



# ROSS CONSULTING

Mineral Rights & Mining Property

Bradley D. Ross, CPG

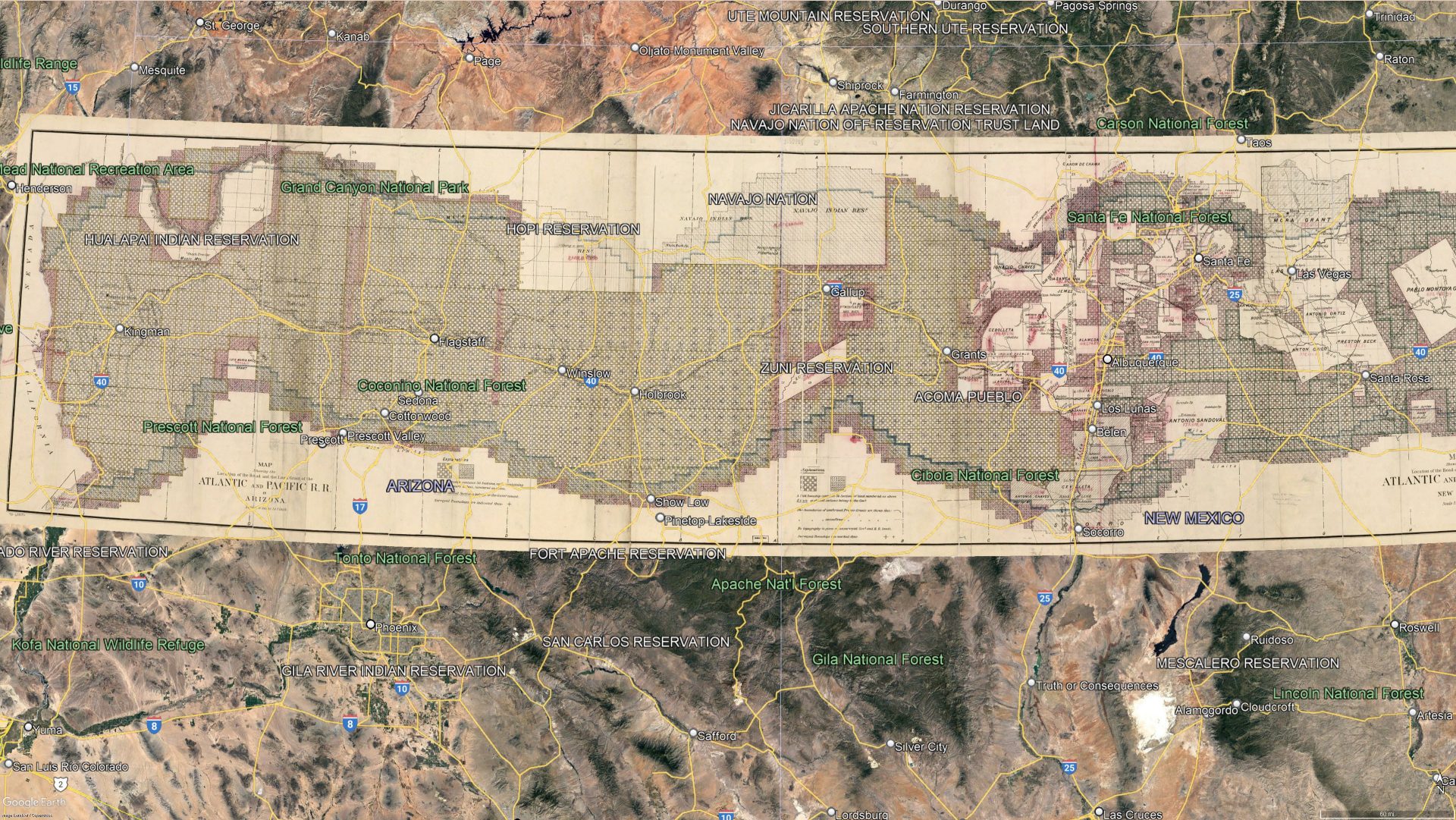
[www.mineralappraisal.com](http://www.mineralappraisal.com)

602-369-6437

[rossconsulting@gmail.com](mailto:rossconsulting@gmail.com)

## Mineral Rights

- **The United States is the only country in the world that allows private ownership of mineral rights.**
- **All land in the United States has a mineral right component, which is either owned privately or by a government entity.**
- **A value for fee simple land also includes a value of the mineral rights.**



MAP of the Navajo and Hopi Tribes of the ARIZONA and NEW MEXICO TERRITORIES

ARIZONA

NEW MEXICO

NAVAJO NATION

HOPi RESERVATION

ZUNI RESERVATION

Coconino National Forest

Prescott National Forest

Santa Fe National Forest

Cibola National Forest

ACOMA PUEBLO

ATLANTIC AND PACIFIC R.R.

Wildlife Range

Grand Canyon National Park

UTE MOUNTAIN RESERVATION SOUTHERN UTE RESERVATION

JICARILLA APACHE NATION RESERVATION NAVAJO NATION OFF-RESERVATION TRUST LAND

Carson National Forest

Tonto National Forest

FORT APACHE RESERVATION

Apache Nat'l Forest

Gila National Forest

Kofa National Wildlife Refuge

GILA RIVER INDIAN RESERVATION

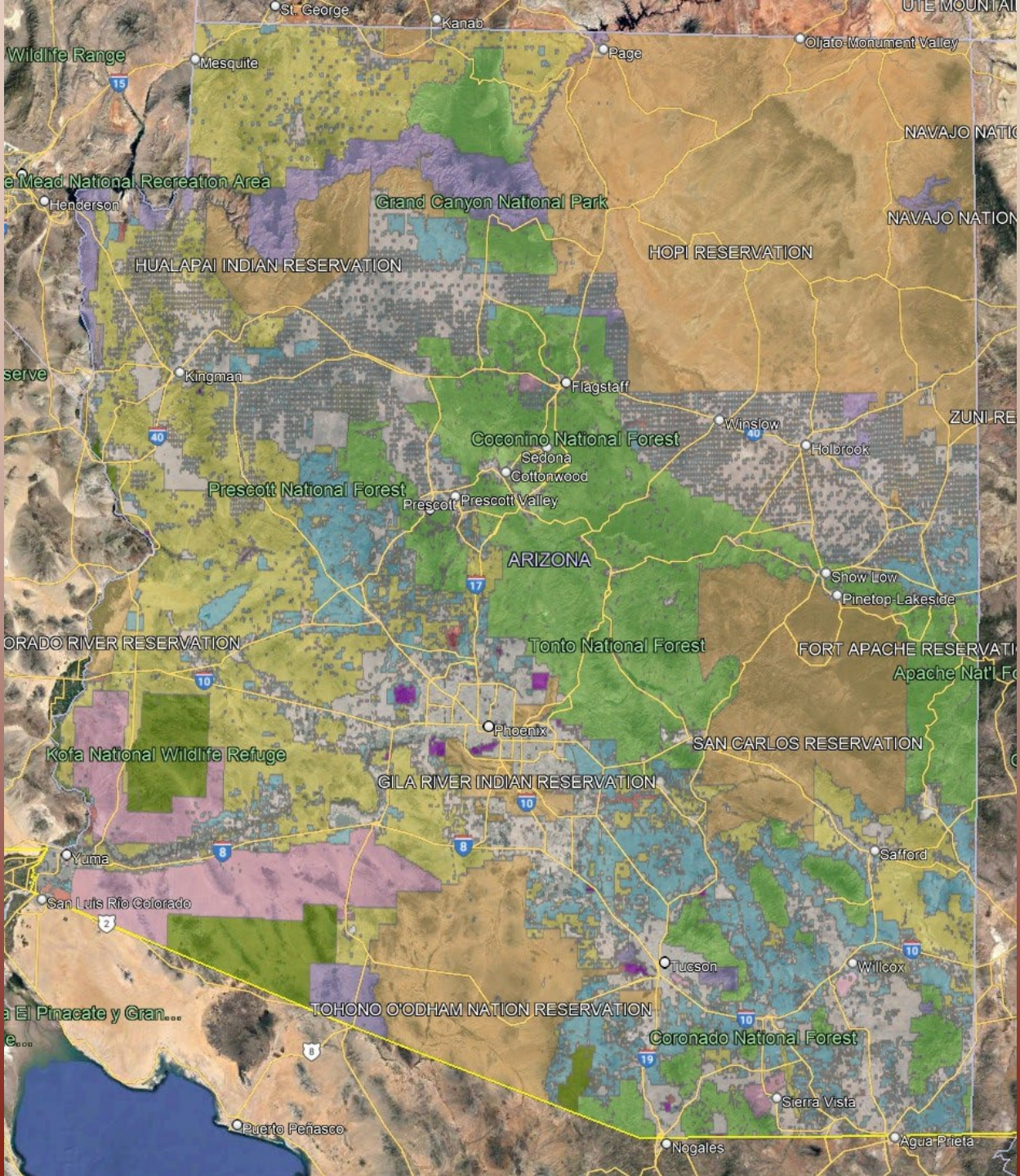
SAN CARLOS RESERVATION

MESCALERO RESERVATION

Lincoln National Forest

Google Earth

60 mi



## Links to Land Use Maps

- [gis.azland.gov/webapps/parcel/](http://gis.azland.gov/webapps/parcel/)
- [land.az.gov/sites/default/files/media/state.pdf](http://land.az.gov/sites/default/files/media/state.pdf)

## Useful Mining and Geology Sites

- [www.mindat.org](http://www.mindat.org)
- [arcg.is/1eKKz11](http://arcg.is/1eKKz11)
- [mrdata.usgs.gov/deposit/](http://mrdata.usgs.gov/deposit/)
- [ngmdb.usgs.gov/mapview/](http://ngmdb.usgs.gov/mapview/)

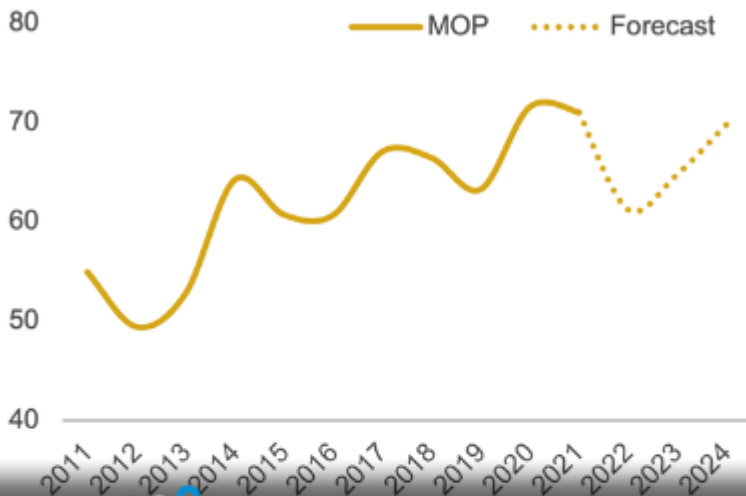


By [Russ Quinn](#), DTN Staff Reporter

Connect with Russ:

[@RussQuinnDTN](#)

Global MOP demand, Mt product



DTN

Global Fertilizer Outlook - 3

Supply concerns with the war in Ukraine and fertilizer price affordability pushed potash demand lower in 2022 and this downward trend is expected to remain in place in 2023. (CRU Graphic)

OMAHA (DTN) -- The global potash (K) outlook in 2023 looks to be a bit of a mixed bag. The entire world fertilizer industry continues to watch closely the continuing war between Ukraine and Russia which could disrupt supply. Russia and Belarus account for 41% of the globally traded K and are the second and third largest producers.

Because of record-high fertilizer prices, farmers across the world cut back on these nutrients which caused much demand to fall. With more supply on deck in 2023, potash prices should push lower in the New Year.

### LOWER K PRICES?

Chris Lawson, head of fertilizers for CRU International Ltd., told DTN that much demand destruction has been done to the K market in 2022. It was thought when the war began in February 2022 that this was going to limit the supply of potash, as so much comes from the Black Sea region -- so prices increased significantly.

However, the largest K producer in the world, Canada, responded with increased production. This increased Canadian production has helped to alleviate possible supply concerns, even with about 10 million metric tons annually from Russia and Belarus, he said.

# HOW MICHIGAN POTASH & SALT COMPANY WILL HELP

Michigan could be the nation's leading source for a critical agricultural resource that is also in demand internationally. Potash is an essential plant nutrient and critical ingredient in fertilizer for the economy's agricultural industry. Currently supplies are running out and there is no known substitute for potash. The U.S. is 95% import reliant, as potash is only found in a few places in the world.

Ted Pagano of Michigan Potash estimates an initial demand for more than 300 workers employed in an enterprise that will produce more than a million tons of potash annually. "It's our responsibility to develop this wisely and in a way that moves Michigan forward," Pagano says. Bringing Michigan potash to market, Pagano says, will provide a domestic source of the element at reduced cost to Midwest farmers as well as to the national agriculture industry. It will reduce imports, improve the nation's trade balance, create jobs and increase the state's tax base.



OMAHA (DTN) -- The many issues facing the global nitrogen market in 2022 are going to continue to test the market in 2023. These include the war in Ukraine, rising natural gas prices, weather and currency concerns.

As a result, the supply and price of nitrogen fertilizers will be subject to the various geopolitical world events. Nitrogen prices are already at high levels and fertilizer analysts don't believe prices will decline any time soon.

Director of Fertilizer for StoneX Josh Linville said nitrogen fertilizer prices in the first quarter of 2023 could be higher for some forms, such as urea. Other forms, such as UAN and anhydrous ammonia, could see steady to higher prices to start the year.

"Fertilizer prices are already high, so prices that even stay fairly steady is not good news for farmers," Linville noted.

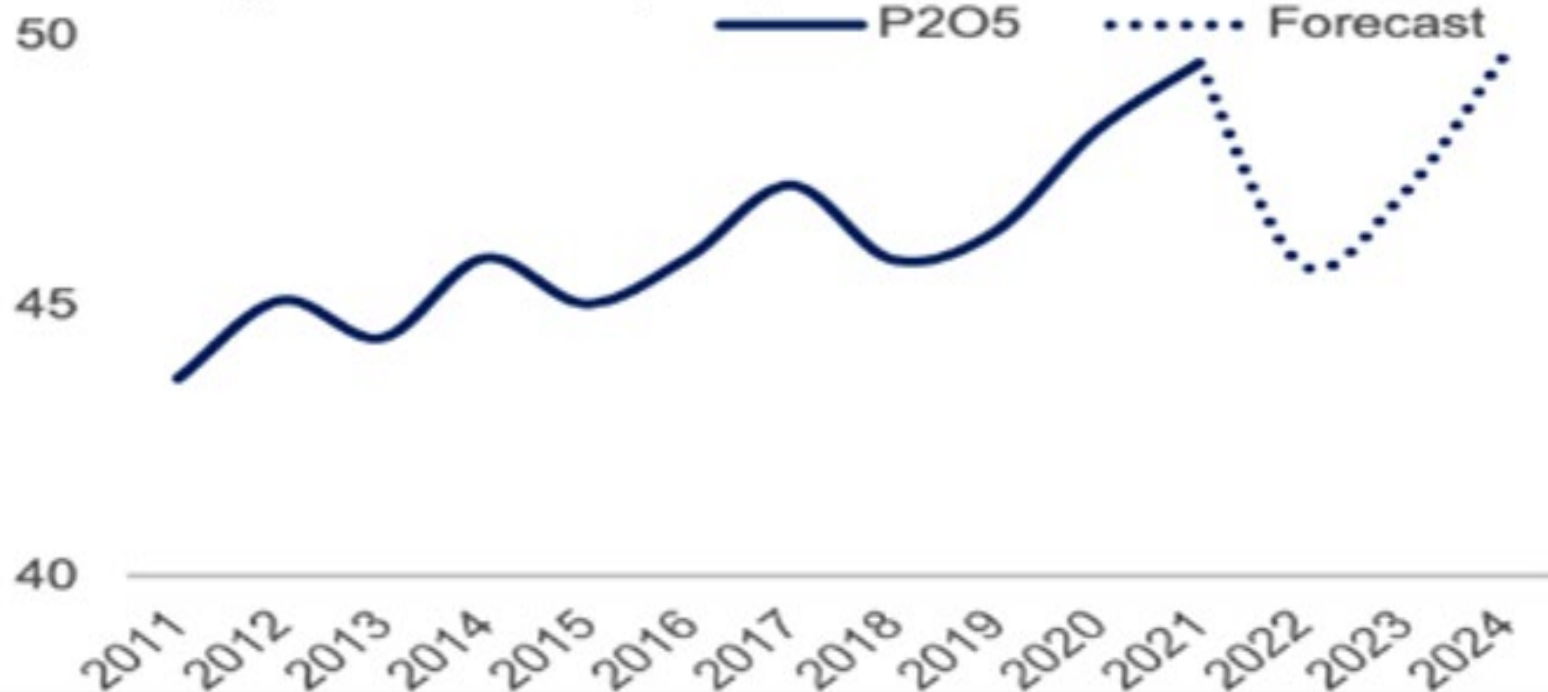
Samuel Taylor, inputs analyst for Rabobank Research, said with so much volatility in the nitrogen market worldwide there is very little chance prices will move lower in 2023. The first part of the year, prices could see some pick up, while some flatness could occur in nitrogen prices in the late quarters of the year, he said.

The issue with supply in nitrogen is not going away any time soon and thus this will continue to inflate prices, he said.

"There just is so much volatility in the nitrogen market as we head into 2023," Taylor said.



### Global ag P2O5 consumption, Mt



## Global Fertilizer Outlook - 2

Demand destruction from record high phosphorus fertilizer prices was seen across the globe in 2022. Demand should rebound in 2023 and 2024, depending on fertilizer affordability. (CRU Graphic)

## PHOSPHATE ROCK

(Data in thousand metric tons unless otherwise noted)

**Domestic Production and Use:** In 2022, phosphate rock ore was mined by five companies at nine mines in four States and processed into an estimated 21 million tons of marketable product, valued at \$1.9 billion, free on board (f.o.b.) mine. Florida and North Carolina accounted for more than 75% of total domestic output; the remainder was produced in Idaho and Utah. Marketable product refers to beneficiated phosphate rock with phosphorus pentoxide (P<sub>2</sub>O<sub>5</sub>) content suitable for phosphoric acid or elemental phosphorus production. More than 95% of the phosphate rock mined in the United States was used to manufacture wet-process phosphoric acid and superphosphoric acid, which were used as intermediate feedstocks in the manufacture of granular and liquid ammonium phosphate fertilizers and animal feed supplements. About 25% of the wet-process phosphoric acid produced was exported in the form of upgraded granular diammonium phosphate (DAP) and monoammonium phosphate (MAP) fertilizer and merchant-grade phosphoric acid. The balance of the phosphate rock mined was for the manufacture of elemental phosphorus, which was used to produce phosphorus compounds for industrial applications, primarily glyphosate herbicide.

<b>Salient Statistics—United States:</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022*</b>
Production, marketable	25,800	23,300	23,500	21,600	21,000
Sold or used by producers	23,300	23,400	22,600	21,900	21,000
Imports for consumption	2,770	2,140	2,520	2,460	2,400
Consumption, apparent <sup>1</sup>	26,000	25,500	25,100	24,400	24,000
Price, average value, f.o.b. mine, <sup>2</sup> dollars per metric ton	70.80	68.00	75.90	83.10	90
Stocks, producer, yearend	10,600	9,830	11,000	10,700	10,000
Employment, mine and beneficiation plant, number <sup>e</sup>	1,900	1,900	1,800	2,000	2,000
Net import reliance <sup>3</sup> as a percentage of apparent consumption	2	11	5	11	12

**Recycling:** None.

**Import Sources (2018–21):** Peru, 95%; and Morocco, 5%.

<b>Tariff:</b>	<b>Item</b>	<b>Number</b>	<b>Normal Trade Relations 12–31–22</b>
	Natural calcium phosphates:		
	Unground	2510.10.0000	Free.
	Ground	2510.20.0000	Free.

**Depletion Allowance:** 14% (domestic and foreign).

**Government Stockpile:** None.

**Events, Trends, and Issues:** Domestic production and consumption of phosphate rock were lower in 2022, owing to slightly lower production of elemental phosphorus and phosphoric acid. Domestic fertilizer production and consumption also were lower because of adverse weather conditions in some areas of the United States during the spring planting season, rail delays, high fertilizer costs, and hurricane damage to some production facilities. In Idaho, all three producers continued to develop new mines that will replace existing mines within the next decade.

World production of phosphate rock was estimated to have been slightly lower in 2022. The conflict between Russia and Ukraine caused some reduction of exports of phosphate rock and fertilizers from Russia. Although fertilizer materials were exempt from sanctions, some countries did not allow Russian ships in their ports.

In 2022, the global phosphate fertilizer market experienced supply disruptions, high fertilizer prices in the first half of the year, and lower consumption in some regions. The most significant supply disruption was from China placing restrictions on exports of DAP and MAP. This reduced Chinese exports by about 5 million tons. Other countries increased exports but were unable to compensate for the loss to the world market. Global consumption of P<sub>2</sub>O<sub>5</sub> contained in fertilizers was estimated to have decreased slightly to about 48 million tons in 2022.

## PHOSPHATE ROCK

**World Mine Production and Reserves:** Reserves for China and Tunisia were revised based on Government reports. Reserves for Israel were revised based on company reports.

	Mine production		Reserves <sup>4</sup>
	2021	2022 <sup>e</sup>	
United States	21,600	21,000	1,000,000
Algeria	<sup>e</sup> 1,400	1,800	2,200,000
Australia	<sup>e</sup> 2,500	2,500	<sup>5</sup> 1,100,000
Brazil	<sup>e</sup> 6,000	5,500	1,600,000
China <sup>6</sup>	<sup>e</sup> 90,000	85,000	1,900,000
Egypt	<sup>e</sup> 5,000	5,000	2,800,000
Finland	990	1,000	1,000,000
India	<sup>e</sup> 1,400	1,400	46,000
Israel	2,430	3,000	60,000
Jordan	10,000	10,000	1,000,000
Kazakhstan	<sup>e</sup> 1,500	1,500	260,000
Mexico	488	450	30,000
Morocco	38,100	40,000	50,000,000
Peru	4,200	4,200	210,000
Russia	<sup>e</sup> 14,000	13,000	600,000
Saudi Arabia	<sup>e</sup> 9,200	9,000	1,400,000
Senegal	<sup>e</sup> 2,100	2,600	50,000
South Africa	2,130	1,600	1,600,000
Togo	<sup>e</sup> 1,000	1,500	30,000
Tunisia	3,730	4,000	2,500,000
Turkey	<sup>e</sup> 600	800	50,000
Uzbekistan	<sup>e</sup> 900	900	100,000
Vietnam	<sup>e</sup> 4,500	4,500	30,000
Other countries	<u>1,950</u>	<u>1,600</u>	<u>2,600,000</u>
World total (rounded)	<u>226,000</u>	<u>220,000</u>	<u>72,000,000</u>

**World Resources:**<sup>4</sup> Some world reserves were reported only in terms of ore tonnage and grade. Phosphate rock resources occur principally as sedimentary marine phosphorites. The largest sedimentary deposits are found in northern Africa, the Middle East, China, and the United States. Significant igneous occurrences are found in Brazil, Canada, Finland, Russia, and South Africa. Large phosphate resources have been identified on the continental shelves and on seamounts in the Atlantic Ocean and the Pacific Ocean. World resources of phosphate rock are more than 300 billion tons. There are no imminent shortages of phosphate rock.

**Substitutes:** There are no substitutes for phosphorus in agriculture.

<sup>e</sup>Estimated.

<sup>1</sup>Defined as phosphate rock sold or used by producers + imports. U.S. producers stopped exporting phosphate rock in 2003.

<sup>2</sup>Marketable phosphate rock, weighted value, all grades.

<sup>3</sup>Defined as imports ± adjustments for industry stock changes.

<sup>4</sup>See Appendix C for resource and reserve definitions and information concerning data sources.

<sup>5</sup>For Australia, Joint Ore Reserves Committee-compliant or equivalent reserves were 124 million tons.

<sup>6</sup>Production data for large mines only, as reported by the National Bureau of Statistics of China.

## NITROGEN (FIXED)—AMMONIA

(Data in thousand metric tons contained nitrogen unless otherwise noted)

**Domestic Production and Use:** Ammonia was produced by 16 companies at 35 plants in 16 States in the United States during 2022; 2 additional plants were idle for the entire year. About 60% of total U.S. ammonia production capacity was in Louisiana, Oklahoma, and Texas because of their large reserves of natural gas, the dominant domestic feedstock for ammonia. In 2022, U.S. producers operated at about 86% of rated capacity. The United States was one of the world's leading producers and consumers of ammonia. Urea, ammonium nitrate, nitric acid, ammonium phosphates, and ammonium sulfate were, in descending order of quantity produced, the major derivatives of ammonia produced in the United States.

Approximately 88% of apparent domestic ammonia consumption was for fertilizer use, including anhydrous ammonia for direct application, urea, ammonium nitrates, ammonium phosphates, and other nitrogen compounds. Ammonia also was used to produce explosives, plastics, synthetic fibers and resins, and numerous other chemical compounds.

**Salient Statistics—United States:**

	2018	2019	2020	2021	2022 <sup>e</sup>
Production <sup>1</sup>	13,100	13,500	14,000	12,700	13,000
Imports for consumption	2,530	2,020	1,990	2,080	2,100
Exports	224	338	369	231	700
Consumption, apparent <sup>2</sup>	15,300	15,200	15,700	14,600	14,000
Stocks, producer, yearend	490	420	310	270	390
Price, average, free on board gulf coast, <sup>3</sup> dollars per short ton	281	232	213	578	1,100
Employment, plant, number <sup>6</sup>	1,600	1,600	1,600	1,600	1,600
Net import reliance <sup>4</sup> as a percentage of apparent consumption	14	11	11	13	9

**Recycling:** None.

**Import Sources (2018–21):** Trinidad and Tobago, 58%; Canada 40%; Venezuela, 1%; and other, 1%.

Tariff:	Item	Number	Normal Trade Relations 12–31–22
	Ammonia, anhydrous	2814.10.0000	Free.
	Urea	3102.10.0000	Free.
	Ammonium sulfate	3102.21.0000	Free.
	Ammonium nitrate	3102.30.0000	Free.

**Depletion Allowance:** Not applicable.

**Government Stockpile:** None.

**Events, Trends, and Issues:** The Henry Hub spot natural gas price ranged between \$3.58 and \$9.85 per million British thermal units for most of the year, with an average of about \$6.63 per million British thermal units. Natural gas prices in 2022 were higher than those in 2021—a result of below-average storage levels of natural gas and strong demand for U.S. liquefied natural gas. The Energy Information Administration, U.S. Department of Energy, projected that Henry Hub natural gas spot prices would average around \$6.00 per million British thermal units in 2023.

The weekly average gulf coast ammonia price was \$1,030 per short ton at the beginning of 2022 and increased to \$1,150 per short ton in late October. The average ammonia price for 2022 was estimated to be \$1,100 per short ton. In 2022, high natural gas prices resulted in higher ammonia prices.

## NITROGEN (FIXED)—AMMONIA

A long period of stable and low natural gas prices in the United States made it economical for companies to upgrade existing ammonia plants and construct new nitrogen facilities. The additional capacity has reduced ammonia imports. Expansion in the ammonia industry took place throughout the past 5 years; however, no additional U.S. ammonia capacity increases have been announced.

Global ammonia capacity is expected to increase by a total of 4% during the next 4 years. About one-third of the capacity additions were expected to take place in Russia and Belarus. As part of the capacity increase, several countries have proposed decarbonized ammonia plants. Consumption of ammonia for fertilizer is expected to increase by 1% per year depending on availability and cost with the largest increases expected in Latin America.

Large corn plantings maintain the continued demand for nitrogen fertilizers in the United States. According to the U.S. Department of Agriculture, U.S. corn growers planted 36.2 million hectares of corn in crop-year 2022 (July 1, 2021, through June 30, 2022), which was 4% less than the area planted in crop-year 2021. Corn acreage in crop-year 2023 is expected to increase because of anticipated higher returns for corn compared with those of other crops.

### **World Ammonia Production and Reserves:**

	<b>Plant production</b>		<b>Reserves<sup>5</sup></b>
	<b>2021</b>	<b>2022<sup>e</sup></b>	
United States	12,700	13,000	Available atmospheric nitrogen and sources of natural gas for production of ammonia were considered adequate for all listed countries.
Algeria	2,600	2,600	
Australia	1,700	1,700	
Canada	3,760	3,800	
China	42,000	42,000	
Egypt	4,000	4,000	
Germany	2,290	2,000	
India	12,100	12,000	
Indonesia	6,000	6,000	
Iran	4,000	4,000	
Malaysia	1,400	1,400	
Netherlands	2,000	2,000	
Nigeria	1,100	1,100	
Oman	1,730	1,700	
Pakistan	3,400	3,400	
Poland	2,100	2,100	
Qatar	3,270	3,300	
Russia	16,300	16,000	
Saudi Arabia	4,300	4,300	
Trinidad and Tobago	4,050	4,200	
Ukraine	2,170	2,000	
Uzbekistan	1,200	1,100	
Vietnam	1,050	1,200	
Other countries	<u>14,500</u>	<u>13,000</u>	
World total (rounded)	150,000	150,000	

**World Resources:**<sup>5</sup> The availability of nitrogen from the atmosphere for fixed nitrogen production is unlimited. Mineralized occurrences of sodium and potassium nitrates, such as those found in the Atacama Desert of Chile, contribute minimally to the global nitrogen supply.

**Substitutes:** Nitrogen is an essential plant nutrient that has no substitute. No practical substitutes for nitrogen explosives and blasting agents are known.

<sup>e</sup>Estimated.

<sup>1</sup>Source: The Fertilizer Institute; data adjusted by the U.S. Geological Survey.

<sup>2</sup>Defined as production + imports – exports ± adjustments for industry stock changes.

<sup>3</sup>Source: Green Markets.

<sup>4</sup>Defined as imports – exports ± adjustments for industry stock changes.

<sup>5</sup>See Appendix C for resource and reserve definitions and information concerning data sources.

## POTASH

[Data in thousand metric tons of potassium oxide (K<sub>2</sub>O) equivalent unless otherwise noted]

**Domestic Production and Use:** In 2022, the estimated sales value of marketable potash, free on board (f.o.b.) mine, was \$760 million, which was 38% higher than that in 2021. The majority of U.S. production was from southeastern New Mexico, where two companies operated two underground mines and one deep-well solution mine. Sylvinitic and langbeinite ores in New Mexico were beneficiated by flotation, dissolution-recrystallization, heavy-media separation, solar evaporation, and (or) combinations of these processes. In Utah, two companies operated three facilities. One company extracted underground sylvinitic ore by deep-well solution mining. Solar evaporation crystallized the sylvinitic ore from the brine solution, and a flotation process separated the muriate of potash (MOP) from byproduct sodium chloride. The firm also processed subsurface brines by solar evaporation and flotation to produce MOP at its other facility. Another company processed brine from the Great Salt Lake by solar evaporation to produce potassium sulfate or sulfate of potash (SOP) and other byproducts.

Potash denotes a variety of mined and manufactured salts that contain the element potassium in water-soluble form. In agriculture, the term potash refers to potassic fertilizers, which are potassium chloride (KCl), SOP, and potassium magnesium sulfate (SOPM) or langbeinite. MOP is an agriculturally acceptable mix of KCl (95% pure or greater) and sodium chloride for fertilizer use. The fertilizer industry used about 85% of U.S. potash sales, and the remainder was used for chemical and industrial applications. About 70% of the potash produced was SOPM and SOP, which are required to fertilize certain chloride-sensitive crops. The remainder of production was MOP and was used for agricultural and chemical applications.

<b>Salient Statistics—United States:</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022<sup>a</sup></b>
Production, marketable <sup>1</sup>	520	510	460	480	440
Sales by producers, marketable <sup>1</sup>	520	480	500	490	440
Imports for consumption	5,710	5,150	5,370	6,480	7,000
Exports	105	145	147	112	300
Consumption, apparent <sup>1,2</sup>	6,100	5,500	5,700	6,900	7,100
Price, average, f.o.b. mine, dollars per ton of K <sub>2</sub> O equivalent:					
All products <sup>3</sup>	750	820	850	1,120	1,700
MOP	440	480	450	650	1,000
Employment, mine and mill, number	900	900	900	900	900
Net import reliance <sup>4</sup> as a percentage of apparent consumption	92	91	92	93	94

**Recycling:** None.

**Import Sources (2018–21):** Canada, 79%; Russia, 9%; Belarus, 7%; and other, 5%.

<b>Tariff:</b>	<b>Item</b>	<b>Number</b>	<b>Normal Trade Relations</b>
	Potassium nitrate	2834.21.0000	<u>12–31–22</u> Free.
	Potassium chloride	3104.20.0000	Free.
	Potassium sulfate	3104.30.0000	Free.
	Potassic fertilizers, other	3104.90.0100	Free.

**Depletion Allowance:** 14% (domestic and foreign).

**Government Stockpile:** None.

**Events, Trends, and Issues:** In 2022, U.S. consumption was estimated to have increased by about 3% compared with that in 2021. World potash supply was affected by economic sanctions on Belarus and Russia and resulted in higher prices and lower consumption. World potash consumption in 2022 for fertilizers was estimated to have decreased to between 35 to 39 million tons from 40.6 million tons in 2021. In January 2022, the Government of Lithuania, citing national security concerns, cancelled the rail transport contract that allowed the state-run producer in Belarus to ship potash from the port of Klaipeda on the Baltic Sea, its only marine export facility. This followed the enactment of economic sanctions on Belarus in 2021 by the European Union (EU) and the United States, which banned the import of potash. Belarus was the third-leading potash supplier prior to 2022, shipping more than 6 million tons per year of K<sub>2</sub>O equivalent. Some Belarus potash was shipped by rail through Russia to other countries in the region and from a Russian port later in the year, but exports and production of potash were significantly lower in 2022.

## POTASH

Following Russian troops taking control of parts of eastern Ukraine in February, the EU, the United States, and other countries placed economic sanctions on Russia. Fertilizer products, including potash, were exempt; however, the EU placed import quotas on potash from Russia. United States sanctions on certain Russian companies, financial institutions, and individuals limited the amount of potash that could be imported. Russia responded by suspending fertilizer exports to countries that it deemed unfriendly. Russia continued exports to China, India, and some countries in Africa and South America, but its exports were about 30% lower in 2022 compared with those in 2021. As a result of the reduction in world supplies of potash, producers in Canada announced production increases over the next year by more than 600,000 tons of K<sub>2</sub>O equivalent. Canadian production capacity was planned to increase by more than 3 million tons per year of K<sub>2</sub>O equivalent by 2025. Production in other exporting countries was expected to increase as well.

A new potash mine was in the development stage in Osceola County, MI. The proposed solution mine would have an initial production capacity of 650,000 tons per year of MOP and was planned to increase up to 1 million tons per year of MOP. The company planned to start production in 2025.

World annual potash production capacity was projected to increase to about 66 million tons in 2025 from 64 million tons in 2022. Most of the increase would be MOP from new mines and expansion projects in Belarus, Canada, and Russia. New SOP mines were planned in Australia and Eritrea, and a polyhalite mine in the United Kingdom would also contribute to the capacity growth. New MOP mines in Brazil, Canada, Ethiopia, Morocco, Spain, and the United States were planned to begin operation past 2025.

**World Mine Production and Reserves:** Reserves for China were revised based on Government reports.

	Mine production		Reserves <sup>5</sup>	
	2021	2022 <sup>e</sup>	Recoverable ore	K <sub>2</sub> O equivalent
United States <sup>1</sup>	480	440	970,000	220,000
Belarus	<sup>e</sup> 7,630	3,000	3,300,000	750,000
Brazil	270	270	10,000	2,300
Canada	14,200	16,000	4,500,000	1,100,000
Chile	858	850	NA	100,000
China	<sup>e</sup> 6,000	6,000	NA	170,000
Germany	<sup>e</sup> 2,800	2,800	NA	150,000
Israel	2,380	2,500	NA	<sup>e</sup> Large
Jordan	1,560	1,700	NA	<sup>e</sup> Large
Laos	<sup>e</sup> 260	600	500,000	75,000
Russia	9,100	5,000	NA	400,000
Spain	365	450	NA	68,000
Other countries	<u>350</u>	<u>350</u>	<u>1,500,000</u>	<u>300,000</u>
World total (rounded)	46,300	40,000	>11,000,000	>3,300,000

**World Resources:**<sup>5</sup> Estimated domestic potash resources total about 7 billion tons. Most of these lie at depths between 1,800 and 3,100 meters in a 3,110-square-kilometer area of Montana and North Dakota as an extension of the Williston Basin deposits in Manitoba and Saskatchewan, Canada. The Paradox Basin in Utah contains resources of about 2 billion tons, mostly at depths of more than 1,200 meters. The Holbrook Basin of Arizona contains resources of about 0.7 to 2.5 billion tons. A large potash resource lies about 2,100 meters under central Michigan and contains more than 75 million tons. Estimated world resources total about 250 billion tons.

**Substitutes:** No substitutes exist for potassium as an essential plant nutrient and as an essential nutritional requirement for animals and humans. Manure and glauconite (greensand) are low-potassium-content materials that can be profitably transported only short distances to crop fields. Glauconite is used as a potassium source for organic farming.

<sup>e</sup>Estimated. NA Not available.

<sup>1</sup>Data are rounded to no more than two significant digits to avoid disclosing company proprietary data.

<sup>2</sup>Defined as sales + imports – exports.

<sup>3</sup>Includes MOP, SOP, and SOPM. Does not include other chemical compounds that contain potassium.

<sup>4</sup>Defined as imports – exports.

<sup>5</sup>See Appendix C for resource and reserve definitions and information concerning data sources.

<sup>6</sup>Israel and Jordan recover potash from the Dead Sea, which contains nearly 2 billion tons of potassium chloride.



# ROSS CONSULTING

Mineral Rights & Mining Property

Bradley D. Ross, CPG

[www.mineralappraisal.com](http://www.mineralappraisal.com)

602-369-6437

[rossconsulting@gmail.com](mailto:rossconsulting@gmail.com)