&D SPENDING		
	2021 (\$ MILLIONS)	CHANGE FROM 2020	% OF CHEMICAL SALES	2021 (\$ MILLIONS)	CHANGE FROM 2020	% OF CHEMICAL SALES
Air Liquide	\$3,396	8.8%	12.5%	\$360	0.3%	1.3%
Air Products	2,464	-1.8	23.9	94	11.4	0.9
Arkema	903	26.1	8.0	287	0.8	2.6
Asahi Kasei	1,099	20.2	10.1	308	2.7	2.8
BASF	4,178	12.9	4.5	2,622	6.2	2.8
Borealis	781	7.5	7.7	21	127.8	0.2
Braskem	634	24.0	3.2	55	18.4	0.3
Covestro	904	8.5	4.8	403	30.2	2.1
Dow	1,501	19.9	2.7	857	11.6	1.6
DSM	512	-5.5	4.7	382	-18.8	3.5
DuPont	891	-25.4	5.4	618	-28.1	3.7
Eastman Chemical	555	44.9	5.3	254	12.4	2.4
EuroChem Group	1,247	6.8	12.2	n/a	n/a	n/a
Evonik Industries	1,023	-9.5	5.8	549	7.2	3.1
ExxonMobil	1,287	-29.0	3.5	n/a	n/a	n/a
Hanwha Solutions	609	29.8	5.6	47	-25.6	0.4
Indorama Ventures	624	19.0	4.3	21	12.2	0.1
Ineos	1,845	-7.0	4.6	92	63.4	0.2
Johnson Matthey	383	19.8	3.7	277	3.6	2.7
Lanxess	567	5.0	6.3	136	6.5	1.5
LG Chem	5,043	4.3	13.5	1,186	21.6	3.2
Linde	3,149	-8.9	11.3	n/a	n/a	n/a
Lotte Chemical	675	-3.6	4.3	81	15.5	0.5
LyondellBasell Industries	1,856	5.3	4.8	124	9.7	0.3
Mitsubishi Chemical Group	1,863	-12.0	6.1	n/a	n/a	n/a
Mitsui Chemicals	975	42.9	6.6	347	12.7	2.4
Mosaic	1,289	10.1	10.4	n/a	n/a	n/a
Sabco	3,083	-12.0	7.1	n/a	n/a	n/a
Shell	3,573	35.3	21.0	106	-2.8	0.6
Shin-Etsu Chemical	1,782	-17.1	9.4	568	21.9	3.0
Sinopec	8,006	97.1	12.2	n/a	n/a	n/a
Solvay	664	23.6	4.9	384	8.3	2.8
Sumitomo Chemical	778	19.7	4.1	n/a	n/a	n/a
Umicore	342	-8.5	2.5	243	4.1	1.8
Wanhua Chemical	n/a	n/a	n/a	491	55.1	2.2
Yara	809	9.5	4.9	94	3.3	0.6

Sources: Company documents, C&EN analysis. Note: Figures are for companies on the top 50 list reporting capital and/or R&D expenditures. n/a means not available.

15 Syngenta Group

2021 chemical sales: \$24.9 billion

The Chinese conglomerate ChemChina bought the Swiss agrochemical maker Syngenta in 2017 and later pursued a merger with another big Chinese industrial giant, Sinochem. Now Syngenta Group operates under the Sinochem umbrella. As it did when it was independent, Syngenta emphasizes technology. It is collaborating with Enko Chem, a start-up that applies drug discovery methods to agricultural applications. For instance, the partners will screen molecular libraries for compounds that act against specific enzymes in pests. They hope to halve the time to bring new molecules to market—which can now take a decade. Syngenta also recently bought two biopesticides from the Welsh firm Bionema. In the deal, it acquired nematodes that kill leatherjackets and a pathogenic fungus that kills vine weevils.

16 Reliance Industries

2021 chemical sales: \$22.6 billion

The Indian conglomerate has abandoned plans to put its refining and chemical operations—which it calls Oil to Chemicals—into a stand-alone business. It also walked away from negotiations with Saudi Aramco to sell a 20% stake in the business for \$15 billion. Instead, Reliance Industries is undertaking what may turn out to be an even bigger change in direction. Last year, it announced an ambitious goal to achieve net-zero carbon emissions by 2035. Reliance is setting aside 2,000 hectares of land at its massive Jamnagar refinery and petrochemical complex for factories that would make photovoltaic modules, batteries, electrolyzers, and fuel cells. Along these lines, Reliance bought

Faradion, a British sodium-ion battery start-up, for \$135 million. It will spend another \$35 million to bring the new battery chemistry to market. It also purchased the Norwegian solar cell maker REC Group for \$771 million.

17 Wanhua Chemical

2021 chemical sales: \$22.6 billion

The Chinese polyurethane and petrochemical maker has been rocketing up the Global Top 50 because of its prodigious growth in recent years. And 2021 was another enormous year for Wanhua Chemical—its revenues nearly doubled from 2020. Ambitious capital expansion projects have helped fuel the growth. In Yantai, China, it opened an ethylene cracker and derivatives plants and revamped methylene diphenyl diisocyanate production. In April, the company announced it would spend \$3.6 billion to build a chemical complex in Penglai, China. The project, to be completed in 2024, will feature a propane dehydrogenation unit as well as downstream plants for polypropylene, propylene oxide, and other chemicals. The company also started producing cathode materials and the biodegradable polymer poly(butylene adipate-co-terephthalate).

18 Braskem

2021 chemical sales: \$19.6 billion

It is possible that Braskem could change hands in the near future. Novonor, the

Brazilian conglomerate formerly known as Odebrecht, is facing hefty fines because of a Brazilian corruption scandal. The US Department of Justice alone is demanding \$2.6 billion from the company. As a consequence, Novonor has been looking to sell its 38% interest in Braskem, which includes control of more than 50% of Braskem's common stock. Sale talks are nothing new for Braskem. The company discussed a sale to LyondellBasell Industries in 2018 and 2019, but nothing came of the negotiations. In 2020, Novonor and Braskem's other major shareholder, the Brazilian state oil company Petrobras, planned to float Braskem shares on public markets. That plan was shelved earlier this year because of financial market volatility. And in April, the private equity firm Apollo Capital was rumored to be bidding for Novonor's stake.

19 Sumitomo Chemical

2021 chemical sales: \$19.2 billion

The Japanese chemical maker Sumitomo Chemical is undertaking a round of downsizing. It will close its caprolactam plant in Ehime, Japan, by October, ending production of the nylon 6 raw material after more than 50 years because of difficulties staying competitive against new production in China. Indeed, Chinese chemical makers have been growing prodigiously in a number of aromatic chemicals, an alarming trend for incumbents in these businesses. Sumitomo is also closing its dyestuff plant in Osaka, Japan, after more than 70 years in business. Sumitomo is

finding areas with brighter futures to invest in. It is building semiconductor chemical and liquid-crystal polymer plants in Ehime and adding photoresist capacity in Japan and South Korea.

20 Shin-Etsu Chemical

2021 chemical sales: \$18.9 billion

Shin-Etsu Chemical is coming off of a prosperous year. The company saw its revenues jump by 39% and its profits swell by 72%. A bright spot was its polyvinyl chloride business, which saw profits triple. Also, Shin-Etsu's semiconductor material business has been trying to ship as much product as it can to help address a worldwide chip shortage. In an expansion move, Shin-Etsu will spend close to \$700 million to raise output of silicone fluids, resins, and rubber at three plants in Japan.

21 Covestro

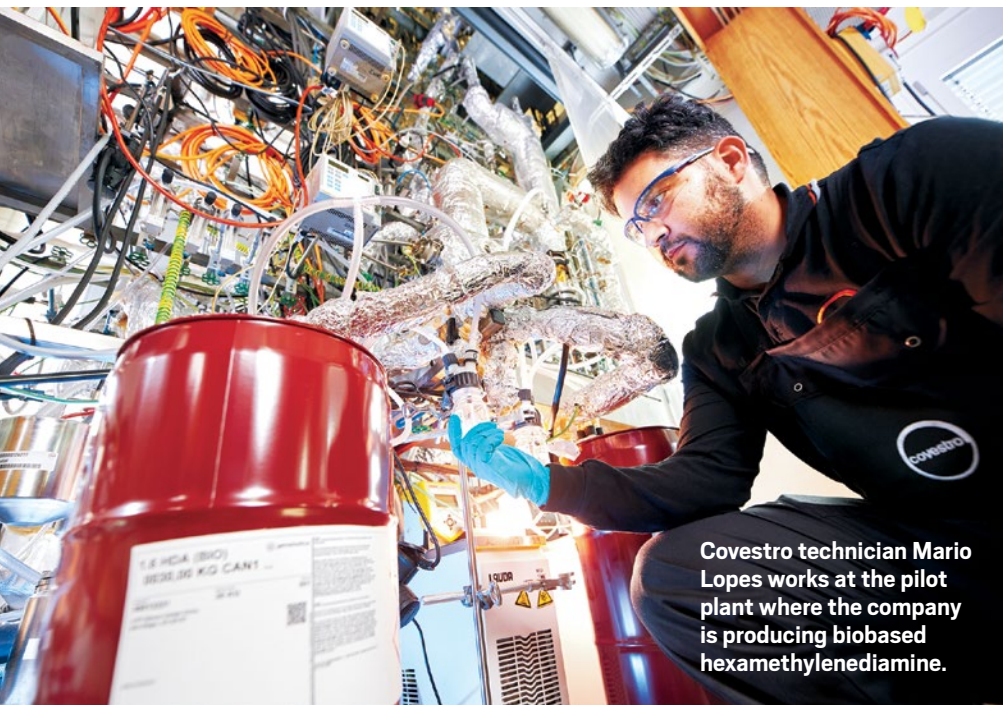
2021 chemical sales: \$18.8 billion

The polyurethane specialist Covestro unveiled a plan late last year to cut up to 1,700 jobs—about 10% of its workforce—by the end of 2023. Most of the cuts will be in Germany. At the same time, the company is resuscitating a plan to build a world-scale methylene diphenyl diisocyanate plant by 2026. While the previous plan pinpointed Texas as the site of the complex, Covestro now says it may build it in either the US or China. The company is also increasing capacity for another polyurethane raw material, toluene diisocyanate, in Dormagen, Germany. And with the biotechnology firm Genomatica, Covestro plans to make biobased hexamethylenediamine, used in the manufacture of polyurethanes and nylon 6,6.

22 Toray Industries

2021 chemical sales: \$17.9 billion

The past year has seen a number of sustainable business initiatives at Toray Industries. The company has launched nylon 5,10 fibers, made from castor oil-derived sebacic acid and corn-based pentamethylenediamine. It hopes to start selling the biobased fibers into textile markets next year. In a recycling push, Toray and the engineering firm Axens are studying a polyethylene terephthalate (PET) depolymerization plant for France. The plant would break down 80,000 metric tons per year of PET into the precursor bis(2-hydroxyethyl) terephthalate. Toray also established a joint venture for lithium-ion battery separator films in Hungary with LG Chem.



Covestro technician Mario Lopes works at the pilot plant where the company is producing biobased hexamethylenediamine.

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23 Evonik Industries

2021 chemical sales: \$17.7 billion

Evonik Industries is yet another major chemical maker planning a portfolio transformation. The German company intends to divest its performance material businesses by the end of 2023. These commodities, such as C₄ chemicals, isononyl alcohol, and superabsorbent polymers, generate about 20% of the firm's sales. Evonik had been considering a sale of superabsorbents—used in diapers and similar applications—since late 2020. At the same time, the firm plans to invest \$3.2 billion in sustainable businesses. Separately, in June, Evonik announced it would build a \$220 million plant in Lafayette, Indiana, for lipids used in messenger RNA applications like COVID-19 vaccines. The company has been supplying this burgeoning market from facilities in Germany. Evonik is also building a plant to make rhamnolipids, a class of biobased surfactants, in Slovakia.

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24 Shell

2021 chemical sales: \$17.0 billion

Later this year, Shell will open an ethylene and polyethylene complex in Monaca, Pennsylvania. The facility was the only one among a wave of new US ethylene crackers to be situated far from the Gulf Coast. The project took a long time. It was announced a decade ago, and construction began in 2017. It may be Shell's last conventional ethylene project for a while. The company is collaborating with Dow to electrify the steam cracking process. The partners recently started an experimental unit in Amsterdam to test designs that could replace current natural gas-fired cracker furnaces. They want to build a large pilot plant by 2025. And at a recent conference, Shell officials said the company is running feedstocks based on biomass and plastic pyrolysis oil through its ethylene complex in Norco, Louisiana. The company intends to process

180,000 metric tons (t) of the alternative feedstocks by 2023 and to ramp up use to 600,000 t in 3–5 years.

25 DuPont

2021 chemical sales: \$16.7 billion

Edward D. Breen took over as DuPont's CEO in October 2015, and since then the company has seen relentless portfolio restructuring. After only a few months on the job, Breen announced a merger with Dow. The resulting company split into the three firms—DuPont, Dow, and Corteva Agriscience—in 2019. Breen wasn't finished, though. Last year, DuPont merged its nutrition and biosciences business with International Flavors & Fragrances. In another big transaction, it agreed in February to sell its engineering polymer business to Celanese for \$11 billion. Meanwhile, DuPont has been bulking up in electronic materials, a business that Breen had previously been on the fence about. Late last year, DuPont agreed to purchase Rogers, a firm that makes laminates for circuit boards, for \$5.2 billion. In July 2021, DuPont bought Laird Performance Materials, which makes heat and electric shielding. ■



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